Plenary Lectures

DARWIN'S SACRED CAUSE

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Why did Charles Darwin, a rich and impeccably upright gentleman, go out of his way to develop privately a subversive image of human evolution in 1837-39? Why did he pursue the subject with tenacity for three decades before publishing The Descent of Man in 1871? A radical reassessment of the basis of Darwin's achievement provides the answer. In the standard myth, Darwin was a heroic genius discovering gems of truth beyond the vision of ordinary mortals. He was a great scientist getting on with a scientist's proper job, not a Victorian naturalist with a consuming moral passion. But today we need to examine the circumstances that made it possible for Darwin to craft a theory from available cultural resources. Underpinning his work on human origins was a belief in racial brotherhood rooted in the greatest moral movement of his age, for the abolition of slavery. For abolitionists, the human races were members of one family, with a common ancestry. Darwin extended the `common descent' image to the rest of life, making not just the races, but all races kin. Darwin's science wasn't the dispassionate practice of textbook caricature; it was driven by human needs and foibles. Even our most vaunted theories may be fostered by humanitarian concern.

THE CUMBERSOME MATERIAL HERITAGE OF ASTRONOMY

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What happens to the material heritage of astronomy 400 years after Galileo's first observations with a telescope? Hundreds of science museums, observatories and universities preserve in their collections historical astronomical instruments. Others, such as ancient astrolabes or astronomical compendia, can also be found in fine art or decorative art museums, where they are exhibited more as precious example of excellent craftsmanship than as tools of science. Finally, the role of private collectors in preserving historical astronomical instruments should not be underestimated. They can partially compensate the inevitably limited collecting capacities of public institutions. If most of the very large astronomical apparatus of the 17th and 18th Century has disappeared, one can consider that as far as table-top and portable instruments are concerned, the heritage of astronomy is quite well preserved.

But the situation is really different when it comes to more recent times. Not only was a large number of observatories built in the 19th and early 20th Century, but their instrumental equipment (meridian circles, refracting and reflecting telescopes, etc.) also grew in size. However, the active life of many of these large apparatus ended in the second half of the 20th Century with the rise of astronomy in the fields of non-visible electromagnetic radiations, the use of satellites, and the introduction of completely new technologies. In the following decades many other astronomical instruments and their ancillary equipment will be put out of duty.

What to do with all these apparatus? Some of them can be used by amateur astronomers, others as didactic instruments. A few observatories will be partially or entirely transformed in museums. But the future of a large number of astronomical instruments will still be at risk. Will it be worthy to preserve instruments separated from their original locations, when we consider that the observatories and their instruments constitute a kind of complex machine which retains its entire signification and value only as a whole?

Also, the restoration of the astronomical heritage is problematic. One can easily justify the expenditure of large sum of money for a restoration, if its final result is to re-establish the functionality of an instrument. Unfortunately, a functional restoration is too often antithetic with a good restoration, which has to carefully preserve and not necessarily repair historical artefacts. A large telescope from late 19th century can attract a public excited to watch the surface of the Moon of the Saturn's rings greatly magnified, but what kind of attraction can draw an early working radio-telescope?

Furthermore, for too many professional astronomers, historical instruments of the 20th century are only obsolete, costly and useless pieces of junk, and history of astronomy is just considered a colourful footnote of their contemporary researches.

But the historical heritage of astronomy is not limited to Medieval astrolabes, Galileo's telescopes and Herschel's refractors. The gigantic steps of astronomy of the 20th century were possible only thanks to a completely new series of apparatus, whose historical importance is often underestimated. My paper will present an overview of some of the most important historical observatories and collections and will focus on the problems related to the preservation, the restoration and the possible uses of late 19th and 20th Century astronomical heritage.

FROM HUNGARY TO THE WORLD: MARTIANS OF SCIENCE

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Hungary has given the Western World a great many talents in various waves during the twentieth century; scientists, composers, playwrights, movie directors, photographers, journalists, writers, actors, investors, sportsmen, and many others. Five of the scientists stand out in that they not only made significant discoveries, but risked their scientific careers in order to devote themselves to the defense of the United States and the Free World at critical periods of history.

The five were Theodore von Kármán (1881–1963), Leo Szilard (1898–1964), Eugene P. Wigner (1902–1995), John von Neumann (1903–1957), and Edward Teller (1908–2003).

They all came from upper-middle–class Jewish–Hungarian families, went to three different high schools in Budapest, and emigrated to Germany to escape the intensifying anti-Semitism and the hopelessness of future. They became recognized members of the scientific community in Germany, which they had to leave because of the Nazi takeover of the country. They ended up in the United States, where they became leading scientists and active participants in defense efforts.

Their works ranged from aerodynamics to quantum mechanics, from the stored program computers to molecular biology, from the nuclear chain reaction to game theory. Von Kármán was important in developing the U.S. Air Force; Szilard initiated the work on the atomic bomb; Wigner was instrumental in building the first nuclear reactors and was the world's first "nuclear engineer;" von Neumann participated in various defense-related projects; and Teller is best known as the father of the American hydrogen bomb. All were dedicated to democracy whether they were conservative politically or not.

The lives and oeuvre of the Martians raise intriguing questions about the importance of scientists providing advice to the political leaders and about the scientists' responsibilities in how society utilizes their discoveries. The lessons we can learn from them in facing the challenges of the twenty-first century will be the main thrust of this presentation.

Bibliography

I. Hargittai, *The Martians of Science: Five Physicists Who Changed the Twentieth Century* (New York: Oxford University Press, 2006; soft cover edition, 2008)

ISLAM AND MODERN SCIENCE

Ekmeleddin Ihsanoglu

SCIENTISTS IN EXILE – A PHENOMENON IN TOTALITARIAN REGIMES. THE CZECHOSLOVAK CASE

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Mobility of scientists belongs to the significant social phenomena affecting scientific development. Escape of scientific elites from countries with totalitarian regimes not only represents a specific (and unwanted) type of mobility and extensive brain drain, but in its consequences leads to heavy cultural and social damage or even impair of genetic potential affecting several generations. The recent gloomy history of scientific exile from Nazi Germany, Soviet Russia, Franco's Spain, Communist countries of Central and Eastern Europe, Chile, South Africa and many other places has shown manifold reasons and motivations of scholars to leave their home countries; among them belonged direct threat to life, active opposition or struggle against the regime, persecution of intelligentsia or some groups of population as a common practice, dissent from the regime, lack of academic freedom or just inadequate living conditions.

Czechoslovakia may be considered a model country for research into scientific exile as it experienced in a relatively short historical time span of 80 years 1918-1989 several waves of scientific exile both as a host country and a country from which intellectuals were forced to flee. These waves taking their course in different historical and political circumstances allow us to study the phenomenon of scientific exile in its variability.

The Czechoslovak Republic founded in 1918 as a one of the successor countries to the Habsburg Empire very soon became thanks to its democratic political system and its central European position target destination of refugees. Between the two World Wars hundreds of scholars were driven to Czechoslovakia by two major exile waves. With the first wave after 1917, refugees arrived from the Bolshevik Russia; in consequence, Prague became between the two World Wars the third most important intellectual centre of the Russian and Ukrainian emigration after Berlin and Paris and seat of its significant scientific institutions, like the Russian and Ukrainian Free Universities and several scientific journals. Foremost Russian and Ukrainian scholars also found positions in the Czech and Slovak universities and contributed to the advancement of several scientific disciplines. The second wave of exile between WW1 and WW2 brought to Czechoslovakia fugitives from Hitler's Germany, mainly Jews and opponents of the Nazis. Among the ten to twenty thousand people who used Czechoslovakia as a transit country between 1933 and 1938 were a number of foremost German scholars.

The years 1938-1939 became the turning point also with regard to exile. Nazi occupation of Czechoslovakia triggered the first exile wave in opposite direction. The country which hosted émigrés turned into a country from which the people were running away. Scholars who declared themselves Czechs, Germans or Jews were leaving under direct threat in all possible directions, especially towards United Kingdom, USA, Palestine, Soviet Union, temporarily France and other later occupied countries, and even Turkey. After WW2 most of the Czech émigré scholars returned back to the liberated country, but part of them diffident of the post-war political developments stayed in their new homelands and often took first-rate academic positions. The second major wave of scientific exile from Czechoslovakia took place after the Communist coup in February 1948. It can be divided into two "sub-waves". The first "sub-wave" began soon after February 1948 but lasted only about two years as after 1950 it practically stopped due to the hermetically closed borders and severe punishments for leaving the country illegally. The second "sub wave" gradually rose in the 1960s with the onset of political thaw when scientists made use of the new opportunities of visiting under some defined conditions meetings abroad and accepting invitations to work at foreign universities. It was the 1968 "Prague Spring" with its political liberalization and the subsequent occupation of Czechoslovakia by the Warsaw Pact armies in August of the same year which provoked the third and strongest wave of scientific and not only scientific exile. From 1968 until the fall of the Communist regime in 1989 fled in total about 200 thousand persons, that is about 1.4 % population. In both the second and third wave the proportion of people with university education was higher than the average in Czechoslovakia. The same applies to people who we call scholars, that is university teachers and researchers acting in sciences and humanities; we may estimate their proportion in both waves at 1.5 % while their proportion in the Czech Lands and Slovakia was only about 2 per thousand inhabitants. The most significant amount of scholars left the country in a short period between autumn 1968 and spring 1969 when countless universities and research establishments all over the world offered positions to the Czech academics. It is necessary to stress that since 1948 the exile was in most cases connected with breaking the law, as leaving the country without official permit was unlawful and legal emigration was practically impossible. Therefore exile scientists were in most cases considered criminals.

Since the 1930s the exile waves have been accompanied by establishing institutions assisting refugees, mostly by scholars themselves. Rescue and professional placement of exile academics started in Great Britain thanks to the *Society for the Protection of Science and Learning* (SPSL), called by its foundation in 1933 *Academic Assistance Council* (AAC), today *Council for Assisting Refugee Academics* (CARA). Through these organizations, probably first time in history, scholars, namely leading British and a few non-British scientists such as Sir William Beveridge, Lord Rutherford, John Maynard Keynes, Leo Szilárd, A V Hill, and others, committed themselves in assisting their imperilled colleagues. SPSL also played important role in assisting refugees from Czechoslovakia. As early as in 1948 was founded the *Czechoslovak Relief Committee for Political Refugees* with branches in several parts of the world. In the USA the *American Fund for Czechoslovak Refugees* started to function in 1948. The *University Assistance Fund* (UAF) which like the CARA has existed until today, was originally founded in 1948 to assist students escaping from Czechoslovakia. The formation of the Czechoslovak exile scientific community has been catalysed by the *Czechoslovak Society of Arts and Sciences* (SVU) established in 1958 in the USA.

Scientific exile is a multifaceted phenomenon with political, economic, social, cultural, psychological, moral, and gender aspects. To understand more deeply its various manifestations a four years lasting project ***Czech Scholars in Exile*** financed by the Grant Agency of the Academy of Sciences of the Czech Republic has been started. It is focused on the circumstances and consequences of the Czech scientific exile especially in the years 1952-1989 concentrating on the target group of scholars affiliated to the Czechoslovak Academy of Sciences as the central research institution of Communist Czechoslovakia. At the heuristic level a database of the scientific workers of the Czechoslovak Academy of Sciences from the Czech and Moravian based institutes who left Czechoslovakia in the year 1952-1989 is being prepared. Also an extensive collection of archives related to the exile scientists' biographies, and contemporary legal, governmental, political and institutional documents and bills associated with the so-called "illegal abandonment of the Republic" is being compiled with special regard to handling scholars. The database is serving among other things as a resource of an encyclopaedia of exile entitled "100 Czech Scholars in Exile" whose manuscript is ready and will be published next year. It encompasses besides biographic entries of foremost Czech exile scholars also chapters analysing the reasons, consequences and meaning of the most recent wave of scientific exile in the Czech history. The biographic entries have been prepared, where possible, by contemporary Czech academics in cooperation with still living émigré scholars. Supplemented by other methodical tools, especially oral history, they offer a valuable resource for the analytical level of the project.

We have so far put together from archival records an almost complete list of over 700 names of the Czech employees of the Czechoslovak Academy of Sciences with university education. This means that around 5% of the highly educated workforce of the Czech part of the Academy has chosen to stay abroad mostly illegally before 1989. The most frequent target countries were West Germany, USA and Canada. About half of the top scientists selected for the Encyclopaedia belong to the life and chemical sciences one third to the group of inanimate sciences, and the rest of it to humanities. The narratives in the biographies testify on the family and political background of exile scientists, motivations of their decisions, sometimes dramatic routes of escape, incorporation in the new scientific communities, scientific achievements before and after escape. The prevalent subjective stimulus for emigration was the complex state of affairs which impaired effective research, grim political and economic situation, along with the perspective of a promising scientific career and more satisfactory personal life in the free world, while almost no scholar who left the country in this period was under direct threat of political victimization, imprisonment or at a risk of life. Family histories played quite important roles in choice of profession and decision making. Although considerable part of the exile scientists were politically neutral or came from families opposing the Communist system, still quite a large proportion were surprisingly members of the Communist Party. Most of the émigré scholars under consideration made successful careers abroad; in sciences the prerequisite was younger age at the time of emigration (approx. under 45) the most prominent group being formed by some young gifted yet hitherto unknown men around 30 who became recognized scientists after settling abroad. In humanities age did not play such role. After the political change in 1989 large part of the successful exile scholars have made effort to assist scientific advance in Czechoslovakia/Czech Republic.

The Czechoslovak example enables to deliberate on both the reasons and consequences of the scientific exile during the Communist regime. Among the general incentives we should mention oppression of scientific and academic freedom and mutilation of independent thinking, ideology driven science, subordination of science to the needs of the socialist economy as "productive force", unproductive planning and control of scientific production, key positions reserved for Party members, etc. Talking about the consequences, it is obvious that scientific exile has been one of the reasons of impairment of scientific progress especially in the fields where the brain drain was enormous. Apart of this apparent effect we may notice others like loss of noteworthy cultural strata of the population, apathy and decline of interest in exploration, downgrade of education of new scientific generations, loss of contacts with the foreign scientific communities, fear and uncertainty in communication with the colleagues who left. Beside mostly disastrous effects, we may also see some positive ones like enhanced dissemination, circulation and cross-fertilisation of ideas and benefit for the countries where the émigré scientists found their new homes. These, however, do not surmount the cost of scientific exile Czechoslovakia had to pay.

Additional data would be needed to collate the situation with countries where the communist regime treated the intellectual strata in a similar manner, especially Slovakia, Hungary, Poland, GDR and other countries of the Eastern Bloc, although each of them had in their history different turning-points triggering scientific exile, like Hungary its 1956 revolution. Nevertheless, even data based on the Czechoslovak model allow drawing a picture of science under political pressure in totalitarian countries.

TECHNOLOGY TRANSFER IN EARLY MODERN EUROPE

Robert Halleux

THE ANTIKYTHERA MECHANISM: ITS MEANING FOR GREEK ASTRONOMY

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The fragments of the bronze device now known as the Antikythera Mechanism were found a century ago among the objects recovered from a Hellenistic shipwreck. It was realized almost immediately that the fragments contained mechanical features such as gears and dials unlike practically anything known from objects surviving from antiquity, whereas texts inscribed on the exposed surfaces had parallels in the ancient Greek astronomical literature, thus implying that the device had its application in astronomy.

Research since the 1950s has resulted in a progressively more detailed and secure reconstruction of the Antikythera Mechanism's structure and functions. While much attention has been given to the role of modern scanning and imaging technologies in this work, the study of the inscriptions in relation to our knowledge of ancient astronomy has also made an indispensible contribution, both by identifying the varieties of data displayed on the exterior of the Mechanism and by providing an incomplete but suggestive repertoire of the theoretical models and parameters that were available in Hellenistic astronomy as a basis for mechanical representation and simulation.

We are now at the point where the Mechanism can begin to repay its debt by telling us things about Greek astronomy that we could not otherwise know. In part this is occurring at the detailed level of the particular classes of astronomical information displayed and predicted on each part of the Mechanism, which are related sometimes to the legacy of the Greek astronomy of the Archaic and Classical periods, sometimes to ancient Near Eastern astronomy, and sometimes to the more recent kinematic modelling associated with Hipparchus and Ptolemy. But the Mechanism also illuminates the broad question of what the discipline of astronomy meant in the time of Apollonius, Hipparchus, and Geminus, and how its specialists portrayed its nature and unity to the intellectual public.

WOMEN IN SCIENCE IN THE US

Margaret Rossiter

WOMEN IN SCIENCE IN EUROPE: FROM SOF'JA KOVALEVSKAJA TO DOROTHY HODGKIN

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The lecture gives an overview on the development of the careers of female scientists at academic institutions in Europe between the end of the 19th century and the millenium. The lecture also gives an overview on the wide-ranging investigations about women scientists, written by historians of science in the last years. Thanks to these publications, which made an important contribution to the history of science as well as to the history written from “below”, it is possible to provide a rich picture of the situation for women scientists across the last 100 years.

In the lecture I'll consider women scientists at various academic institutions, i. e. the world of academia, at Universities as well as at research institutes, as members of the scientific communities as well as as members of the different Academies of Sciences during the last century. A few are well known - like the mathematician Sof'ja V. Kovalevskaja and the physicist Dorothy Hodgkin-Crowfoot; some are known to experts in particular fields - like the geneticists Kristine Bonnevie and Tine Tammes, the biochemist Lina S. Stern and the chemist Gertrud Woker or the cell researcher Rhoda Erdmann; others are known only to experts in specialised fields - like the female scholars Alice Salomon and Else Richter, the chemists Gertrud Kornfeld and Mona Spiegel-Adolf, the teacher Alice Masaryková and the physicist Jarmila Pétrova, the biochemist Gertrud Szabolcsi and the mathematician Rózsa Péter.

The lecture consists of three parts, it will be proceed chronologically. For different periods I'll sketch the changes and the continuities in the world of academia as well as in the social role of women during that time. An analysis of the careers of women scientists will be given connected with the different types of academic institutions, with the circumstances in different scientific disciplines as well as the situations in various European countries. In the lecture I'll examines the factors, structural and scientific, which promoted or hindered employment and careers of women scientists, including the role of academic institutions and concepts of objectivity. Many of the problems that were part of the historical discourse women are now facing once again, such as the debates about women's role in science and society, the controversy about scholarly work versus motherhood, and the existence of couples in science.

Symposia

Symposium S01
Ancient and Medieval Astronomy with Special Emphasis on its Socio-cultural Context

BABYLONIAN AND GREEK ANTECEDENTS OF PTOLEMY'S TABLES

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In Ptolemy's *Almagest* (or *Mathematical Syntaxis*) tables are the primary means by which one can predict positions of heavenly bodies and other astronomical phenomena on the basis of Ptolemy's theoretical models. Ptolemy subsequently pubished a revised version of the *Almagest* tables as the *Handy Tables*. Both sets of tables were preserved through the medieval manuscript tradition.

It was long presumed that Ptolemy's tables were preceded by earlier astronomical tables serving a similar predictive function, but until the late Nineteenth Century practically no evidence existed for what these earlier tables looked like. We now have at our disposal not only numerous fragments of astronomical tables from around Ptolemy's time in Greco-Egyptian papyri, but also Babylonian cuneiform tables made during the last three centuries B.C. in Babylon and Uruk. The transmission of the techniques of generating the Babylonian tables can be shown to have been transmitted into Greek astronomy, and were in current use for more than a century after Ptolemy.

The present paper will consider some aspects of the generation and organization of the earlier Babylonian and Greek astronomical tables, and will seek to show that the general trends of development were at first towards structural simplification, and then, in Ptolemy's tables, towards a new variety of complexity. These trends in turn reflect changing approaches in the modelling of astronomical phenomena.

PTOLEMY AND HIS TIME : AN UNEDITED ASTRONOMICAL PAPYRUS

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During the Congress of Bejing in 2005 I presented a new astronomical Papyrus discovered in Cairo by the French Papyrologist Jean-Luc Fournet. A first draft of the astronomical contain of this document was given to the audience. The analysis of the papyrus is now finished and the reading of the text itself has been established by Jean-Luc Fournet and myself during stays at the IFAO in Cairo in 2008 and 2009. In this talk I will summarize the main features which allow us to reconstruct the astronomical system which appears in this papyrus : an unknown author who worked in Alexandria in 130 AD - thus exactly at the time of Ptolemy- used sophisticated tables based on an Hipparchus' observation. A comparison with Ptolemy's tables will be given in order to emphasize the originality of the this text as well as the common features with Ptolemy's tables. A conclusion will be drafted about the scientific context of Ptolemy's work : far from being an isolated achievement, Ptolemy's astronomical tables were elaborated in a context of intense astronomical activities.

INTRODUCING THE EDITION OF THE HANDY TABLES OF PTOLEMY

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The work on the edition and commentary of Ptolemy's Handy Tables has raised a number of issues, even though the work has so far been confined to the tables of ascension and the Chronological list. The edition is based on the oldest Byzantine manuscripts, of the 9th century. The analysis of the tables of oblique ascension shows systematic departures from the values that would be expected from a straightforward calculation, departures that argue for a textual tradition that must have departed from Ptolemy's original. In the Syriac work of Severus Sebokt (ca. 620), where he provides considerable information about the oblique ascension, the same departures are to be found; that is, we know that he drew from the same textual tradition as we find in the 9th century Byzantine manuscripts. The problem as to what textual tradition was known to Theon of Alexandria (ca. 370) cannot be firmly fixed, since in all his examples, where the tables of oblique ascension are used, he cites only entries that do not reflect the crucial variants in the text.

The tables of oblique ascension are drawn up for each of the seven climates, bands of latitude that are defined by the maximum length of day. This raises two issues, since while Ptolemy gives the corresponding latitude in degrees, the calculations of the tables depend not so much on that latitude, but on the latitude actually implied by the length of day; this can differ by up to four minutes, and it shows up in the tabulated figures. The other issue concerns the length of the day. Ptolemy's arguments about the length of the day depend on the theory given in the *Almagest* Book II, but there he overlooks the motion of the sun during the day, so that its implied length is not based on the true moment of sunrise. The calculation of that moment must depend on an iterative routine, such as that used by Ptolemy (*Almagest* VI.4) to fix the true syzygy. The transmission into the Arabic milieu of the *Handy Tables* is made clearer by the discovery of a portion of the Arabic version found in a Syriac palimpsest, which will be discussed here.

IBN AL-RAQQAM'S AL-ZIJ AL-MUSTAWFI

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Abu cAbd Allah Muhammad b. Ibrahim b. cAli b. Ahmad (b. Muhammad?) b. Yusuf al-Mursi al-Andalusi al-Tunisi al-Awsi, known as Ibn al-Raqqam was probably born in Murcia, and left this city when it was conquered by Alfonso X in 664/1266. He seems to have lived in Tunis and Bijaya, until – after 680/1280-81 - he was invited to settle in Granada by king Muhammad II (671/1273-701/1302). He died in that city on 21 *safar* 715/ 26 May 1315. Until recently we knew him as the author of two "editions" of the unfinished *zij* of Ibn Ishaq al-Tunisi (fl. Tunis and Marrakesh ca. 589/1193-619/1222): the *al-Zij al-Shamil fi tahdhib al-Kamil* (in which he completes the tables of Ibn Ishaq with a summary of the canons written by Ibn al-Ha'im al-Ishbili towards the beginning of the 7th/13th c. in his *al-Zij al-Kamil fi l-Ta'lim*) and the *al-Zij al-Qawim fi funun al-tacdil wa-l-taqwim,* a work having less theoretical interest than the *Shamil Zij*. The former of these two *zij*es was finished in Bijaya in 678/1279-80, while we can only say about the *Qawim Zij* that it was compiled in Tunis after 680/1281-82 and that some canons and tables were added in Granada, after the arrival of the author to that city.

al-Zij al-Mustawfi li-man haza min al-bast wa l-hazz al-awfar wa l-qist al-awfa is the third of Ibn al-Raqqam's *zij*es and it has not attracted the attention of scholars until very recently. Like the two others, it is also an "edition" of Ibn Ishaq's *Zij*. It is extant in MSS 2461 and 4157 of Rabat's General Library, as well as in MS 4156 (fragment on the equation of time); MS 11018 of the National Library in Tunis (col. Ahmadiyya: old number 5584) and MS DM 718,0 of the National Library in Cairo (only chapters 50-51). Like the *Qawim Zij*, we know that it was compiled in Tunis after 680/1281-82; there is no evidence of its being known in Granada but it seems to have been quite popular in the Maghrib, for it was used by the *muwaqqit* al-Jadiri for the composition of his famous *urjuza* on timekeeping (written in Fez in 794/1391-92) and by several commentators of this latter work. This *zij* contains important new materials and, like the *Shamil Zij*, it bears witness to the fact that Ibn al-Raqqam was interested in the problems of spherical astronomy and astrology. The paper will present the contents of this new *zij* and will try to place it within the Maghribi tradition of Andalusian *zij*es.

PTOLEMAISM IN AL-ANDALUS: JĀBIR B. AFLAH AND THE EVOLUTION OF THE TERM *HAY'A*.

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In the early 1990s, Prof. George Saliba mentioned the need for a thorough study of the *hay'a* tradition in al-Andalus, focusing on al-Bitrūjī and on Jābir b. Aflah. In 1992, Prof. Samsó took up his suggestion and studied the *hay'a* tradition in relation to al-Bitrūjī in his paper "On al-Bitrūjī and the *Hay'a* Tradition in al-Andalus", presented at the International Symposium for the History of Arabic Science in Granada (April-May, 1992) and later published in his *Islamic Astronomy in Medieval Spain* (Aldershot, 1994), XII. In this presentation, I will try to clarify the use of the term *hay'a* in Jābir b. Aflah.

As is well known, ancient astronomical models sought only to describe the astronomical motions, whereas the main explanation of these motions was provided by Aristotelian physics. As there were major discrepancies between the Ptolemaic mathematical models and the Aristotelian physics, Islamic astronomers initiated what has been called the *hay'a* tradition, in an attempt to construct astronomical models that were consistent with the Aristotelian tradition.

Jābir b. Aflah was an Andalusian mathematician and theoretical astronomer, probably from Seville, who was active during the first half of the twelfth century. His most famous work is the *Islāh al-Majistī*, where he intends to write a corrected re-edition of the *Almagest* in the form of a handbook essentially for pedagogical purposes. The *Islāh al-Majistī* contains some criticisms of Ptolemy's *Almagest* where Jābir b. Aflah points out what he considers to be errors in it. These criticisms are only of a mathematical, technical nature. While some may have had profound cosmological implications and a strong influence on later astronomers, the errors themselves are minor corrections to geometrical inconsistencies. Hence, the corrections postulated in Jābir b. Aflah's criticisms of the *Almagest* have nothing to do with Aristotelian physics. But in any case, his criticisms of the *Almagest* have earned him an important place among the heirs of Ibn al-Haytham and his *Shukūk 'alā Batlamyus*.

However, even though he is not involved in the revision of astronomical models from the point of view of Aristotelian physics, Jābir b. Aflah uses the term *hay'a* to refer strictly to the *Almagest* and to Ptolemaic mathematical models, which seems to be in contradiction with the use of this term by al-Bitrūjī and others.

In this paper I will try to show that, in Jābir b. Aflah's view, the consideration of the *Almagest* to be *hay'a* does not involve a contradiction, because there is a shift in his understanding of the astronomical models: he sees them no longer as merely descriptive, but as an explanation of the actual astronomical motions. To support this view, I will give an example of his approach to the *Almagest* by summarizing his criticism of Ptolemy's description of the order of the spheres, in which he clearly shows his confidence in Ptolemy's models as an explanation of actual astronomical phenomena.

The order of the spheres was an issue under discussion long before Ptolemy. For some authors, including Ptolemy, the spheres of Mercury and Venus must be below the sphere of the Sun; while for others, these spheres must be above the Sun. Jābir b. Aflah adheres to this last group whereas he criticises Ptolemy's view. In his criticism, Jābir b. Aflah first considers the geocentric distance of Mercury and Venus computed with Ptolemy's models and concludes that, in case that Mercury and Venus were below the Sun, their parallax ought to be clearly perceptible. As this is not the case, both planets must be above the Sun. In addition, he considers Ptolemy's models for the latitude of Mercury and Venus and concludes that, in case the spheres of Mercury and Venus were below the Sun, some solar transits of these two planets ought to be reported. As there were not, the spheres of Mercury and Venus must be above the Sun. That shows Jābir b. Aflah's confidence on Ptolemy's models as an explanation of actual astronomical phenomena.

This criticism had a deep impact on the authors of the *hay'a* tradition and fed discussions on this topic that last until Copernicus.

ON *TASYIR*. PTOLEMY'S TRACES IN THE ISLAMIC WEST: IBN ABI-L-RIJAL AND ALFONSO X

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The astrological book *al-Bari' fi ahkam al-nujum wa-l-tawali'* by Ibn Abi-l-Rijal (fl. Tunis, *ca*. 965-1050) was read widely throughout the Islamic world, as attested by the large amount of extant manuscripts. The King of Castile and León Alfonso X (1221-1284) helped to introduce *al-Bari'* into medieval Europe by sponsoring its translation into Castilian (*El Libro conplido en los iudizios de las estrellas*).

Gerold Hilty has recently edited the Castilian text. Nevertheless, of the Arabic original we have only the edition and translation of a few chapters by Charles Burnett and Keiji Yamamoto.

In this paper, I present the results of 1) an analysis of the chapter in *al-Bari'* on the astrological technique called *tasyir*, and 2) a comparative study between my critical edition of this chapter, based on seven manuscripts, and its Castilian translation.

The appraisal reveals that Ibn Abi-l-Rijal used two methods of *tasyir*: the first method is a simplification of one of the equatorial methods of Ptolemy in his *Tetrabiblos*; the second method is a development of the ecliptical method of Dorotheus in his *Carmen astrologicum* and that Ibn Abi-l-Rijal introduced Eastern sources (*al-Mawalid* by pseudoZaradusht and *al-Mugni* by Ibn Hibinta) into the Maghrib, which do not seem to have been known in al-Andalus. It also highlights the peculiarities of Maghribi astrology and the method used by Alfonso X´s team of translators to produce the Castilian version of *al-Bari'*.

JAGANNĀTHA'S SAMRĀT-SIDDHĀNTA: A TRANSLATION OF ALMAGEST INTO SANSKRIT

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Among the huge corpus of astronomical literature that is available in Sanskrit, Jagannātha's *Samrāt-siddhānta* stands unique in that it is a Sanskrit rendition of *al-Majistīż*—an Arabic version/translation of Ptolemy's Greek text of Almagest. Jagannātha mentions this at the very beginning of his work and also adds that it is being authored by him at the instance of Maharaja Sawai Jai Singh (c. 1730 ad).

The magnum opus of Jagannātha, also known as *Siddhāntasāra-kaustubha*, is essentially made of two parts. The early and major part of the text consists of thirteen chapters that run parallel to the thirteen books of Ptolemy's Almagest. The first couple of chapters besides presenting a detailed description of the nature and the location of the earth, also discuss sine tables and a class of diurnal problems. The third and the fourth chapters primarily deal with the computation of the mean and the true positions of the sun and the moon respectively. The later two chapters present the parameters, and a number look-up tables involved in the computation of eclipses. Chapters 7 and 8 describe about the rotation of the celestial sphere, the rising and setting of the stars, the shapes observed in different *rāśis* (zodiacal signs) and so on. The next two chapters deal with the motion of the Mercury, Venus and their apsis. Here one also finds citations made from various Muslim astronomers to prove that the orbit of Venus must be inside the Sun's orbit. The last three chapters of the first part of the *Samrāt-siddhānta* deal with the different types of the observed motion of the exterior planets. This also includes discussion on their rising and setting. Tables related to the retrograde motion of the planets are also presented.

The second part has five chapters (*adhyāyas*) that bear the name, *yantra* (instruments), *tripraśna* (three problems), *krāntisādhana* (determination of declination), *madhyama* (mean positions) and *spaṣṭa* (true positions). Of these chapters, the one on instruments would be of particular interest as a detailed study of it is likely to throw light on the need for the giant masonry instruments constructed by Raja Jai Singh under the guidance of Jagannātha, who was the teacher and one of the most favored astronomer of the Jai Singh. Finally, Jagannātha also attempts to present rationale for the *manda* and *śīżghra* corrections iterated in various ways in Indian astronomical works. During our presentation, besides giving an overview of this unique work on astronomy in Sanskrit, attempt will also be made to demonstrate as to how the same problem has been conceived and solved by different traditions in quite different ways.

THE INDIAN SCHOLAR KHAYRULLĀH MUHANDIS AND HIS PERSIAN TRANSLATION OF AL–TŪSĪ RECENSION OF *ALMAGEST*

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Abul Khayr Khayrullāh Khān Muhandis bin Lutfullāh Muhandis (d. 1747) belonged to the family of Indian mathematicians; his grandfather Ahmad Ma'mār was the architect of the famous Taj Mahal at Agra. Khayrullāh had to his credit eleven mathematical-astronomical writings according to our recent survey. He was appointed by the Mughal Emperor Muhammad Shāh as the director of the observatory at Delhi, in which capacity he compiled also astronomical tables, the *Zīj,* dedicated to the Emperor. Besides that, he was renowned especially for his Persian translation of the Nasīruddīn al–Tūsī's Recension of Euclid's *Elements* and of Ptolemy's *Almagest, Tahrīr al–Majistī.* In this paper, we wish to deal with the significance of the latter and its Persian translation in India by Khayrullāh.

The originality of the Recension (*Tahrīr*) of Almagest by Tūsī (written in 1247 ad) lies in the fact that it was a reworking and upgrading of *Almagest.* For instance, he replaced the Ptolemaic method of chords by then known trigonometrical functions and employed the sine and tangent theorems of spherical geometry. Further, he discussed the difficulties or obscurities (in Arabic *ishkālāt*), of *Ptolemaic* epicyclic-eccentric theory; e.g., the occurrence of annular solar eclipse and the possibility of transits of Venus and Mercury across the solar disc. The most significant feature of *Tahrīr* is, however, Tūsī's *awareness* of the central problem of *Almagest*, namely, the problem of Ptolemy's *equant*, the detailed study of which led Tūsī to propound later his Non-Ptolemaic model of planetary motion in his "*Memoir on Astronomy*". We know today that six commentaries/glosses of *Tahrīr* were written, including one in Arabic by an *Indian* scholar, 'Ismatullāh Sahāranpūrī (d.1670), one abridgment in Persian by a theologian Ghiyathuddīn Muhammad al-Shīrāzī (d.1542), and the Persian paraphrase and commentary by Khayrullāh.

Khayrullāh completed his Persian paraphrase and commentary, *Taqrīb al–Tahrīr* in 1747ad, that is just before his death. The text was then revised and copy-faired by Khayrullāh's son, Muhammad 'Alī Riyādī in 1748ad, with his own foreword preceding Khayrullāh's preface. According to our own survey five manuscript copies of this text are extant in the Indian manuscripts collections as follows: in the towns of Lucknow (copy of 1756 ad), Kolkata (Ms. of 1762), Rampur (Ms. of 1772) scribed by Khayrullāh's son 'Alī Riyādī, Patna (Ms. of 1835), and Aligarh (ca.19th c.). The text consists of 13 Chapters (*Maqālah*), a total of 141 sections (*Fasl*) and 196 theorems (*Shakl*). The style of Khayrullāh is just to cite first from Tūsī's Arabic text, followed by his Persian translation/paraphrase. If required, he inserts from the Arabic commentary by 'Abdul 'Alī Bīrjandī, written in 1515 ad, and thereafter his own commentary on the same text.

In this paper, we discuss at length the above-mentioned features of this work.

BUDDHIST ASTRONOMY IN ITS CULTURAL CONTEXT

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There is no independent Sanskrit Buddhist text that is entirely devoted to astronomy. What we mean by 'Buddhist Astronomy' is a sum of knowledges of astronomy which are sporadically found in Buddhist texts. Collecting such informaiton I would like to figure out what is Buddhist astronomy and astrology, especially in its cultural context. From a viewpoint of the history of science, the long history of Indian Buddhism is divided into three periods :

(1) Early Buddhism
(2) Mahayana Buddhism
(3) Tantric Buddhism

In the first period what I call `lunar astrology' was prevalent. The most important role was played by the lunar mansions (nakṣatras) where the moon stays. What is remarkable is that the planets (grahas) play no significant role. The most importnat Sanskrit Buddhist text belonging to this period is the *śāduulakarnāvadāna.* It is noteworthy that in this text the kowledge of astronomy and astrology was conveyed by the king of the Mātanga tribe that was segregated and sometimes identified with the outcaste people called Candāla. This might suggest that the origin of Indian astrology was outside Brahmanical society. If this were the case, the system of Indian astrology which I call 'lunar astrology' could have originated in the non Brahmanical society. However, I have a different opinion. The knowledge of astronomy and astrology in this text should have been that of ex-Brahmins who converted to Buddhism. As if to support my argument, the King of the Mātangatribe says that he remembers the Vedas which he learned in his 'previous life' (puurvajanma).

I would interprete this as his 'life before conversion to Buddhism'. I can refer to numerous passages that show very professional learnings that had been monopolized by orthodox Brahmins, for example, enumeration of the Vedic schools and the use of Vedic mantras for each four classes. I think there were many cases of such converted Brahmins who shared their knowledges with Buddhist colleagues. The text of the *śāduulakarnāvadāna* hows a very critical view against the value system of Brahmins. Such an harsh criticism reveals the complexed mind of the author.

In fact the knowledge of astrology communicated in this text is very close to that of the *Nakṣatrakalpa* of the *Atharvavedaparśista*. Thus I would like to compare the astronomical contents of the two texts.

PATRONAGE OF ASTRONOMY AND ASTROLOGY IN POST-CLASSICAL ISLAMIC SOCIETIES

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One of the explanations repeatedly presented for the so-called decline of the 'ancient sciences' in post-classical Islamic societies (after 1200) is the assumption that courtly patronage for these disciplines either disappeared fully or was reduced to supporting elementary, mostly astrological, or fully standardized, mostly time-keeping and prayer-direction related, practices.

In my paper I will present evidence that this assumption is in conflict with courtly cultures in various post-classical societies, the best known of which is the Ilkhanid sponsorship for a broad range of activities in theoretical as well as practical aspects of astronomy and astrology. But it was the only dynasty that found reasons to do so.

I will discuss the language of patronage and ask which conclusions we can draw from this rhetoric. I will survey manuscript themes written or copied in the context of such patronage activities. I will ask whether the patronage patterns differed between different dynasties as well as different disciplines and arts. I will suggest that contrary to the general assumption that with the emergence of the madrasa the support by courts for the 'ancient sciences' disappeared or was considerably reduced madrasas were a part of courtly patronage activities.

As a result we need to study in detail the forms of interactions that evolved between rulers, their families, courtiers, administrators and the military on the one hand and scholars situated primarily within the households of these groups in comparison to those scholars that acted primarily within the spaces of the madrasa, the mosque and cognate institutes. I will suggest some preliminary results of such a reformulation of the issues of courtly patronage and madrasa activities with regard to the 'ancient sciences'. Part of my discussion will focus on the disciplinary and classificatory shifts from the 'ancient' to the 'rational' sciences.

KNOWLEDGE SECRECY AND THE CHINESE ASSIMILATION OF ISLAMIC ASTRONOMY IN THE 14th CENTURY

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In 1382, by the order of the Ming emperor Zhu Yuanzhang (1328-1398), a group of Chinese and Muslim scholars worked together and completed the translation of Kusyar ibn Labban's *Introduction to Astrology*, and entitled the Chinese version *Tianwen shu* (Book on Celestial Patterns). Soon, another work known as the *Huihui lifa* (Chinese-Islamic System of Calendrical Astronomy), a typical *Zīj* in Chinese, was also completed. In the subsequent years of the Ming dynasty, the *Huihui lifa* became an important source of inspiration for a number of Han astronomers.

Up to the late Ming and early Qing Dynasties in the 17th century, however, some Han astronomers eventually realized that the available versions of the *Huihui lifa* contained a fatal defect. In modern terminology, the defect can be summarized as follows: the pre-calculated tables in the *Huihui lifa* are based on a version of the *Hijra* lunar calendar, but the algorithms provided for the practical application of these tables is a true solar calendar. Therefore, a procedure is necessary to solve the problem of date-conversion between the two different calendars so as to fill up the big technical gap. To the great dismay of Han astronomers in the late Ming and early Qing dynasties, in all versions of the *Huihui lifa* available to them, these facts and the necessary procedure were not mentioned at all. Hence arose the issue of knowledge secrecy of Muslim astronomers in their introduction of Islamic astronomy to Han astronomers.

For most Han Chinese astronomers in the 17th century, who had quite fresh memory of the conflicts between the advocators of Chinese and European astronomy since the end of the Ming dynasty, it was quite natural to interpret the lack of such an important procedure as a result of the rivalry between Han and Muslim astronomers since the beginning of the Ming Dynasty. But does this interpretation reflect the historical truth in any rate? A book from the early Ming Dynasty contains a key to this question. The book is entitled *Weidu taiyang tongjing* (*A Gateway to the Islamic Method for the Calculation of the Sun*), completed in 1396 by Yuan Tong, the director of the Bureau of Astronomy of the Ming Dynasty. It is devoted to the positional calculation of the sun according to the *Huihui lifa*, but Yuan Tong tries to convert the original tables and algorithms in the *Huihui lifa* from using the vernal equinox to using the winter solstice as the beginning of an astronomical year, thus to adapt the Islamic system to Chinese conventions.

Together with the *Huihui lifa*, the book was imported into Korea in 1430s, reprinted there. One copy of these reprints is now preserved in the *Kyujianggak* Archives at the Seoul National University, the former Royal Library of the Choson Dynasty. The book contains new information about the production of the *Huihui lifa*. It also sheds new light on our discussion of the issue whether the Muslim calendar makers, while transmitting the *Huihui lifa* in China, really kept some secrete knowledge from their Han Chinese colleagues.

THE IMPACT OF THE TELESCOPE ON ASTRONOMY AND SOCIETY IN CHINA

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The telescope was introduced into China in early seventeenth century, not long after Galileo made his telescopic observations in 1610. In Europe, Galileo's discoveries with the telescope provided substantial evidences supporting Copernicanism, shaking the very foundation on which the Roman Catholic authority was built, thus arousing fierce debates over cosmological issues. What impact had the telescope on Chinese astronomy and society at large?

Chinese astronomy consisted of two major parts, mathematical astronomy and astrology. A good astronomical system indicated the legitimacy of the imperial rule and symbolized good governance. The telescope was introduced into China when the Ming astronomers were engaged in debating over methods to produce an accurate astronomical system and its associated calendar. This was a very practical and politically important issue. Using the telescope to observe the solar and lunar eclipses, Xu Guangqi (1562 - 1633) and his Jesuit collaborators demonstrated that the "Western method" was superior to traditional Chinese methods in calendar-making. Ironically, the "Western method" legitimatized by telescopic observations in China was not Copernican, but Tychonic. Galileo's major discoveries with the telescope were introduced to the Chinese as early as 1615 by Emmanual Diaz in his *Catechism of the Heavens* (*Tian wen lue*). These discoveries, however, came hardly as a shock to the Chinese. The information the Chinese got from the Jesuits was partial. The Jesuits did not mention even Galileo's name, not to say the cosmological and religious controversies related to these discoveries. For the Chinese, there was no categorical distinction between the celestial and the terrestrial domains. Substances in the heavens were just as likely subject to changes and corruptions as things on the earth. As the matter of fact, the Chinese had long before Galileo observed sunspots. Some historians even claimed that the Chinese had observed the satellites of Jupiter before the telescope. The Chinese considered these types of celestial phenomena as omens, indicating warnings from the Heaven on the rulers. Since the rulers could never be assured that they govern the country with complete perfectness, they were on constant alert of strange occurrences. It was almost anticipated by the court officials and astronomers that some extraordinary phenomena would occur in the sky. So the Chinese eagerly accepted the findings by Galileo, without interpreting them as a challenge to the traditional Chinese philosophy.

The telescopic observations did stimulate some Chinese literati to make new speculations on cosmological issues, but this only occurred within the framework of traditional Chinese cosmology, which was essentially pluralistic and eclectic. For example, Fang Yizhi(1611 - 1671) use the telescopic observation of the Milky Way to validate an ancient thought by Zhang Heng (78 A.D. – 139 A.D.) that the stars were essence of water. Some also used Chinese precedence in observing some celestial phenomena to justify the claim of "the Chinese origin of the western learning. The telescope was seen just as an aid the naked. And it was on this account only that the Westerner had made some progress in the learning that was originally Chinese. This claim may sound awkward to a modern observer, but it solved the psychological barrier to the acceptance of Western knowledge.

YAVANA-YANTRA TO YANTRA-RĀJA
REWORKING OF ARABIC ASTROLABES IN INDIA

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When the astrolabe was introduced into India, it was enthusiastically received by the astronomers of India, who hailed this foreign instrument (*yavana-yantra*) as the 'king of instruments' (*yantra-rāja*). Their response to the astrolabe was three-fold. Between 1370 and 1870, they composed at least fifteen manuals in Sanskrit which discuss the astrolabe either exclusively or as one of several astronomical instruments. They also caused to be produced several Sanskrit astrolabes, i.e. astrolabes with legends and inscriptions in Sanskrit language and Devanāgarī script. Some eighty of such Sanskrit astrolabes are extant today in various museums all over the world. These two facets of the reception of the astrolabe have been discussed by me in several articles. A third facet is the 'appropriation' of Arabic astrolabes by engraving additional legends and numerals in Sanskrit so that these astrolabes could be used by astronomers who not did read Arabic script.

As early as 1856, William H. Morley drew attention to one such reworked astrolabe, which came to be known as 'Professor Wilson's astrolabe'. In 1983, Margarida Archinard devoted a full-length monograph to another specimen, now preserved at the Musée d'Histoire des Sciences de Genčve. In the course of my survey of extant specimens of pre-modern astronomical instruments produced in India, I came across some more reworked Arabic astrolabes and also celestial globes. These instruments constitute an interesting chapter in the dissemination of Islamic instruments in India. The additions in Sanskrit were not all uniform. While some astronomers were content with identifying just those latitude plates which were useful to them with Sanskrit labels, others attempted to render every single Arabic legend into Sanskrit.

This paper describes these reworked astrolabes and celestial globes, explains the nature of the additional inscriptions in Sanskrit, and attempts to identify the astronomers who may have been responsible for the reworking of these instruments.

ASTRONOMY PART OF THE KERALA WORK, *YUKTIBHASA* (CIRCA 1530 CE)

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Kerala in the south-western part of India is a rich repository of the traditional Indian sciences, technologies, medicine, and architecture. The Kerala school of astronomy and mathematics made significant contributions during 14th -17th centuries. Madhava (1340-1425) and Nilakantha Somayaji (1444 – 1550), were two great astronomers of this school. Nilakantha gave the correct formulation of the equation of centre for interior planets in his *Tantrasangraha* (c.1500). He also proposed a geometrical model according to which the planets move in eccentric orbits around the mean Sun, which moves around the earth.

Ganita -Yukti –bhasa (Rationales of Mathematical Astronomy) of Jyesthadeva (c.1530) (or, just *Yuktibhasa*) is a seminal text of the Kerala school of astronomy. Jyesthadeva was a junior contemporary of Nilakantha and probably received instruction from him. *Yuktibhasa* is composed in the Malayalam, which is the language of Kerala . Almost all the scientific literature in India in the ancient and medieval period are in Sanskrit, apart from the Islamic works. Here, it is the first time that a very significant original work is written in a local, spoken language. It presents detailed *yukti*s or explanations and demonstrations for the results and processes of mathematical astronomy. The text comprising fifteen chapters is naturally divided into two parts, Mathematics and Astronomy.

The mathematics part has seven chapters. Apart from other topics, it presents detailed demonstrations of the famous results on the infinite series for , the arc-tangent and the sine, cosine functions, the estimation of correction terms and their use in the generation of faster convergent series. All these results are attributed to Madhava . The proofs for these which are complete and very novel are presented in *Yuktibhasa* for the first time . One sees the beginnings of calculus here.

Indian astronomy is algorithmic in nature, and most of the important works present only the procedures for astronomical problems. *Ganita –yukti – bhasa* is different in this aspect. Astronomy is developed logically as a subject here. It is self-contained and written in the style of a textbook. The entire matter is in prose, without equations as we write now, or drawings and figures. However, from the detailed descriptions , we can write down the equations, and draw the figures, <u>without ambiguity</u>. All the algorithms of *Tantrasangraha* are explained/proved here.

The Astronomy part is divided into eight chapters and the usual topics in an Indian text like mean and true positions of planets, diurnal problems associated with the Sun and the Moon, eclipses etc., are covered. The discussion of the celestial sphere and the terrestrial sphere, is far more detailed here than in other texts. It presents systematic derivations of most of the results of spherical astronomy that are discussed in Indian Astronomy. A distinguishing feature of this work is that it gives a detailed exposition of the revised planetary model of Nilakantha.

A SURVEY OF PERSIAN ZIJES EXTANT IN IRAN WITH SPECIAL STRESS ON THEIR USE IN MEDIEVAL IRANIAN SOCIETY

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The tradition of compiling astronomical-mathematical tables (Zīj) in the Islamic countries or societies owes to three main origins: Indian astronomy, Greek astronomy and pre Islamic-Iranian astronomy. Between these three schools, Iranian astronomy was the only one, which survived and continued to develop during the Islamic medieval period, in which many books were written in Persian and particularly several Zijes were compiled in Persian. For instance, al-Bīrūnī wrote a book on the *Art of Astrology* originally in Arabic, but later translated it himself into Persian for the use of common man.

The tradition of compiling Zijes in Persian had spanned a period of about 800 years, i.e., from nine to sixteen centuries. The production of so many Zijes was actually facilitated by several observatories established in Islamic countries. We know now about three very important observatories, which existed at Maraghah, Samarqand and Rey. Besides Iran and Central Asia, Persian Zijes were also compiled in Medieval India, especially by the court astronomers of Sultans and Mughal emperors. We discuss briefly this background briefly.

In this talk, we wish to present salient features of our project: “A Catalogue of extant Persian Zijes compiled in Iran”. We mention also in passing some Zijes, which are not extant now but they were compiled also in Iran. Finally, we attempt to point out some of the applications of Zijes in Medieval Iran. For instance, one of the most important usages of Zijes had been in mathematical astrology, in which Iranian in general and governors in particular were always interested. Another use of Zijes was for calculating the beginning of the Iranian New year, the famous Nowrooz, which is a very important festival for Iranians even to this day. Another very important practical utility of medieval Islamic Persian Zijes, was the prediction of the visibility of the lunar crescent. In Islam, the religion of Moslem, the Lunar crescent plays an important role for determining the beginning of Islamic months and especially for Ramazan, the month of fasting. Similar is the case of lunar and solar eclipses, the accurate prediction of which had been also important. We discuss these practices also briefly.

Symposium S03
Status in Mathematics: In Particular the Role of Applications in the First World War

THE RISE OF COMPLEX ANALYSIS IN FRANCE AND GERMANY

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Complex analysis was created as a research subject in different ways and for different reasons by Cauchy, Riemann, and Weierstrass. By and large it was left to their followers to bring it into the university syllabuses and to give it a central place in the teaching curriculum. This talk examines the different ways this was done in France and Germany by looking at the textbooks that were written up to 1914.

CAUCHY'S AND WEIERSTRASS'S 'SCHOOLS' ON COMPLEX FUNCTION THEORY: A COMPARISON

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In the second half of the 19th-century the leading role in complex function theory (and more generally, in mathematics) shifted from France to Germany, more precisely from Paris to Berlin. Cauchy had obtained a number of fundamental results, and his work – combined with contemporary studies by Liouville, Laurent, Puiseux and others – had contributed to the establishment of a 'French school' in complex analysis. However, despite being tremendously influential in France, Cauchy's scientific heritage prevented the French mathematicians from appreciating new developments taking place abroad, in the Prussian capital in particular. Led by Weierstrass, a 'school' grew up there that promoted a theoretical and abstract approach to analysis. Perhaps because of his very different training, Weierstrass did not share with the ingénieur-savant Cauchy his broad interest in applied mathematics. Instead, he made a point of establishing complex analysis (and the whole of analysis in general) on rigorous, arithmetical foundations. Eventually, his arithmetical approach became dominant, and the German term /Funktionenlehre/ became synonymous with analytic function theory according to Weierstrass's principles.

FUNCTION THEORY FOR WAR: BALLISTICS AND FLUID MECHANICS IN FRANCE, 1915-1930

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Starting in 1915, mathematicians played an especially prominent part in French military efforts in the field of ballistics and fluid mechanics. In both cases, nontrivial aspects of function theory were the tools of choice mobilized by mathematicians. This paper will show how an urgent need for new kinds of ballistic tables gave rise to new computing techniques that used function theory in order to provide better assessments of errors. Once computing procedures were established, the main problem shifted to physics and meteorology. Many in particular felt the need to improve the resistance law of a body in motion in a fluid (which was also useful for aviation). French mathematicians therefore endeavored to developed sophisticated mathematical techniques that ultimately gave rise to important new development in function theory. Mathematicians involved in this story include Jules Haag, Henri Villat and Jean Leray. This paper will discuss the various ways in which mathematicians argued for their social usefulness in the aftermath of World War I.

THE BRITISH USE OF MATHEMATICS IN THE FIRST WORLD WAR

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'This is a Mathematical War' declared a veteran British mathematician to his colleagues in January 1915. Two years later his words were echoed at the front by a young British soldier who found himself fighting in a 'war of guns and mathematics'. Were these accurate descriptions or isolated observations? What effect did the war have on British mathematicians and on their subject? To answer these questions, I shall consider the extent to which British mathematicians were encouraged to contribute to the war effort and the nature of their contributions.

DEVELOPING A THEORY OF BALLISTICS FROM EXPERIMENTATION AND MATHEMATICS: OSWALD VEBLEN, FOREST RAY MOULTON, AND THE ABERDEEN PROVING GROUND PROJECT

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The introduction of long-range artillery, high-altitude fire, and anti-aircraft guns in the First World War rendered Siacci theory largely outmoded. At the Army Ordnance office in Washington, F.R. Moulton assumed the role of developing a new, more effective theory of ballistics. This effort incorporated data collection and computation overseen by Veblen at Aberdeen together with new applications of mathematics to ballistics. This paper considers mathematical work at the Aberdeen Proving Ground in context of the new relations it created between the mathematical community and both the United States government and military.

THE RISE OF EXTERIOR BALLISTICS IN AMERICA, 1880-1929

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Exterior ballistics – the study of the flight of a projectile after its firing from a gun – evolved in several stages in the United States. The first – from the founding of the country until about 1880 – involved somewhat cursory adaptations of studies in Europe, notably those of Leonhard Euler, Benjamin Robins, and Francis Bashforth. These appeared primarily in textbooks issued from the United States Military Academy at West Point, founded in 1802. The second began in the early 1880's with the first textbook in America devoted to exterior ballistics – James Ingalls' « Exterior Ballistics in the Plane of Fire ». This was also an adaptation, this time of Francesco Siacci's widely adopted solution of the differential equations of motion by means of approximations. The second stage – the period from 1880 to the beginning of World War I – was dominated by the elaboration and use of this theory for American guns, an effort initiated by military officers at the Coast Artillery School at Fort Monroe, Virginia. This school, established in 1824, had evolved into an institution for advanced officer training, providing a followup to a West Point education. The third stage came as a result of a call to the mathematical community at large for assistance in solving new problems arising as a result of challenges of the World War. This era, dating roughly from 1917 through 1929, saw a rise in the sophistication of the mathematics brought to bear on the problems and the entrance of this material into university settings as well as newer specialized military schools. Many of the contributions of this era were for the first time made by professional mathematicians, not military personnel, and were independent of developments in Europe.

This paper examines the second and third eras and reviews the increasing status of exterior ballistics as a topic in military and civilian educational institutions during these times. New institutional courses devoted to the material will be mentioned, as will new military journals whose articles were often devoted to aspects of it. The lives of some of the men who brought about the changes are examined, and their roles in the rise of exterior ballistics explained. The establishment of the Aberdeen Proving Grounds in 1917 as a model of scientific treatment of ballistic problems will be discussed. Several mathematical topics were a part of the new American treatment of the subject in the third era, and each experienced an increase in prominence, albeit short-lived, as a result of their use ; details on this phenomenon will be given. Mathematicians wrote some new books on exterior ballistics as well as articles appearing in mathematical journals ; their work will be described. A long-term project involving general ballistic tables was undertaken in 1919 using the new methods ; we will see how this project developed. We relate the context in which these changes occurred and the fate of exterior ballistics, in both university and military settings, in the late 1920's.

MATHEMATICS IN A DEAD END: ARNOLD SOMMERFELD AND THE TURBULENCE PROBLEM OF THE EARLY 20th CENTURY

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During the last decades of the 19th century, natural philosophers, mathematicians, physicists and engineers (like Lord Kelvin, Lord Rayleigh, Osborn Reynolds, Joseph Boussinesq, Hendrik A. Lorentz) tried in vain to bridge the gap between theoretical and practical hydrodynamics - a gap which was mainly rooted in the different modes of laminar and turbulent flow. Only the former was in agreement with mathematical analysis. The latter, most often met in practice and addressed as 'hydraulic', appeared intractable.

In 1908, Arnold Sommerfeld presented at the Fourth International Mathematical Congress in Rome a mathematical approach for deriving the transition to turbulence for a plane laminar flow with a linear velocity profile (plane Couette flow). By linearization of the differential equations for such a flow he obtained a transcendental equation which offered the opportunity to derive criteria for the onset of turbulence. One year before and unknown to Sommerfeld, the Irish mathematician William McFadden Orr had arrived at similar results. This approach (later named after Orr and Sommerfeld) was regarded as a promising avenue to explain the transition from laminar to turbulent flow. Although Sommerfeld pursued the conceptual paths paved by the British protagonists, the context of his approach was different. Sommerfeld's mathematical roots had grown in Göttingen (as Felix Klein's assistant) and Aachen (as professor of mechanics), where he became used to apply sophisticated mathematical techniques to a variety of physical and technical problems. Prior to his paper for the Rome Congress, Sommerfeld was involved both in discussions about the principles of hydrodynamics (with Lorentz and Hilbert) and in technical applications (for example, he had published in 1904 a theory of lubrication).

After the Rome Congress, "the turbulence problem", as the challenge to describe the transition from laminar to turbulent flow was labelled subsequently, became a fashionable topic for further analysis. However, despite the efforts of Sommerfeld himself and a number of his disciples (among them Otto Blumenthal, Ludwig Hopf, Fritz Noether and Werner Heisenberg), the Orr-Sommerfeld approach did not live up to its expectations. Even worse, it provided mathematical evidence that certain flows could never perform the transition to turbulence – in obvious contrast to experiments. Applied mathematicians outside Sommerfeld's school, most prominently Richard von Mises, arrived at the same result. Although based on solid theoretical ground and sparked by the prospect of technical applications, the Orr-Sommerfeld approach was unable to bridge the gap between theoretical hydrodynamics and practical hydraulics. By 1920, the turbulence problem was widely recognized as an outstanding challenge for applied mathematicians. Despite (or because?) its paradoxical results, it contributed to the consolidation of applied mathematics as a specialty of its own right.

RICHARD VON MISES: A PIONEER OF PRACTICAL AND THEORETICAL AERODYNAMICS

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Richard von Mises (1883-1953), who studied mechanical engineering at the Technical University in Vienna (1901-1905), was a pioneer of teaching (Strasbourg 1912) and research (wing theory 1917/20, based on complex function theory) in aerodynamics. During World War I, as an officer in the Austrian-Hungarian Flying Corps in Vienna, he built a ‚huge airplane' (Grossflugzeug) which, however, never went into service.

The talk considers the interplay of the practical and theoretical dimensions in von Mises' work in aerodynamics and compares it briefly with other, in the end more successful approaches (von Kármán, Prandtl).

The talk reflects also on the status of function theory acquired by important applications such as found in wing theory.

AVIATION AND AERODYNAMICS ALONGSIDE MATHEMATICS: THE CASE OF THE UNIVERSITY OF LEIPZIG

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As many others, academic institutions around Leipzig and Halle too were influenced by the rapid and impressive development of aviation in the first decades of the 20th century. The talk will answer the question how scientists at Leipzig University took part in this process. It seems at first glance that only physicists tackled problems of aerodynamics. But mathematicians contributed to the theoretical investigations, too. With reference to Harry Schmidt's treatise on aerodynamics it will be shown in which way the work of men like Leipzig's well known mathematician L. Lichtenstein attacked aerodynamical problems.

Symposium S04
Mathematical Analysis from the Eighteenth to the Nineteenth Centuries

ELABORATION OF EULER'S IDEAS ON SERIES IN THE EARLY 19th CENTURY

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In a paper of 1760 titled "De seriebus divergentibus" L. Euler justified the 18th century use of divergent series by the definition „the sum of any series is a closed expression out of whose development that series has been formed".

Surely, this was a rather informal definition, but in the early 19th century there were some mathematicians who tried to elaborate Euler's idea by distinguishing systematically between a notion of "formal equality" between power series (close to the modern idea of formal power series) and numerical equality. They felt a need for more rigour but tried to be more faithful to 18th century practices than Cauchy's radical ban of divergent series. One of them was the Berlin mathematician Martin Ohm (1792-1872). He published his approach in 1822 one year after Cauchy's famous Analyse algébrique. In 1823 Ohm was able to correct one of the most discussed incorrect results of the time by consciously using divergent series.

EULER AND FUNCTIONS OF A COMPLEX VARIABLE

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In the last ten years of his life Euler wrote several papers on functions of a complex variable. Published posthumously, these researches contributed to the initial identification of complex analysis as an autonomous part of analysis. The paper examines Eulers work, focussing on some ideas that would become important in the later development of the subject. A general question of interest is how differential forms and integration were understood in different parts of analysis during the period. Particular attention will be paid to Eulers De integrationibus maxime memorabilibus ex calculo imaginariorum oriundis, a paper submitted to the St. Petersburg Academy in 1777 and published in 1793.

TWO WAYS OF UNDERSTANDING THE NATURE OF TRANSCENDENTAL FUNCTIONS IN MATHEMATICAL ANALYSIS

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It is a remarkable fact that the development in power series of the transcendental function e^x or the trigonometric functions *sinx, cosx* can already be found in some of Newton's and Leibniz's texts, but new proofs to support these developments are provided throughout the 18th century, by Jacques and Jean Bernoulli and Euler among others, and it is still a major discussion point for Cauchy in his *Cours d'Analyse* of 1821.

Our aim in this talk is to give an interpretation of why the study of these transcendental functions and their development in power series became such an important matter in the period treated in our symposium. Whether they appear in relation to a geometric problem (for instance the section of angles) for Bernoulli or in the wider scope of Euler's infinitesimal analysis, or in Cauchy's real and complex analysis, it turns out that these functions provide an important support to the "analysis" that each of them developed and worked on.

After a brief introduction related to the geometric origin of the problem, we will focus on the way in which Euler and Cauchy understood these transcendental functions and the role they played in their respective treatises on analysis.

FROM LAGRANGE TO FREGE: IS A FUNCTION AN EXPRESSION?

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Frege's *Grundgesetze* (1893) opens with the assertion that one should not confound a function with an expression that designates it. This claim was apparently intended to exclude the definition of a function admitted by many 18th-century mathematicians, according to which a function is just an expression. Lagrange was one of these mathematicians, more particularly one who tried to draw more radical conclusions from this definition and related ideas about functions and quantities. Still, in spite of this opposition between Frege's claim and Lagrange's definition, it is possible to identify important analogies in their respective views on the subject.

The aim of my talk is to describe and discuss these analogies and to explore theor underlying rationality. I argue that this comparison sheds some light both on Lagrange's and Frege's foundational program.

DA CUNHA, STOCKLER AND MATHEMATICAL ANALYSIS IN PORTUGAL IN THE PERIOD 1770-1820

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From about the middle of the 16th century until the middle of the 18th century there was little significant mathematics done in Portugal, and the country lost touch with the more advanced European countries.

A change arrived with the coming to power of King D. José in 1750. Under the direction of the Marquis of Pombal, the King's Prime Minister, a policy of reforms was instituted, the more significant one being the 1772 reform of the University, then located in Coimbra, the first reform of the Portuguese University in 160 years. With this reform came the establishment of the first faculty of mathematics in Portugal. Two important Portuguese mathematicians were called to lecture in mathematics, José Monteiro da Rocha (1734-1819) the mastermind behind the University's reform, who mostly worked in applied mathematics and astronomy, and José Anastácio da Cunha (1744-1787), the most distinguished Portuguese mathematician of the 18th century, who made important contributions to mathematical analysis.

However, the King died in 1777, Pombal was dismissed, and there was a purge of the intelligentsia, which in particular led to da Cunha's expulsion from the University, cutting short (but not eliminating) his influence on the development of mathematics in Portugal.

The most important scientific institution during the 19th century was the Lisbon Academy of Sciences, founded in 1779. Up to the second half of the 19th century, the Academy's *Memoirs* was the only journal where mathematical papers could be published. An important figure, at one time the Academy's secretary, was the mathematician Francisco de Borja Garção Stockler (1759-1829), who also specialized in mathematical analysis.

In the first half of the 19th century publications in mathematics stagnated. To a significant degree this was due to the successive wars that ravaged the country, starting with a short war with Spain (1801), then the Napoleonic invasions (1807-1811), which caused the court to move to Rio de Janeiro. Brazil became from 1807 to 1822, the year of its independence, the center of the Portuguese empire. There followed a long period of civil unrest that culminated in a civil war (1832-1834). In the 19th century the military was the dominant group among mathematicians, and so any civil unrest would affect their research directly. In our talk we analyze the contributions of da Cunha and Stockler, in the context of Portuguese mathematics of the time, with a particular emphasis on the 1772 reform of the University and on the work of the Lisbon Academy of Sciences in its first decades.

LE STATUT DE L'ANALYSE MATHÉMATIQUE: DE L'*ENCYCLOPÉDIE* AU COURS DE L'ECOLE POLYTECHNIQUE

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Nous nous proposons d'étudier le phénomène d'institutionnalisation de l'analyse comme science mathématique spécifique, entre le milieu du XVIII^e siècle et le milieu du XIX^e siècle. On étudiera notamment les rapports complexes entre le statut de l'analyse et celui de l'algèbre dans cette période. Pour cela, nous regarderons particulièrement comment la situation se présente dans les grandes encyclopédies et les rubriques académiques, puis dans le cadre de l'Ecole polytechnique de Paris laquelle, dès sa fondation, institue un cours d'analyse au rôle important.

Dans l'*Encyclopédie*, éditée par d'Alembert et Diderot, le statut de l'analyse en mathématiques est ambivalent : il désigne tantôt une méthode, tantôt une discipline. Dans ce dernier cas, la présentation de son rapport à l'algèbre est aussi variable. Il est utile de comparer cette situation à celle que l'on trouve dans la *Cyclopædia* de Chambers, dont l'*Encyclopédie* devait être, au départ, une simple traduction.

Une évolution importante apparaît avec *l'Encyclopédie méthodique*, nouveau grand projet éditorial qui reprend les matériaux de l'*Encyclopédie* en les actualisant et en les organisant par « ordre de matières » au lieu de l'ordre alphabétique. La partie Mathématiques, éditée (sauf l'astronomie) par Bossut, Condorcet et Charles, paraît de 1784 à 1789. Elle comprend une « Table de lecture » destinée à permettre une utilisation du dictionnaire comme un traité. Cette table présente une classification des sciences mathématiques en dix rubriques dont l'originalité est l'introduction explicite d'une partie « Analyse », distincte en particulier de la partie « Algèbre ». Pour l'essentiel, la rubrique analyse comprend des articles relatifs à des concepts ou des théories faisant intervenir des quantités infinies, au lieu de quantités finies pour les articles d'algèbre. Beaucoup d'articles classés en analyse concernent le calcul intégral et reflétent les travaux effectués sur ce sujet dans la période récente. On peut penser que c'est l'expansion rapide alors du domaine du calcul intégral qui conduit ces trois membres de l'Académie des sciences de Paris à introduire l'analyse comme nouvelle science mathématique, distincte à la fois de la géométrie et de l'algèbre.

Cependant, cette nouvelle classification des mathématiques est loin d'être encore stabilisée. La création de l'Ecole polytechnique, au moment de la Révolution française marque aussi l'institutionnalisation de l'analyse comme une discipline, faisant l'objet d'un cours considéré comme fondamental. Mais le programme de ce cours ne correspond pas, au départ, au contenu de la partie analyse de *l'Encyclopédie méthodique* ; il recouvre, plus largement, l'ensemble des mathématiques pures à l'exception de la géométrie. La structure du programme officiel du cours d'analyse de Polytechnique va évoluer, sous l'effet convergent de positions pourtant profondément différentes : celle de Cauchy, préoccupé par l'établissement de nouveaux fondements du domaine, et celle de la direction de l'Ecole, soucieuse d'orienter davantage l'enseignement vers les applications. A partir de la fin des années 1820, et pour longtemps, le contenu du cours d'analyse va s'identifier au calcul différentiel et intégral.

NUMBERS, LIMITS AND CONTINUITY IN GAUSS. SOME OBSERVATIONS ON THE FOUNDATIONS OF MATHEMATICS AROUND 1800

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In his analytical writings, Gauss introduced many novelties in the fabric of eighteenth-century analysis. He, indeed, rejected the formal methodology and the traditional notions of complex number, function, integral and of the sum of series. However, the investigation of some of his theorems shows he conceived the continuum in a way substantially different from the modern one. For instance, in the definition of the arithmetico-geometric mean, he assumes the following hidden lemma: if an increasing (decreasing) sequence λ_k has an upper (lower) bound, then there exists a real number Λ that is the limit λ_k for $k \to \infty$.

This and other hidden lemmas are due to the lacking of an adequate construction of real numbers and show that Gauss's mathematics was based upon a revised version of the traditional concept of continuous quantity, which he had inherited from eighteenth-century mathematicians. The traditional continuum did not consist of points but was given as a whole. It was an intensional idea characterized by the relation between the whole and its possible parts, unlike in Dedekind-Cantor theory, which is based on extensional set theory. This conception have remarkable consequences in the calculus: it is sufficient to think that an interval was always thought of as including its endpoints (in modern terms, it was always a closed interval). In my opinion, the main difference between Gauss and the traditional 18th-century continuum is that the latter thought to a geometrical continuum, immediately referred to geometric quantities, while the former to a numerical continuum, which, in principle, embodies the flowing of time.

Moreover, Gauss's concept of the continuum has consequences on his notion of continuous functions and on some procedures (for instance, the interchange of limits), which are similar to those later used by Cauchy in his *Cours d'analyse*.

References

Breger, H. Les Continu chez Leibniz. In Salanskis, J.-M. and Sinaceur, H. (Eds.), *Le Labyrinthe du Continu*, Paris: Springer-Verlag France, 1992, 75-84.
Ferraro, G., Analytical symbols and geometrical figures. Eighteenth Century Analysis as Nonfigural Geometry, *Studies In History and Philosophy of Science Part A,* 32 (2001), 535-555.
Ferraro, G., Differentials and differential coefficients in the Eulerian foundations of the calculus, *Historia Mathematica,* 31 (2004) 34-61.
Ferraro, G., The foundational aspects of Gauss's work on the hypergeometric, factorial and digamma functions, The foundational aspects of Gauss's work on the hypergeometric, factorial and digamma functions, *Archive for History of Exact Sciences* 61 (2007), 457-518.
Gauss, C.F., Disquisitiones generales circa seriem infinitam $1+\frac{\alpha\beta}{1\cdot\gamma}x+\frac{\alpha(\alpha+1)\beta(\beta+1)}{1\cdot2\cdot\gamma(\gamma+1)}xx+\frac{\alpha(\alpha+1)(\alpha+2)\beta(\beta+1)(\beta+2)}{1\cdot2\cdot3\cdot\gamma(\gamma+1)(\gamma+2)}x^3$ +etc.

Pars Prior, *Commentationes societatis regiae scientiarum Gottingensis recentiores*, 2 (1813). In *Werke*, 3:125-162.
Gauss, C.F. Determinatio seriei nostrae per aequationem differentialem secondi ordinis, in *Werke*, 3: 207-229.
Gauss, C.F., Zur Lehre von den Reihen in *Werke*,, 10, Abt.1, 382-428.
Gauss, C.F., Zur Metaphysik der Mathematik, in *Werke*, 12: 57-61.
Gauss, C.F., *De origine proprietatibusque generales numerorum mediorum arithm. Geometricorum*, in *Werke*,, 3: 361-374.

"THROWING SOME LIGHT ON THE VAST DARKNESS THAT IS ANALYSIS": NIELS HENRIK ABEL'S CONTRIBUTIONS TO THE REORIENTATION OF ANALYSIS IN THE 1820s

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In the 1820s, the young Norwegian mathematician Niels Henrik Abel (1802-1829) became one of the earliest adherents to and advocates of Augustin-Louis Cauchy's (1789-1857) new approach to analysis. Ivor Grattan-Guinness has even characterised Abel as "more Cauchyian than Cauchy himself". In Abel's notebooks, a single scribble has been found mentioning the Czech Bernard Bolzano (1781-1848), who simultaneously with Cauchy undertook a similar reorientation of analysis. In letters from his European Tour back to his mentors in Norway, Abel vowed to help "throwing some light on the vast darkness that is Analysis". This paper is devoted to investigating what that darkness consisted in for Abel and how he went about illuminating it.

Cauchy advanced his new analysis under the banner of rejecting any and all arguments conducted "by the generality of algebra". By that slogan, Cauchy insisted on an interpretation of mathematical equality as numerical equality instead of the formal equivalence central to an older Eulerian, formula-centred style. Such a radical reinterpretation of a fundamental concept in mathematical analysis meant that mathematicians – including Abel – began to look at established procedures and proofs to figure out whether they were still valid, and if so, why ungrounded reasoning could lead to correct results.

Abel's mathematical production falls in between the formula-centred style of Euler that he followed in his work on elliptic functions and the new more concept-centred style of Cauchy's new analysis. Abel's contributions to the new style rested mainly on three pillars. First, he exemplified the new style of rigour and conceptual reasoning in his proof of the most general case of the binomial theorem, published 1826. That theorem had already been the vehicle by which Bolzano sought to reform the standards of rigour in analysis, and its central position in the analytical edifice is a good starting point for evaluating the impact of the conceptual reorientation. Second, Abel employed the new style in discussing certain criteria for convergence of series in a dispute with the otherwise largely unknown mathematician Louis Olivier. Third, albeit of more local importance only, Abel's letters documenting the attraction to the new analytical style were – and are – of great interest in understanding the early reception of Cauchy's work.

This talk will begin by outlining the issues involved in the reorientation of analysis from its 18th century formula-centred style to its 19th century more concept-centred style. Then, I will discuss in more detail the contributions of Abel and their contextualisation within the larger transformation. In particular, I will emphasise the role of 'critical revision' as part of connecting the new concept-centred style to the existing body of analytical knowledge.

WHAT MAKES MATHEMATICAL ANALYSIS RIGOROUS? COUNTEREXAMPLES AND PATHOLOGICAL FUNCTIONS

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The 19th century is known in the history of mathematics as the age of rigor. Mathematicians began to discuss some important notions in analysis that could not be grasped by geometric intuition. The adoption of ε-δ inequalities was an important part of this trend. The present paper explores the relationship between the development of new theories in analysis and the increasing emphasis on rigor.

In his *Cours d'analyse,* published in 1821, Cauchy described the geometric idea of a limit concept in terms of inequalities Although he developed his theory in an abbreviated style by means of ε-δ methods, his analysis was not completely free of geometric notions. Another important aspect of his approach was the rejection of what he called "the generality of algebra." He noted that a general formula for power series may not hold for particular values, a fact to which18th mathematicians were largely indifferent. His special attention to counterexamples was an important factor in his formulation of the notions of convergence and divergence.

The publication of Fourier's theory of series in 1822 was a crucial event in the emergence of the concept of rigor. Fourier expansions provided counterexamples to results about series traditionally assumed to be valid. Mathematicians modified existing theories using ε-δ inequalities. They also sought necessary and sufficient conditions for the convergence of a series. This program of research led them to reconsider the concept of a function. Riemann arrived at his famous example of an everywhere continuous but nowhere-differentiable function in the course of his investigation of functions that were represented by Fourier series. The evidence suggests that he had this example by 1861 at the latest.

Weierstrass realized that confusion could result if one tried to grasp the properties of Riemann's function by means of geometric intuition. Weierstrass defined the limit concept in terms of ε-δ inequalities without any reference to geometric conceptions. His primary motivation was not the clarification of the notion of uniform convergence but rather the construction of a purely algebraic theory of analysis using the method of ε-δ inequalities. He developed this new framework in his 1861 lectures, a work that is often regarded as a prototype of the new rigor in analysis.

THE PLACE OF ANALYSIS IN 19th-CENTURY BRITISH MATHEMATICS

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While one could easily name 19th-century British mathematicians who made substantial contributions to algebra (e.g. Boole, Cayley, Sylvester), geometry (Salmon, Clifford) and mathematical physics (Stokes, Maxwell, Kelvin), the task of finding those who were first-rate analysts is somewhat harder. In fact, it is rare to find *anyone* of note in 19th-century Britain who worked on analysis purely for its own sake. This is all the more remarkable considering that analysis was probably *the* major forte of British pure mathematics in the first half of the 20th century. All this leads to some interesting questions: Why was the subject neglected by British mathematicians for so much of the 19th century? When did this situation change? And what were the reasons for the turnaround? In order to provide some sort of answers, this paper will look at those who comprised the British mathematical community (to the extent that such an entity existed) at that time, their mathematical training and backgrounds, and, most importantly, what was understood in 19th-century Britain by the word "analysis" itself.

MITTAG-LEFFLER AND WEIERSTRASSIAN ANALYSIS

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In recent years the Swedish mathematician Gösta Mittag-Leffer (1846-1927) has attracted the attention of historians as an important organizer of mathematics, a journal editor, and, to some extent, a mathematician. However, very little attention has been paid to his role as a teacher, and relatively little has been done to investigate his impact on the shape and development of Swedish mathematics in the late 19th century through this area of his career.

This paper has two aims: first, to describe Mittag-Leffler's "mission" to promote specialized mathematical study at Stockholms Högskola (founded 1878), where he held the institution's first chair of mathematics, and to establish a research ethos there. In attempting to do so Weierstrassian analysis, specifically in connection with Mittag-Leffler's research investigations concerning the analytic representation of single-valued functions, played a central role in the early- to mid-1880s.

Second, I will analyze the impact that this mission had on two of Mittag-Leffler's first students there, Ivar Bendixson (1861-1935) and Edvard Phragmén (1863-1937), focusing on among other things Mittag-Leffler's roles in problem-selection and concept shifts, and the transmission of certain values regarding mathematical practice and study.

RIGOUR VS. INTUITION: TEACHING AND RESEARCH IN ANALYSIS IN TURIN IN THE SECOND HALF OF THE NINETEENTH CENTURY

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This paper will identify some internal and external factors that contributed to changes and developments in how analysis was taught and understood in Italy – and especially in Turin – in the last decades of the nineteenth century. On one hand, the emergence of an interest in foundational studies and the goal of elevating Italian mathematics to a level comparable to the leading countries of Europe led to a complete renewal of studies in infinitesimal calculus, thanks to the contributions of E. Betti, F. Brioschi, F. Casorati and U. Dini. On the other hand, the birth of the Italian national education system stimulated the study of teaching programs for universities and technical schools and let to the writing of specialized treatises. In Piedmont, among the main events that caused a change in the research and teaching of analysis were the lectures of Augustin-Louis Cauchy during his stay in Turin (1831-33) and those of Angelo Genocchi, Felice Chiò and Francesco Faà di Bruno, the latter all being teachers of Giuseppe Peano. A lively scientific and didactic tradition in calculus was established, which was characterised by a rigorous and abstract approach, and gave rise to significant results in the theory of real and complex functions and in foundational studies on continuous functions, derivatives and series.

To document these changes we examine Peano's lectures on analysis, held at the Turin University and at the Military Academy (1882-1901), which illustrate both progress and differences with respect to Genocchi's lectures. Also relevant were the lively debates that surrounded Peano's treatises *Genocchi-Peano* (1884), *Applicazioni geometriche del Calcolo infinitesimale* (1887) and *Lezioni di Analisi infinitesimale* (1893). The study of the correspondence between Peano, Genocchi and other contemporaries (H.A. Schwarz, C. Hermite, F. Casorati, P. Tardy, E. Cesàro …) will shed light on the scientific and institutional context of the publication of these books, which formed the basis for the subsequent encyclopaedic *Formulaire de Mathématiques* (1895-1908). An examination of Peano's and Genocchi's published and unpublished lectures will show: the extent of the influence exerted by Genocchi on his assistant; their internal interaction in choices of research themes and teaching practice; and the critical studies they completed of earlier and contemporary literature.

Finally, Peano's autograph *marginalia* in his treatises allows one to follow the development of his scientific thinking, to understand the role of logical notations in his analysis, and to appreciate his preference for formal-algorithmic procedures over synthetic-geometrical approaches.

References

Roero C.S. (ed.) 1999, *La Facoltà di Scienze Matematiche Fisiche Naturali di Torino, 1848-1998*, 2 volls., Torino, Deputazione Subalpina di Storia Patria.

Luciano E. 2007, *Il trattato Genocchi-Peano (1884) alla luce di documenti inediti*, Bollettino di Storia delle Scienze Matematiche, 27, 2, p. 219-264.

Symposium S06
Transmission and Transformation of Mathematics and Mathematical Instruments in their Social Contexts, East and West

QIN JIUSHAO'S DIVINING METHOD AND IN WHICH THE MATHEMATICAL THEORY CONTAINED

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Qin Jiushao was a mathematician in Southern Song China. In his mathematical work, *Shushu Jiuzhang* (*Mathematical Treatise in Nine Sections*), he advanced a method for divination by counting yarrow stalks that was distinct from the divining method derived from *Zhouyi* (*Book of Changes*). Qin's method had its own origin, which was involved in the first problem titled *Shigua Fawei*of the first chapter of his work. Qin obviously took *shigua fawei* as a model brought to light the pith of *Dayan zongshu* method that, in nowadays mathematics terms, is a systematic solving process for simultaneous linear congruence equations. He not only clarified the algorithm in accordance with the theory of congruence but also revealed the connection between the algorithm and the method for divination by counting yarrow stalks.

THE INTRODUCTION OF NAPIER'S RODS IN CHINA

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The Scottish John Napier (1550-1617), besides his logarithms, also developed other instruments devoted to facilitate computations in his book *Rabdology* (1617). One of these methods consists of a set of small rods (*Napier's rods* or *bones*), that enable fast multiplications, divisions and square and cubic roots. This method was popular for several decades in Europe, especially in Scotland, but it was soon replaced with other methods, such as logarithms.

It is really interesting that the *Rabdology* was one of the first methods for arithmetic calculations introduced in China by Jesuits. In 1628, Giacomo Rho (*Luo Yagu*, 1592-1638) wrote his *Chou Suan* (*Calculus with rods*). The *Chou Suan* was included in the *Xiyang Xinfa Lishu* (*Calendar compendium according to the Western new methods*), an encyclopedic work on mathematics and astronomy reedited by Adam Schall von Bell (*Tang Ruowang*, 1592-1666) in 1645 after the *Chongzhen Lishu* (*Calendar compendium of the Chongzhen era*), which contained many European mathematical and astronomical treatises translated into Chinese by Rho and Schall between 1630 and 1635.

Probably, Rho's *Chou Suan* would not have been very important for Chinese mathematics if Mei Wending (1633-1721) had not written his own *Chou Suan*. Mei Wending is considered one of the Chinese mathematicians more influential of his time. His *Chou Suan* has several differences from Rho's one. For example, rods are not vertical, but horizontal ones.

In this paper, I will give a general survey on Rho's and Mei's *Chou Suan*, and I will compare these books with Napier's *Rabdology* as a typical example of adaptation of a European computation device in China.

KAREL SLAVÍČEK AND YAN JIALE METHOD

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It is well-known that the Jesuits had played important role to the transmission of some knowledge of Western science to China during the 17 and 18 centuries. Among them, Karel Slavíček (1678—1735), with the Chinese name Yan Jia-le, was a versatile scholar but unfortunately ignored by most researchers in the field concerned. Slavíèek was born in Moravia in 1678, arrived in Macao in 1716 and died in Beijing in 1735.

During the 19 years of his stay in China, in the immediate aftermath of the Chinese Rites Controversy, like his contemporary colleagues, Slavíček experienced tremendous limitation to activities of evangelization; nevertheless, thanks to his profound knowledge of astronomy, mathematics, machinery and musicology, Slavíček was high in the favor of Emperor Kangxi (1654—1722), the sole monarch in Chinese history who favored mathematics and natural sciences.

There is evidence suggesting that Slavíček was involved in writing many literature on astronomy, part of which was compiled into *Lixiang Kaocheng Houbian* (later edition of the established system of calendric astronomy, 1743). While in China, he carried out a number of scientific activities, including and not limited to the drawing of a map of Beijing, measuring the altitude at which the Northern Star rises above the horizon, observing the motion and location of the moon, drawing a map of the lunar surface, analysis of Chinese record of solar eclipse and research in Chinese calendar, musical tones and chronology.

The works mentioned above could be gleaned from his letters to personages in and outside the European churches. In addition, in *Chishui Yizhen* (precious relic along the red river, before 1744) by Chinese mathematician Mei Juecheng (1681-1763), the approach to determining geographical latitude through the height of a star, and its hour angle is recorded, and this is called “Method of Western Scholar Yan Jia-le”.

ON THE HISTORY OF THE COMPASS

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The compass is one of the most ancient tools that mankind has used since the Stone Age. Apparently, one of the most ancient images of a compass is from ancient China, where a stone relief from a Han dynasty tomb depicts the mythical figure, Fu Xi, with a gnomon and his consort, Nu Wa, holding a compass. These tools symbolize divine knowledge. It is possible to divide all compasses into four basic groups:

1. *Cord compasses:* cords with pegs at the extremities. Such compasses are still applied in various engineering operations (for example, by roofers). 2. *Bow compasses:* compasses with two legs connected by a hinge. One modification of the bow compass is the “perfect” or “elliptic” compass, created in antiquity for drawing hyperbolas, parabolas, and ellipses (whole-and-half compasses), and reconstructed by Arabic scientists in the tenth century. 3. *Beam compasses:* compasses ith two short legs that move along a ruled rod (bar), today used basically for measurements. 4. *Proportional compasses:* These are used for reducing or enlarging drawings, and have legs crossing so as to present a pair on each side of a common pivot. By means of a slit in the legs, and the movable pivot, the relative distances between the points at the respective ends may be adjusted to any required proportion. The second type of proportional compass has legs in the form of two wide bars on which various scales are plotted; with their help one can easily solve complicated geometrical and algebraic problems.

In ancient times, the compass and carpenter’s square or gnomon were symbols of knowledge, and we find traces of the widespread use of geometrical algebra. The mathematics of all ancient civilizations has surpassed this stage of development. For a long time geometrical calculations were the basic tool of science and engineering. In the Middle Ages the art of using compasses was widely appreciated, and the compass was regarded as a divine creation. The compass was adopted as the emblem of craft communities, a secret symbol of masons, and a figure that appeared on the arms of noblemen.

The complexity (and sometimes the impossibility) of using compasses in certain problems led to new designs for drawing tools used for the resolution of practical problems. New compasses based on various adaptations (usually having a basis in established, classical designs) were also created.

Later, when numerical systems were more highly developed, geometrical methods receded into the background. However, the art of geometrical constructions was highly regarded and was an important basis of mathematical training. The geometry of ruler and compass was fundamental to the development of new mathematics in Europe. And in practical designing and measuring, there is nothing than can replace the compass.

Now there are new models of compasses, including electronic digital compasses, but these nevertheless are based on designs as ancient as humanity.

CIRCLES AND SQUARES, CUBES AND SPHERES, EAST AND WEST

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Among the oldest extant mathematical records are methods for finding the side of a square with a given area, or the volume of a cube or sphere. Were the methods for approaching and solving such mathematical problems similar or different in Egyptian, Babylonian, Greek, Indian, Islamic, and Chinese contexts? By approaching this question from a comparative point of view, the differences in methods are as striking as their similarities. Comparisons within a given culture are also instructive, for instance the methods found in the earliest yet-known Chinese mathematical text, the *Suan Shu Shu* (A Book on Numbers and Computations, ca. 186 BCE) and the classic texts of ancient Chinese mathematics, especially the *Jiu zhang suan shu* (Nine Chapters on the Art of Mathematics; the edition with commentary by Liu Hui dates to 263 CE).

LEIBNIZ'S VIEW OF THE *I CHING*

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The *I Ching* or *Book of Changes* is one of the oldest Chinese classic texts. Although it is a set of oracular statements, it is traditionally said that Confucius wrote a set of philosophical commentaries on the *I Ching* known as the *Shi Yi*. And there are statements in this text that are very near to the philosophy of Leibniz, for example; the dynamic balance of opposites, the evolution of events as a process, or the acceptance of the inevitability of change.

Leibniz was in contact with the French Jesuit R.P. Bouvet who informed him about the *I Ching,* and this came as great news to Leibniz and reinforced his idea of the universality of knowledge.

We can see some of Leibniz's views about this in his texts, including:

1. Explication de l'Arithmétique binaire, Mémoires de l'Académie des Sciences de Paris, 1703. Dutens, III, 390-4. GM, VII, 223. 5p.
2. De inventione Arithmeticae Binariae, excerpt. ex Vita Leibnitii a D. Jaucourt scripta, Dutens, III, 345-8.
3. Epistolae duae ad Schulenburgium De Arithmetica Dyadica, 1724, Dutens III, 349-54.
4. Erklärung der Aritmeticae binariae, Journal des Sçavans, 81-112. Etc.

We will comment in particular on the binary system as a very important concept in the theory of combinatorics.

THE CALCULATING PROGRAM OF THE LUNAR MOTION IN *YUZHI LIXIANG KAOCHENG* (1725)

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In the early period of the Qing Dynasty (1644-1911), the four calendars had been put into use, which are *Xiyang Xinfa Lishu* (Treatise on Mathematics (Astronomy and Calendrical Science) according to the Western Method, this encyclopedia was issued in the Ming (1635) as Chongzhen reign-period Treatise on (Astronomy and) Calendrical Science, first form of the Jesuit astronomical encyclopedia, reissued as the former by Johann Adam Schall von Bell (1591-1666) in 1645, 1628-1827, and the year of 1628 was selected as the epoch of the Calendar), *Kangxi Yongnian Lifa* (The Eternal Calendar of Kangxi Emperor, compiled by Ferdinand Verbiest (1623-1688) in 1669, 1828-3827), *Yuzhi Lixiang Kaocheng* (Complete Studies on Astronomy and Calendar, 1684-1983) and *Yuzhi Lixiang Kaocheng Houbian* (The Supplement to Complete Studies on Astronomy and Calendar, 1723-2022).

The theory of the lunar motion in *Yuzhi Lixiang Kaocheng* was derived from the model of epicycle- oblique circle- sub-epicycle- sub-oblique circle (Benlun- Junlun- Cilun- Cijunlun). The diameters of the epicycle, oblique circle, sub-epicycle and sub-oblique circle were 1,160,000, 580,000, 434,000 and 235,000 respectively when the distance between the Earth and the Moon was supposed as 10,000,000. The calculating program for the lunar motion in *Yuzhi Lixiang Kaocheng* has been realised and the correspondingly preliminary conclusions as followed.

1. The characters of leap years in *Xiyang Xinfa Lishu* (1645), *Kangxi Yongnian Lifa* (1669) and *Yuzhi Lixiang Kaocheng* (1725) had a common continuity.
2. The Ersan Junshu Biao in *Yuzhi Lixiang Kaocheng*, and Ersan Junshu Zongshu Jiajian Biao in *Xiyang Xinfa Lishu* as well, could be derived by the above mentioned model as the result of the eight calculating formulae.
3. The Moon's greatest distance from the Earth, the parallaxes of the Moon and the apparent diameters of the Moon in *Yuzhi Lixiang Kaocheng* were different from the values given by Claudius Ptolemaeus (c.90-168), Nicolaus Copernicus (1473-1543), Tycho Brahe (1546-1601), and Johannes Kepler (1571-1630).
4. The ratio of the diameter of Earth and the diameter of the Moon in *Yuzhi Lixiang Kaocheng* is 3.72 and 1, which was different from the value of 3.5 and 1 given by Nicolaus Copernicus and appeared in *Xiyang Xinfa Lishu*.
5. The calculating formulae for semi-diameter of the Sun (Ri Banjing), semi-diameter of the Moon (Yue Banjing), and shadow's semi-diameter of the Earth (Ying Banjing), have been outlined, which are different from that in Copernicus' *Revolutions* (1543).
6. The theory of the lunar motion in Isaac Newton's 1702 *Theory of the Moon's Motion* and the second edition of *Principia* (1713) had not introduced in *Yuzhi Lixiang Kaocheng*, which was slightly revised and incorporated in *Yuzhi Lixiang Kaocheng Houbian*.

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"WASAN" MATHEMATICIANS, TECHNOCRATS AND SAMURAI DURING THE EDO PERIOD IN JAPAN –SEKI TAKAKAZU'S RESIDENCE AND THE SOCIAL STATUS OF MATHEMATICIANS

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Seki Takakazu (1642?-1708) lived in the age of Samurai warriors, or Samurai technocrats. In the middle of the 17th century, there was nothing for Samurai warriors to do, but Samurai technocrats controlled the Shogun government. Samurai technocrats surveyed their own land. Seki was the second son of Uchiyama Nagaakira (?-1646?/1662?), an unemployed Samurai; as the second son, it was quite difficult for Seki to become a Samurai as well. However, Seki studied Wasan, traditional Japanese mathematics, and was adopted as a foster son by Seki Gorozaemon (?-1665£©. Seki Takakazu became an examiner of accounts for the lord of -han, Tokugawa Tsunashige. Consequently, we can conclude that the Wasan was a means for success in life for Samurai in this era. Thus we could call this era the "Kanjo-gata Wasan era" since the appearance of Seki's *Hatsubi Sampo* (Seki, 1674). After Seki, there were Takebe Katahiro (1664-1739) and Yamaji Nushizumi (1704-1773) who also studied Wasan and lived the successful life of the Samurai.

We must consider where Seki lived, because we can determine the social position of Kanjo-gata from their residential area. In the *Kofu-sama Goninshu Bugencho* (1695), it is said that Seki lived in Tenryuji. The problem is, in which Tenryu-ji did Seki live? That is to say, Yotsuya's Teryu-ji or Ushigome's Tenryu-ji, because Tenryu-ji was in Ushigome before the big fire of Tenwa (1682). We can examine the maps of *Gofunai Enkaku Zusho* (1808-1861), where Uchiyama Nagasada's residence was in the former Tenryu-ji, or where the Ushigome police station is now. Moreover, the residence of Seki Gorozaemon, Seki's father, was in the former Tenryu-ji; also, the Jorin-ji temple of both Seki's family and Uchiyama's family is in Ushigome. Therefore we can conclude that Seki lived in Ushigome. Kanjo-gata today live in Shinjuku, that is to say, the "new town." We can know something of the life style of Kanjo-gata thorough Seki's former residence.

Key Words: Seki Takakazu (Kowa)'s Residence, Ushigome Jorin-ji, Kofu-han, Gofunai Enkaku Zusho

TRIGONOMETRIC TABLES, THEIR UTILITY, AND MAKING IN LATE IMPERIAL CHINA

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Integration of Jesuit and Chinese methods in astronomy was one of the phases Xu Guangqi (1579-1659) prescribed for the Calendar Reform in late Ming. One of the obstacles in integration of the two methods was the incommensurability of trigonometric tables the Jesuits introduced and the measuring unit for arcs in the traditional Chinese system. As an important computing "instrument," trigonometric tables in China as well as its utility and making warrant close examination.

The Jesuits utilized trigonometric tables to simplify the computations in astronomy while Chinese astronomers, before the arrival of the Jesuits, employed the method of interpolation to serve the same computational needs. Although the Jesuits provided the basic principles of making trigonometric tables, there were technical details left unexplained, which made the reconstruction of a complete trigonometric table with impossible. Some Chinese scholars in the 18th century tried to remedy this situation by changing the measuring unit of arcs from 360 degree for the full circle to some other units. Such changes rarely had any following. In the 19th century, after the publication of *Geyuan milü jiefa* (Quick Methods for Circle-Division and Determining the Precise ratio of the circle) by Ming Antu (1692?-1765?), a trigonometric treatise which discussed the power series approach of finding the length of an arc from its sine value and related properties provided an easy and fast way to complete the construction of trigonometric tables. In this paper, I compare the Chinese indigenous computation methods, trigonometric tables introduced by Jesuits, and trigonometric tables constructed by Chinese scholars in the 17th-19th century utilizing various computation methods to investigate how Chinese scholars at different time viewed and received trigonometric tables. Moreover, I examine the how scholars' views on Western learning influenced their approach to making trigonometric tables.

Symposium S07
The Nature and Aims of Prediction in Ancient Science

PREDICTION FROM AND IN THE SKY IN BABYLONIA

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Prediction of future events on earth is the purpose of the vast Babylonian omen compendia, although at the same time it is believed that these events may be prevented from happening by appropriate actions.

Prediction of events in the sky becomes a purpose of the activity of scholars at the Assyrian court in the 7th century BC who are experts in the interpretation of celestial omens for the king. Centuries later, prediction of some celestial events is achieved by both mathematical and other procedures. The relation between the different types of prediction will be the topic of this paper.

"ASSYRO-BABYLONIAN INFERENCES FROM SIGNS AND THEIR RELATION TO PREDICTION"

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Assyro-Babylonian divination by signs was codified in lists of indicative conditional "If P, then Q" statements. The conditional has been an important source of investigation of various kinds of reasoning, especially of inference and deduction, of the relation between propositions, the form of arguments, of causality, and other aspects of what comes under the rubric of conditional logic. Prediction can also be embedded in the meaning and function of conditional statements, the most basic being in the form of the assertion "if p is true then q is also true."

The meaning of conditional statements can vary widely, from co-occurrences without an understood causal connection (Hume's "constant conjunctions," If there is fire, there is heat) to certain events in the future necessarily following certain events in the past (Cicero's analysis of the omen "If someone is born at the rising of the Dogstar, he will not die at sea"), to causal relations, where"if P, then Q" can mean Q occurred because P occurred, often taken as an explanation of the form "Q would not have occurred but for P," e.g., if he trips, then he will fall." In order to evaluate the predictive nature of the conditionals found in cuneiform omens, it is worthwhile to understand the particular meaning of those conditionals, defined in terms of the kinds of connections established between sign and portent. On this basis the relation between the formal aspect of omens and their use in divinatory practice and prediction can be considered. In these terms, this paper will discuss the predictive (and non-predictive) nature Babylonian omen statements "If P, then Q."

THE EARLIEST SCIENTIFIC PREDICTIONS

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To the extent that "scientific" predictions are distinguished by an ability to predict events not previously experienced, they begin in Babylon around - 625 with the discovery of a reliable method for answering the prosaic question: will future months contain 29 or 30 days?.

The paper amplifies this assertion.

BABYLONIAN PERIOD RELATIONS

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Using the observed dates of first and last visibility of the planets and of their conjunctions with ‘Normal stars’ as recorded in the Astronomical Diaries Babylonian scholars managed to identify periods (counted in years) after which a planetary first/last visibility or a conjunction with a particular Normal star recurred on about the same date in their lunar calendar. The lengths of these periods vary from about 10 years to about 100 years. The earliest text containing a list of such periods dates from the late 7th century BC.

These periods provide the basis for the “Goal-year” method, the simple computational scheme developed by the Babylonian scholars to predict planetary positions by using observations from one period earlier. Preserved Goal-year texts date from the last three centuries BC.

They also form a significant first step in the construction of much longer periods, varying from 250 to 1500 years, which play a central role in the development of the elegant arithmetic schemes to predict the positions of planets for arbitrary dates (the ACT-type ephemeredes from the last three centuries BC). The accuracy of the predicted positions in these ephemeredes is of order one degree, comparable to that of the later Hellenistic planetary models of Hipparchus and Ptolemy.

In this paper 200 years of synthetic observations are used to investigate how the Babylonian scholars may have derived the planetary periods from the recorded dates of first and last visibilities of planets and of stellar conjunctions. I discuss the difficulties that they may have encountered in the process and the accuracy of their results. I further show that the long periods used in the Babylonian planetary theories can be constructed from linear combinations of the fundamental ones and, finally, that all parameters of the planetary theory can be determined from the observed dates alone. This is illustrated for system-A theories of Mercury and Jupiter. Once the parameters have been fixed only one observed position is required to generate positions for anyone time in the future.

While Babylonian planetary theory might be considered to be the first successful scientific model of natural phenomena in the intellectual history of mankind, it is interesting - and at the same time somewhat sobering - to realize that its original aim was quite mundane: to have a formula by which catastrophic events in life can be foreseen and subsequently neutralized by religious ritual so that personal happiness may be safeguarded.

MATHEMATICAL MODELS OR OBSERVATIONAL AIDS? SHADOW LENGTH SCHEMES IN BABYLONIAN ASTRONOMY

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A variety of cuneiform texts contain schemes relating the length of a shadow cast by a gnomon to the time of day throughout the year. One scheme is found in the early compendium of astronomical material known as MUL.APIN, others are on single tablets by themselves, and one is found in a mathematical collection of metrological material. Neugebauer has shown that the scheme found in MUL.APIN is based upon reciprocals (the length of shadow multiplied by the time since sunrise is a constant); nevertheless aspects of this and other schemes correspond well with astronomical reality for the latitude of Babylon. In this paper I will discuss the corpus of tablets containing shadow length schemes and address the question of their purpose: were they simply mathematical schemes or were they actually used to measure time.

Symposium S08
Ideas and Instruments in the Development of Physics and their Use in Science Education

ATWOOD'S MACHINE: A HISTORICAL CASE STUDY TO COMPLEMENT AND ENRICH CONTEMPORARY METHODS OF TEACHING NEWTON'S LAWS OF MOTION.

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Atwood's machine was a research instrument, invented in the 1780s, to study Newtonian mechanics. One of the standard exemplars for elementary physics, featured in every textbook, is the study of the motion of two unequal weights attached to a pulley.

Textbooks do mention Atwood's machine, but very few texts discuss the history of this exemplar. Students learn the algorithm for the solution of the motion of the weights and then proceed to solve standard textbook problems. I will argue that as an important part of the education of future physics teachers we should illustrate the mathematization of the physics of mechanics, using this common exemplar. One can begin with a thought experiment, followed by the standard application Newtonian physics, ending with the Lagrangian reformulation of Newton's laws. This is a simple example to show how the progressively more sophisticated application of mathematics to physical phenomena allows elegant solutions to problems but often hides the physics behind it. This realization is important for physics teachers when they present the mathematical equations of motion to students with an inadequate discussion of the concepts involved.

JOULE'S ELECTROMAGNETIC ROTOR AND PADDLE WHEEL APPARATUS. EXPERIMENTAL DEMONSTRATIONS OF THE CONSERVATION PRINCIPLE BETWEEN MECHANICAL POWER AND HEAT

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We organized an analysis from an historical point of view of two Joule's apparata. These devices are important for different reasons. In particular, for being the concrete link between two main aims in Joule's research: his original interest about the efficiency of electromagnetic engines and his later interest concerning the so-called Joule Effect.

For a better comprehension of Joule's work we preliminarily reproduced the apparatus of Joule Electromagnetic Rotor. We have to consider several things: loss of heat for leakage, frictions, terrestrial magnetic field, better insulation… The above quoted difficulties could be not just ours, but of Joule himself. In other words, the new technology used by Joule in this apparatus could be, for the time, an obstacle to believe in it. It was difficult, we mean, for the scientists of that period, to trust in something of physically almost totally new. So the difficulties were probably born not only for the new concepts regarding a unitary view of physics in which every phenomenon could relate to each other, but also due to the difficulties to use a new electromagnetic technology, to do measure with them, to take measurements with new instruments and so on…

So, in Joule's attempt to convince the scientists (and perhaps himself), he was obliged to return on his feet using the old but reliable technology (mechanical and hydraulic), in particular with his Paddle wheel. Following this hypothesis we reproduced a replica of Paddle wheel apparatus trying to compare them, in order to reach a demonstration of the first principle of Thermodynamics.

Physical instruments and apparata are – as well known – a concrete way to do experimental physics. The physical models are not only a good way to reproduce physics but moreover to understand it, even a way for a better understanding of history of physics.

THE HERO AND THE DRAGON – FRAUNHOFER AND THE DARK LINES OF THE SUN'S SPECTRUM

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The story of Fraunhofer's discovery of his spectral lines around 1813/1814 is well known and also the final astrophysical solution of this problem by Kirchhoff and Bunsen 1859. But why did it take so long to find the right physico-chemical answer? And why was there so little interest by astronomers in observing and comparing lines in star spectra (or in objects like nebulae) before 1859, in spite of the fact that Fraunhofer and his immediate "successor" Lamont in Munich began that investigation? Was the Dragon so strong, or were the heroes too weak to recognize this new promising field of research? The answer has to do with the complex interplay among problems of visualisation, optical technology, tradition and lack of interdisciplinary communication. Apart from historical interpretations, this unrealized potential development of a new branch of science seems, at least in retrospect, criminally negligent and makes for exciting lectures.

THE INDUCTION COIL AND THE ELECTROMAGNETIC WAVES

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The experiments of Heinrich Hertz in 1887/88 demonstrated clearly that the electromagnetic field of Faraday and Maxwell is not only a theoretical construct, or mathematical model, but an existing physical reality. These were crucial experiments for electromagnetic phenomena, because most of the scientists clung to the Newtonian theory of the long distance effect of forces that was in harmony with the known phenomena of gravitation, electricity and magnetism. Actually, the laws of electrostatics and electrodynamics of direct currents of the age of Volta, the equations of Ampère and Weber were not inconsistent with the long distance effect. The differences arise only in the case of very fast changes that exist in electric oscillations. William Thomson (Lord Kelvin) recognized in 1853 that the discharge of a capacitor generates oscillations and found the well known formula of the LC circuits. Feddersen documentated experimentally that the spark discharge of a Leyden-jar is not a continous current, but an oscillation. The spark coil of Rühmkorff (1851) made possibile further research work. The instrument was indispensable for the work and the length of its spark became a status symbol of laboratories.

The equations of Maxwell theoretically included the existence of electric (electromagnetic) waves and the experimental radiation and detection of the waves justified the electromagnetic field theory against the old theory of long distance effects. As a source of high freqency Hertz applied the sparks of an induction coil and demonstrated the spreading, reflection, refraction, polarization, interference of the waves and learned that they were the same as those of light. This similarity supported the idea that light is also an electromagnetic wave. The experiments became part of physics teaching and soon the practical application resulted in the invention of wireless telegraphy. The induction coil also played an important role in the discovery of another kind of very high frequency electromagnetic waves, namely the X-rays.

THE CHANGING MEANINGS OF PRECISION - FROM COULOMB TO GAUSS AND WEBER

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Gauss is widely acknowledged as the founder of error treatment in the natural sciences. His mathematical approach is nowadays widely accepted and used. Thus it seems a common belief that his methods improved scientific practice significantly and once introduced instantly took hold in the scientific community.

However, from our perspective there are two questions that can be raised:

- What may have been relevant developments of the understanding of measuring processes that may have served as a basis for Gauss to introduce his error treatment?
- How did Gauss' contemporaries react to his approach of the mathematical treatment of experimental data?

Thus, in the first part of the presentation a particular focus will be placed on the developing understanding of precision measurement. In doing so, we will use the example of pre-revolutionary France as a starting point of our analysis. By discussing the changing meaning of precision during the first quarter of the 19^{th} century, we are describing one of the basic conceptual grounds on which Gauss' interpretation of measurements had been founded.

In the second part we are going to discuss the relation between Gauss' individual experimental practice in comparison to the established one. In doing so, this will also serve as a key to understanding how his approach of data treatment was received among his contemporaries in the scientific community.

THE EÖTVÖS APPARATUS:
THE EQUIVALENCE OF INERTIAL AND GRAVITATIONAL MASS

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"Between 1888 and 1922, a Hungarian nobleman, Baron Lorand Eötvös, in an incredibly clever series of experiments using pendulum bobs of aluminium, copper, wood and various other materials, proved that the equality of these two very different properties of matter was accurate to better than five parts in a billion."
Leon Lederman, 1993.

Showing the equivalence of inertial and gravitational mass provided a solid experimental basis for the fundamental assumptions of Einstein's General Theory of Relativity. Einstein may have read about the experiments earlier, or heard about the torsion balance experiment of Eötvös from a comment made by Gyõzõ Zemplén, who attended his lecture in Vienna in 1913.

Eötvös did not set out to confirm this equivalence, he just had a keen interest in the laws of nature and their use in education. He measured the variation of gravitiy in different places and determined the gravitational constant using an essentially new method. He wanted to know whether the attraction changed because of a chemical reaction or the dissolutin in the attracted body. He made observations for the attraction not only by the Earth but also by the Sun. He even made observations using radioactive substances. The final result of his work is summed up by his statement: ".. in no case do we see a noticeable change in the law of proportionality between inertia and gravity."

"Since 1888 the observation of gravity pheomena has been part of the every-day experimnts of the Physics Institute of the University. My students have the opportunity to learn both the theory and parctice of gravitation by studying their own observations" Eötvös, 1896.

Eötvös designed demonstration for pupil's experiments as well, using:

- a qudrant gravimeter *with mercury*,
- attracting masses on a horizontal turn-table *below* the torsion balace beam level,
- gravity multiplication with the help of an *electromagnetic multiplicator,*
- a resonance-curves-*drawing mashine.*

Pál Selényi used the torsion balance for the demonstration of the *Eötvös effect*: the gravity variation to which a body is subjected when moving to the East or West on the surface of the Earth. Eötvös himself used for the experimental demonstration of his effect a rotational beam-like body, essentially a balance.

We will show an etching, a bronz medal, a terracotta relief , and a small statue of Eötvös.

THE EXPERIMENTAL CONFIRMATION OF EINSTEIN'S 'HEURISTIC' TO EXPLAIN THE PHOTOELECTRIC EFFECT: GOING BEYOND THE TEXTBOOK PRESENTATION

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Einstein (1905) proposed that ordinary light behaves as though it consists of a stream of independent localized units of energy that he called *lightquanta*, which helped to explain the photoelectric effect. General physics textbooks consider it useful for the introduction of quantum theory. According to most physicists it provides a good example of how a theory comes along to explain existing experimental data (black body radiation and the photoelectric phenomenon) that were difficult to explain, and thus shows the heuristic power of the new theory. Millikan devoted considerable effort to the experimental determination of Einstein's photoelectric equation and as a consequence calculated the experimental value of Planck's constant h. Millikan, however, was emphatic in denying that this constituted a confirmation of the underlying hypothesis of lightquanta. Actually, he went beyond and considered the hypothesis to be 'reckless' as it was contrary to the classical wave theory of light. On the contrary, most textbooks and physicists at present would consider Millikan's (1916) experimental data as evidence for Einstein's quantum theory (hypothesis of lightquanta). Based on a history and philosophy of science framework, this study has analyzed general physics textbooks. It is concluded that this historical reconstruction provides a means to go beyond the traditional textbook presentation.

Symposium S09
Islamic Science in Context: Texts, Instruments, Locales, and Institutions “in Memory of Professor Edward S. Kennedy"

TRIGONOMETRIC INSTRUMENTS IN MEDIEVAL ISLAM. NEW PERSPECTIVES AND POSSIBILITIES

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Trigonometric instruments for astronomical calculations are found in Islam since the beginning of the development of astronomy. We find them as circular plates, half circles and quadrants and they can be used for different purposes such as calculations related to spherical astronomy, timekeeping, calculations related to the sun, the stars, the planets, etc.

Sine quadrants were constructed in the Islamic East from the ninth century onwards. The first known description of these instruments was by al-Khwārizmī, following his two treatises on the astrolabe. In the beginning, the quadrant was an independent instrument, but from the tenth century onwards it was usually found on the back of the standard astrolabe.

An example of trigonometric circle is the instrument devised by ©abash al-©āsib. Another one of these earlier descriptions of a trigonometric instrument can be found in the *zīj al-½afā'ih* written by the 10^{th} century astronomer Abū Ja^{c}far al-Khāzin. In the following centuries al-Abharī (d. A.D. 1274) and Abū-l-Hasan ^{c}Alī al-Marrākushī described similar instruments.

Ibn al-Zarqālluh seems to be the first astronomer from al-Andalus to introduce the sine quadrant on the back of an astronomical instrument. Some centuries later Ibn Bā½o (d. A.D. 1316) knew Ibn al-Zarqālluh's work, and some elements in his treatise on the use of his trigonometric plate could derive from Ibn al-Zarqālluh although there is a difference since Ibn Bā½o is describing a complete plate and not only a quadrant.

One of the most prominent astronomers who devoted some treatises to the construction and use of trigonometric instruments was Ibn al-ShāŠir. Although he worked mainly in planetary astronomy he was also concerned with spherical astronomy and timekeeping. He devised a circular plate, called *Jāmi^{c}a* (universal) plate, one side of which displayed two orthogonal grids superimposed at an angle equal to the obliquity of the ecliptic. An example of this instrument, made by Ibn al-Shatir himself, now missing the rete and alidade, is preserved in Cairo.

Another related instrument is the one called *sexagenarium.* A trigonometric quadrant introduced in the Iberian Peninsula at the end of the XVth century. This instrument had two faces, one planetary and one trigonometric which makes it very similar to al-Khāzin's *zīj al-safā'ih.* Of Arabic origin, it was used by the *muwaqqits* in Egypt and a *faq÷h* introduced it in the Iberian peninsula in 1450 and later it was introduced in Europe.

The aim of my paper is to give a general overview of the trigonometric instruments devised in Islam known up to now, their common features, characteristics and possibilities from the examples preserved and the treatises on their use still extant.

MEDIEVAL ARABIC ASTRONOMICAL INSTRUMENTS WITH ASTROLOGICAL FUNCTIONS

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The presentation concerns the application of analogical instruments, of the kind of the astrolabe, to the astrological practices and presents information which is not always considered in the studies on astronomical instruments. The material arises from both the preserved instruments and the treatises on astronomical devices, and it is arranged in sections corresponding to the kind of lines that are inscribed on an instrument's plate, depending on whether these lines are position circles (great circles passing through the north and south points of the local horizon) distributed according to divisions of the prime vertical, position circles crossing equal divisions of the celestial equator or the lines for seasonal hours or fractions of these hours, plus a fourth section dealing with some procedures not needing the drawing of specific lines.

EXPOSING THE FORGERY OF AN ASTRONOMICAL INSTRUMENT: AN ALLEGED MOROCCAN ASTROLABE DATED 1845

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The astrolabe is an instrument designed to measure the altitude of celestial bodies in order to tell time by day or by night. An astrolabe in the Royal Ontario Museum's collections was acquired at auction in 1988 by the ROM's Planetarium. According to the auction catalogue, it was made in Morocco, dated 1845. When the Planetarium was closed to the public, the instrument languished neglected. Years later, in preparation for a university course on the history of science, my scrutiny of the astrolabe's inscribed features and physical condition suggested that it was a forgery. This paper explains the mistakes the forger made.

THE SIMPLE VERSION OF THE SARRAJIYYA INSTRUMENT (14C): TEXTUAL AND TECHNICAL REMARKS

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There are two versions of the *sarrājiyya* instrument for solving problems of spherical astronomy for all latitudes. Here we describe the simpler version of the instrument, discuss its relationship with the *shakkāziyya* plate of al-Zarqālī (11C), and explain how and when its use is recommended.

MATHEMATICAL ASTROLOGY IN ASTRONOMICAL HANDBOOKS

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During the last decade I have worked on a *New Survey of Islamic Astronomical Handbooks* (*zīj*es), which is hoped to in the end replace E.S. Kennedy's still highly valuable Survey of 1956. The new Survey will include all handbooks that have become known since then, and will provide much more complete information on tens of handbooks whose manuscripts have not yet been studied or even inspected before. In particular, on the basis of the manuscripts of more than 100 extant handbooks that I have collected, the development of the various topics treated in *zīj*es may be described in much more detail than possible until now. In this talk, I will demonstrate this by sketching some of the developments in mathematical astrology that are represented by *zīj*es and by discussing to which extent *zīj*es were used by practising astrologers.

BĪMĀRISTĀN AL-MANSŪRĪ: STATE AND MEDICAL PRACTICE 1285-1382

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In 1285, the Mamluk Sultan al-Mansūr Qalāwūn inaugurated his famous Bīmāristān, which was in the center of a huge complex, comprising the Sultan's shrine and a madrasa. The complex was located in the center of Mamluk Cairo facing the mosque and shrine of the last Ayyubid king and the master of Qalāwūn himself. The waqf document of the Bīmāristān indicated that the institution would provide medical care and social relief to the sick and the needy in the Mamluk capital. Accounts made by several Nazirs of the Bīmāristān provide evidence of the Bīmāristān performing its legally prescribed role.

The Bīmāristān was thus situated in the center of the medical scene. It was the only place available for free medical care and social relief in the Mamluk capital. Although it was not the only hospital in the Mamluk realm, it was by far the biggest and the closest to the Sultan and the ruling elites. Moreover, the chief physician of the Mamluk empire was

demanded by the waqf document to provide a lecture of medicine in the Bīmāristān and to maintain a close eye on the medical practice taking place inside the huge institution.

On the political, legal and administrative aspect, the bimaristan was directly linked to the reigning Qalāwūnid Sultan. The Sultan, who was the legitimate heir to the founder of the waqf, was, thus, the legitimate supervisor and caretaker/beneficiary of the waqf. He was to appoint a nāzir to manage the daily affairs of the institution and its waqf.

In fact, the position of the nazir, which was described by al-Qalaqashandi as one of the religious posts, was occupied by two persons at the same time; an emir, who was normally the deputy of the Sultan of the commander-in-chief of the armies, and a bureaucrat, who was the Market inspector in most of the occasions. The Shafii Grand Judge, who was the nazir of all the shafii waqfs, was also supposed to oversee the Bīmāristān, by virtue of its being a shafii waqf.

The bimaristan was the site for a vivid and a dynamic interaction among the medical, the religious and the political elites. Such reaction, which existed in different forms in the Sultanic courts, was intensified by the actual intersecting responsibilities and the overarching interests in such huge and rich institution. These reactions led to a number of results, which affected the medical practice, the medical thought and the perception of the medical profession in its totality. The political and religious elites became more conscious of the details of the medical practice and more aware of the theoretical debates within the medical discourse and were encouraged to take a stance.

Through analyzing the relations inside the Bīmāristān, the paper investigates the role of Bīmāristān al-Mansūrī as an institution in formulating the relation/control between the Mamluk State bureaucracy and the practice of medicine through its role as the only locality for free medical care in Cairo, its waqf being sponsored by the State, its bodies managed by the Muhtasib and its medical staff headed by chief physician.

THE BOUNDARIES OF TRIGONOMETRY: AL-SAMAW'AL AND THE 480° CIRCLE

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Ever since Ptolemy's *Almagest*, mathematical astronomers had to face the problem that sine values of integer angles are only obtainable for angles that are multiples of 3°. A number of Muslim scientists, from Ibn Yūnus to al-Kāshī, devised clever methods for approximating sin(1°), which then allowed them to build up the foundational trigonometric tables that they needed for their astronomy. But the 12th-century mathematician al-Samaw'al ibn Ya+yā al-Maghribī objected: these approximations take one out of the realm of geometry. His solution, outlined early in his exhaustive treatise *Exposure of the Errors of the Astronomers*, was unexpected: divide the circle into 480, rather than 360, parts. We shall present his 480-degree sine table, as well as one of its applications for astronomical use.

ENVIRONMENTAL STUDIES ABOUT CITIES IN MEDIEVAL ISLAM

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The earliest known writings concerned with pollution were Arabic medical treatises written between the 9th and 13th centuries, by physicians. Their works covered a number of subjects related to pollution such as air contamination, water contamination, soil contamination, solid waste mishandling, and environmental assessments of certain localities.

Of the last genre, i.e. environmental assessments of certain localities, the paper reviews the following extant treatises:

1 Daf᾿ ***Madņār al-Abdān bi-Ardņ Misr*** (On the Prevention of Bodily Ills in metropolitan Cairo) by ᾿Alī ibn Ridņwān
2 ***Tab᾿ al-Iskandariyya*** (Nature of Alexandria) by Ibn Jumay᾿
3 Mizāj Dimashq wa Wa***dņ ᾿ihā wa Tafāwutihā min Misr*** (Temperament of Damascus, Its Location and Variance from Egypt) by Ya᾿qūb al-Isrā᾿īlī
4 Kitāb al-Ifādah wa'l-I᾿***tibār*** (Book of Instruction and Admonition the things seen and events recorded in metropolitan Cairo) by ᾿Abdallatīf al-Baghdādī.

THE SULTAN AND THE STARS: THE *KITAB AL-TABSIRA FI ILM AL-NUJUM* OF AL-ASHRAF UMAR (YEMEN, D. 1296)

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The *Kitab al-Tabsira fi ilm al-nujum* of the Rasulid Sultan al-Ashraf Umar (Yemen, d. 1296) is the starting point of a new project on science in medieval Yemen. Edition, translation, and commentary of the introduction and of the table of content of this intriguing text will be the fundament for further research on science in context taking into account not only rulers as patrons but also as scholars themselves.

This talk will provide a "state-of-the-art" report on this project, and will inform on the first results obtained till then.

SEVERAL REMARKS ON THE "ASHKAL AL-TA'SĪS" BY AL-SAMARQANDĪ AND COMMENTARIES ON IT BY AL-RŪMĪ.

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The treatise "Ashkal al-Ta'sīs" (Propositions of Substantiation) by Shams al-Dīn al-Samarqandī (c.1250–c.1310) is a revision of 35 propositions and definitions mostly of the Book I of Euclid's "Elements", including the Vth postulate on parallels considered here as a theorem. It was of a special interest to medieval Muslim scholars and had been commented repeatedly. The most famous are the commentaries by Qadī Zada al-Rūmī (1364–1436) which were rather popular as a textbook on the foundations of geometry. The same applies to the "Ashkal al-Ta'sīs" proper. Thus, it was al-Samarqandī's work which had been studied and used in the lectures by the renowned seventeenth century Muslim bibliographer H?ajj?ī Khalīfa as it has been indicated in his autobiographical conclusion of treatise "The balance of truth".

The given investigation of al-Samarqandī's work and al-Rūmī's commentaries on it is based on their manuscript copies from the Scientific Library of the Kazan' State University (N 1121 arab and N 97 arab correspondingly). The very first study of the manuscripts has given rise to doubts a propos the author of the propositions which constitute the proof of the Vth postulate and which have been attributed earlier to al-Samarqandī. Thus, the Kazan' manuscript of the "Ashkal al-Ta'sīs" being besides one of its earliest copies (copied in 1337) does not contain these propositions, whereas their exposition in the Kazan' manuscript of the commentaries by al-Rūmī together with the graphical peculiarities of this manuscript testify to the authorship of al-Rūmī.

The main issues of the study are however mostly philosophical and methodological. Among them: – the discrepancy between the stated by both authors (in the frames of in fact Aristotelian classification of sciences) inadmissibility of solving "the problems of one science by means of another science" (the first one is mathematics which "while it studies physical things has to consider them devoid of matter", whereas the second one is natural philosophy which "studies the states of physical bodies in motion and rest") and the use of superposition in their geometrical proofs, the discrepancy which one can reveal even in the treatise on parallels by such famous opponents of application of motion in geometry as al-Khayyam (1048–1131) and al-T?ūsī (1201–1274), which were definitely known to al-Samarqandī and al-Rūmī; – certain philosophical approaches to the proof of the Vth postulate quoted in both treatises and based on the assumption of either infinite divisibility or existence of infinitesimals, which had been mentioned also by al-Khayyām and discussed as geometrical paradoxes by al-Kindī (800–870) and al-Bīrūnī (973-1048).

„STEALING THE WATER“ AND COMMENTING THE VOID: PHILOSOPHICAL AND TECHNOLOGICAL ASPECTS OF THE GREEK AND ARABIC PERCEPTIONS OF THE CLEPSYDRA

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One of the argumentation settings in the controversies among the *mutakallimūn* since the 2nd/8th century is known as the atomistic theory (*šawhar*) and involves special speculations on the void. Typical reports are found e.g. in the *Maqalāt* (4th/10th century)of al-A□?arī with (polemical) references to philosophers and *mutakallimūn* of the Mu?tazila schools such as the Basrian al-Šubbā'ī and the Baghdadī Abū al-Qāsim al-Balkhī. Elaborate argumentative constructions are typical for the wirtings of the speculative theology of *kalām*; however, topics like *šawhar* (atom, essence) and *khalā* (void) are too strongly associated with pagan physical philosophy. The scenery becomes even more uncanny when technological devices like *sarrāqatu al mā'* ("device for stealing the water") emerge as examples in the arguments in favour of or against the existence of the void. How did such profane topics find their way into the theological discourses of Basra and Baghdad?

The present study traces the itineraries of Greek philosophical doctrines and East Mediterranean technological devices like the clepsydra (the Greek etymology means "stealing the water") towards Iraq. A pivot place was the major town of Diyār Mud?ar, H?arrān, transmission node among Greek, Syriac and Arabic traditions. Presumable transmitters were neoplatonic commentators of Aristotle, notably Simplicius (*Sinbilīqiyūs, Samlis*), who, like the Alexandrinian commentator Philoponus (*Yah?yā al-Nah?wī*), treated the question of the existence of the void and referred explicitly to the clepsydra. Two further important references of the Arabic perception and transmission are Philon of Byzantium (about 200 BC) and Heron of Alexandria (1st century AD) with their treatises on *Pneumatics.* The early translation into Arabic and the transmission (eventually as compilations) of many treatises of these scholars can be justified by the theological relevance of their commentaries on Aristotle's positions concerning causality and the eternity vs. creation of the world for the Muslim scholars. The present study demonstrates also the importance of the high level of hydraulic technology in Syria/Palestine during the Late Antiquity for the above transmission. As characteristic example the hydraulic clock of Gaza is considered. The comparison of quotations from Simplicius' commentary on *De caelo*, presumably composed in H?arrān and nowadays known in a Greek version and a Latin translation from the Greek) as well as of Philon of Byzantium with texts of Basra and Baghdad *mutakallimūn* on physical theory and causality, as well as with hydraulic devices of the Late Antiquity (some of which were in Syria/Palestine) and similar examples described in the works of Banū Mūsa (3rd/9th century) in Baghdad illustrate the role of the clepsydra in the correlation of theological, philosophical and technological discourses – both in the Greek and the Arabic frame.

A HIDDEN SCHOOL: THE SCIENTISTS-PHILOSOPHERS OF THE 12th CENTURY IN AL-ANDALUS

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The paper deals with the scholars who, from the late 11th century to the late 12th century, approached scientific issues with the methods and paradigms they had learned from philosophy. They covered a large number of fields (almost the full range of matters characterised as "theoretical sciences" by medieval philosophers). Most of them were also physicians. Although they lived in different parts of al-Andalus (Muslim Iberian Peninsula) and flourished in different periods of the 12th century, there is historical evidence showing that they can be considered as members of one and the same school. The purpose of this paper is thus to discuss the existence of a school of "andalusi scientists-philosophers" and to provide further infomation on its members and their works.

ASTROLOGY AND EARLY *KALĀM* AND *TAFSĪR*

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This paper surveys reactions to and discussions of judicial astrology in *kalām* and *tafsīr* in the first 250 years of Islam. My findings can be divided into three categories. The first type of response, though the rarest, is that of a *mutakallim* such as al-Nazzām who is reported to have said that he saw no problem with judicial astrology as judicial astrology could provide insight into God's wisdom.

The second type of response is found is passages in Tabarī's *tafsīr* (*Jāmi' al-bayān*), but attributed to earlier figures, that acknowledge that the celestial realm can be an intermediate cause of events on earth and that humans are able to understand something about how these causes operate. The passages I have found discuss specific events in the past; these passages neither endorse nor criticize the study of astrology.

Third, there exist attacks on astrology in reports about early *mutakallimūn* and in the writings of al-Jāhiz. My preliminary conclusion about these attacks is that they focus on the inferiority of an astrological forecast when compared with the reliable knowledge of prophecy. Considerations of how astrology might infringe on definitions of free will or on God's omniscience may have been secondary. Time permitting, this paper will make comparisons with discussions of astrology in Jewish and Christian sources.

IBN FADLALLAH ON THE NAUTICAL WINDS

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Ibn Fadlallah al-Umari's (1301-49) large encyclopaedia *Masalik al-absar* includes a chapter with general remarks on the navigational purpose of the wind network, a distinctive feature of Mediterranean sea charts. This Arabic text, of interest to historians of cartography, is one of the earliest sources to deal with the role of winds in Mediterranean navigation, and their characteristic representation as a system of rhumb lines on most sea charts. In Mediterranean nautical cartography, the oldest extant testimony to the use of the wind network is the Pisan Chart, datable to the late 13th century. We examine Ibn Fadlallah's description in connection with the drawing and structure of the wind network in the extant tradition of Maghrebi and Andalusian chartmaking, starting with the Maghreb Chart, perhaps datable to his own time, and al-Tanjī's chart (Tunis, 1413-14), the first dated example we have. Furthermore, we discuss his Arabic terminology for the winds in comparison with related Maghrebi, Majorcan and Italian sources, with particular attention to a few little known references in 16th century Tunisian chartmaking.

AL-MURSĪ'S NAUTICAL CHART IN THE MEDITERRANEAN CONTEXT

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In the Mediterranean milieu, from 14th to 17th centuries, several generations of cartographers developed a kind of strikingly accurate maps, the nautical charts of the Mediterranean, which supposed a complete break with the previous tradition and one of the most important turning points in the whole history of the maps.

However, while Catalan and Italian Mediterranean nautical charts have been widely studied, their Arabic counterparts have deserved small attention or have been only subject of superficial approaches and as a consequence their role in the Mediterranean context has been neglected.

The aim of this communication is to present a modern detailed study of Ibrāhīm al-Mursī's chart with the objective to place this chart, together with the rest of Arabic nautical cartography, in the general Mediterranean context.

THE *QIBLA*, FROM THE SKY TO THE SEA

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The sacred direction in Islam, the *qibla*, is one of the most prolific questions in the Islamic science from medieval to present times. Books written by *fuqahā'* and astronomers have been studied by modern scholars, but there is a gap that should be filled. Nautical charts offer a new perspective on the circulation of science between the Mediterranean Sea shores. The object of this paper is to make a preliminary analysis of the related information present in the schemes found in the neck of the Islamic nautical charts not studied to the date, which include different information, amongst them the names of the lunar mansions. The oldest two cases, subject of this study, are the 15th century sea charts by Ibrāhīm al-Mursi's and Ahmad b. Sulayman al-Tanji's.

Symposium S12
Ideas and Instruments in the Social Context in the Ottoman Empire and the National States

EVOLUTION, FUNCTIONING AND CAPACITY OF THE MEDITERRANEAN WINDMILLS

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The earliest known reference to windmills is around 400 B.C. by a Chinese traveler. Later, according to a significant source, Caliph Omar I (634-644) ordered a Persian to build a windmill. There are references to the 10^{th} and 11^{th} century Persian windmills. These windmills had sails radiating from vertical axis standing in a fixed building that has an opening to the inlet and outlet of the wind diametrically opposite to each other. The first description of this windmill is illustrated by Syrian cosmographer Al-Dimashqi (1256/7-1326/7).

There is no evidence for the use of windmills in Europe before the end of the 12^{th} century. Once they were introduced they spread with greet rapidity over the plains of northern Europe. These windmills with a set of gears are similar to the Mediterranean one and have a horizontal axel and vertical sails. The mechanism of this windmills are probably inspired by the water mill with vertical wheels invented in 3^{rd} century B.C. in Anatolia. Mediterranean windmills which must have been matured by 17^{th} or 18^{th} centuries, are abundantly used till middle of the 20^{th} century in east and west cost of Mediterranean and Aegean Sea. An evolution of the sail construction can be followed from pictorial illustrations.

In this paper, taking in consideration the existing wind power of the west Anatolian cost, the functioning of the mechanism and the capacity of the typical Mediterranean windmills is largely investigated. The top of the tower and the horizontal shaft with the main gear can manually be directed to the prevailing wind direction. The sail area precisely regulates the grinding power. The stone distance is steadily regulated by an arm and the upper grinding stone carrying counterweight mechanism.

THE OTTOMAN ROYAL CANNON FOUNDRY: “TOPHANE-I AMIRE”

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Firearms came into use at the beginning of the fourteenth century but became more effectual weaponry towards the later period of the century. They were used first by Andalusian Muslim armies then by Christian European armies, started to be used by The Ottomans towards to end of the fourteenth century. They became more widespread in there domains after the first quarter of the fifteenth century to the extent that they were exported from their own weapon manufacturing plants. During Mehmed the Conqueror’s period (1451-81) cannon casting technology and their use were much active. Novel cannons were designed and made including large size barrels, split type barrels as well as mortars. In this paper Mehmed II’s reign’s firearms technology will be examined from the point of history and engineering. Mehmed II gave much attention to the production of firearms after the conquest; he constructed a casting centre called “Tophane-i Amire” (The Royal Cannon Foundry), the biggest casting centre of the day, which included both the indigenous and foreign gunners. Even though there is not much specific knowledge about the arsenal of cannon during the reign of Mehmed II, it is known that large calibres of cannon were cast. Indeed some parts of the cannon still exist today. It is known that the Ottomans produced many types and quantities of cannon during the time of Mehmed II.

At the beginning of the 16^{th} century Sultan Suleyman the Magnificent demolished old foundries, which had been built by the Sultan Mehmed II, and at the same place he built a new complex for cannon founding. Apart from Istanbul they also established foundries in varies cities such as Buda, Cairo, Smederevo and Basra. These centres of foundry were managed by the *topcibashi'*s appointed by the Sultan himself.

Many skilled people were employed in the Tophane-i Amire. *Topcubashi* was primarily responsible for all the artillery corps and foundry, than would come the *nazir*, the *emin* and the *katip*. In addition to official people there were also artisans such as moulders, blacksmiths and the carpenters. At times some temporary labourers were employed for varies auxiliary purposes.

Tophane-i Amire complex contained foundry (*dökümhane*), barracks, magazines, carpentery and a training centre (*talimhane)* was a big centre of military industry. Those necessary raw materials for founding a cannon such as copper, iron were delivered from the various Ottoman regions whereas tin and steel were imported from abroad. Since the Ottomans organised very good foundry institutions, they were able to develop an advanced technology in moulding systems.

The chemical analyses of the some cannons, which were moulded from the middle of 15th century onwards by the Ottomans indicate that these cannons were moulded from the ideal bronze alloys. During the reign of Suleyman the Magnificent the Ottoman cannonry technology of founding were at its highest level. At that time the ordnances, which were founded were used for centuries and they even survived until this time. In the Tophane-i Amire, not only cannons were moulded but also gunpowder, balls and gun carriages were produced.

SHEMSEDDIN SAMI'S TREATISE OF ASTRONOMY *GÖK (SKY)*: AN EFFORT IN THE WAY OF FORMATION OF TURKISH SCIENTIFIC LANGUAGE

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Semseddin Sami (1850-1904), a man of letters, encyclopaedist and lexicographer, is one of the prominent representatives of the transformation of the classical Ottoman Turkish, a mixture of three languages, to a modern one which expresses modern scientific knowledge inherited from classical Islamic tradition in an independent and integral style.

Semseddin Sami argued the importance of the simplification and Turkification of the language and drew attention to this issue in his works. In this regard the main purpose of the books published by Semseddin Sami under the general title of 'Pocket Library' was to explain things that had to be known through a language understandable to everybody. In this series Semseddin Sami gave place for booklets on astronomy, geology, anthropology, history of Islamic civilization, women, mythology and philology.

In this paper I will try to introduce the *Gök*, a monograph written in a simple language and style in 1880/1881, and reveal the significance of the efforts made by Semseddin Sami in terms of simplification and popularization of Turkish scientific language.

AN ANALYSIS OF QUSHJĪ'S ASTRONOMICAL TEXTBOOKS

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'Alī Qushjī's *Risāle dar 'Ilm-i Hey'e* (1458) was one of the most popular astronomy textbooks in Persian, used in teaching elementary astronomy even in the first half of the 19th century. This book was a continuation of a tradition starting from Bīrūnī's *Kitāb al-tafhīm* (early 11th century) to provide basic concepts for those who were either not practiced in astronomy or were not skillful in Arabic – the standard language of madrasas. Therefore, the majority of Persian astronomical textbooks are dealing with elementary astronomy or are summaries of technical texts such as the *Almagest*. The concepts they cover, the methods of their presentation, the level of their simplification, and even the size of each work not only reflect the authors' approaches to astronomy in general, but can also display what aspects of astronomy were more emphasized in different periods, and what combination of astronomical concepts were considered essential to learn first.

Writing astronomical texts, even *Zij*s, in Persian increased from the mid 13 century. By the mid 15th century three popular Persian astronomical textbooks were *Zubdah-i hay'a*, and *Mu'īniyya* (both by Nasīr al-Dīn al-Tūsī), and *Risāle dar 'Ilm-i Hey'e* by 'Ali Qushjī. The latter was translated to Arabic as *al-Risālat al-Fathiyya* by Qushjī. This work, its commentary (by Mīram ?elebī, Qushjī's grandson), and its translation to Turkish (by Seydī 'Alī Reīs) also became popular texts, mostly in the Ottoman madrasas.

The present study provides a comparison between Qushjī's elementary astronomy text and those of Tūsī. In this comparison, the structure of those works, the basic concepts that are defined or explained, their sequences, and finally the authors' approaches in dealing with astronomy and its content will be discussed.

ENGINEERING PERIODICALS IN THE OTTOMAN TURKISH

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The engineering periodicals are substantial sources of information to grasp the developments in the area, to understand the changing positions of academic society in a specific period in question, to show the different applications of engineering in other fields, and to point out the scientific, social and even political consequences of those applications. The present study gives bibliographical information about the engineering periodicals in Ottoman Turkish (printed until 1928) and makes a general evaluation on the contents. In this respect the article aims at providing information about the primary sources to the researchers who will study the history of engineering and the development of engineering sciences. The article also pays attention to the engineering periodicals, which are in general ignored, and hence makes a contribution to the studies about the history of Turkish press.

OTTOMAN NAUTICAL TERMINOLOGY AS ATTESTED IN THE 18th CENTURY SOURCES

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There is no doubt that nautical terminology of a certain period is a proper indicator of the technological level and state of the navy in a country. This paper aims to provide a general assessment of the 18th century Ottoman nautical terminology as reflected in the Ottoman archival records. We know that 18th century, in fact, witnessed many technological breakthroughs such as the systematic building, classification and copper-sheathing of the sailing warships; the construction of the first-dry dock, an anchor production house, a ship-modeling workshop and a sailcloth production facility; the adoption of new galleon launching method (floating-out technique); the creation of new kitchen system on the galleons and the beginning of the use of keeping logbooks; the introduction of the new navigational instruments, raw materials, tools, equipment, new navigational tactics, and maneuvers.

The present paper is intended to take up the above-mentioned technical developments along with their social, psychological and political aspects, since the technical terminology is also reflective of Ottoman perception and conceptualization of the sea and the use of related symbols and metaphors, ship-naming tradition, and the role of foreigners in the naval modernization.

LOCKS AND KEYS: THEIR STORY FROM PAST TO PRESENT

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Locks have been widely used in our daily life. In this paper an attempt is made to study the history of locks and to give the kinds of locks and the samples from past to present : Ancient Egypt, Roman, Turk Islam Locks. Ancient locks relied on the pin tumbler principle that many of today’s locks use. Many early Roman Keys were made to be worn as rings, because clothing of Romans did not have pockets. It is hoped that this article can simulate more research and publications regarding the development of ancient locks.

BOOKS ON DARWIN AND DARWINISM IN THE OTTOMAN EMPIRE

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Formation of modernity in the Ottoman Empire brought massive amount of new ideologies to social, scientific and political areas and the modernity itself rose on these new ideologies. Positivism was one of the major ideologies, which affected generations during 19th and 20th centuries. Darwin and his theory of evolution was a breakthrough in biological positivism. This paper mainly focuses on books about Darwin and Darwinism in the Ottoman Empire to have a better understanding of the perception of Darwin and his theories. This work is also supported with the articles in newspapers and periodicals, which help to examine the whole picture about Darwin. Books by Subhi Edhem: "Darvinizm" (Darwinism) and "Lamarkizm" (Lamarkism); "Tekâmül ve Kanunlari" (*Evolution and Its Laws*) by Doktor Edhem Necdet, can be counted as major books about Darwin.

THE POINT AND IMPORTANCE OF WORKS OF THE NASIRUDDIN TUSI IN THE OTTOMAN WORLD

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The Nasiruddin Tusi who is well-known as the scholar of astronomy and mathematics, established the first biggest observatory in the Islamic world called 'The Meraga' and worked there till the end of his life.Tusi who did observations for a long time in the meraga and prepared an almanac, provided valuable works of art in many kinds of areas leading astronomy and mathematics.The Works of Tusi in math area especially which we are going to discuss in this presentation, are very important in the world of the history of mathematics. For instance till Tusi trigonometry was seen as a branch of the astronomy,he provided trigonometry known as a different branch of science by writing his first independent well-known work of art '*Kashf al-qina' 'an asrar al-shakl al-qatta'* (Disclosing the secrets of the figure of secants/ removal of the veil from mysteries of figure of secants) or *Kitâb al-shakl al-qatta'* (the book on the figure of secants) *Seklü'l-Katta'* in this area.In this work of art of Tusi handed new corelations regarding sinus theorem and right angled triangles.

The innovations which Nasireddin Tûsî provided to mathematics especially trigonometry and the explanations he wrote to the geometry of ochlid were accepted well by the islamic world and the other geographies and lighted the way for the next centuries. The works of Tusi in both astronomy and mathematics world were observed carefully in also the science of Ottomon world and numbers of studies were made about them. Thus, it is extremely important that his works of art which he reconciliated in both areas, taking part of curriculum of Ottoman moslem thelogical schools as was in the other instutions of education in the islamic world.The *'Tahrir-i Usul-i Hendese'* is basic one of the works of art of his which was in the curriculum of geometry lessons.

In this presentation it is going to be utilized that Tusi's establishing trigonometry as a different branch of science in the direction of the newness which tusi provided to mathematics and the affects of his studies about these subjects across the world of Ottoman. Leading lectured his Works of art in moslem theological schools, the affect on Ottoman world is tried to be shown dealing with the explanations facilitations and translations about his works.Furthermore it is going to be scrutinized in which ways and process the determinations which were made on transmission of his works to The Ottoman world and Europe.

OTTOMAN PHD DISSERTATIONS OF CHEMISTRY COMPLETED IN EUROPEAN UNIVERSITIES

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In the Ottoman Empire chemistry had an important place among various PhD dissertations made in the European universities. As far as we could determine six chemistry dissertations were completed in the late 19th and early 20th centuries in this context. These are as follows:

1. Joseph Zanni (1854 – 1934): Heidelberg University (1876), Supervisor: Robert Wilhelm Bunsen
2. Halil Edhem [Eldem] (1861 – 1938): Bern University (1885)
3. Mehmed Arif [Beylikçi] (1865 - ?): Halle – Wittenberg University (1891), Supervisor: Jacob Volhard
4. Mustafa Azmi [Sümen]: München Technische Hochschule (1917)
5. Osman Nuri [Somer]: Berlin University (1918), Supervisor: Emil Fischer
6. Avni Refik Kadýzade [Bekman]: Berlin University (1918), Supervisor: Emil Fischer

Joseph Zanni and Halil Edhem completed thir dissertations on their own financial sources, while others were financed by the Ottoman State. Unlike others, Mustafa Azmi was an officer. Five of the dissertations were completed under the supervision of well-known chemists at the leading universities and high vocational schools in Germany.

During or after their phd studies although these figures published some academical articles in the scientific journals in Germany, they could not carry their research tradition to Turkey and maintain it.

FIRST INSTRUMENTS OF NATIONAL OBSERVATORY OF ATHENS. WHEN, FROM WHERE, WHY AND HOW.

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The National Observatory of Athens has a long and remarkable record. The present study focuses on the scientific apparatus used from the time the Observatory's establishment and up to 1900; most of these instruments remain in the site of the Observatory. It also tries to correlate the route of the Observatory with the social and economical circumstances in Greece at this period.

In 1838, a little more than a decade after the establishment of the first Greek University in Athens, George Vouris, professor of Astronomy in the School of Physics and Mathematics, aided by the Austrian ambassador in Athens, convinced the Baron G. Sina to assume the cost for the construction of an Observatory in Athens. The foundation stone of the first Observatory in the Balkans area is laid in Athens on June 26th, 1842.

Among the first instruments of the Observatory are a Fraunhofer equatorial refracting telescope, a meridian equatorial refracting telescope, two pendulums and a Kessel timekeeper. Vouris calculated the coordinates of the Observatory, which helped in the latter charting of the entire Greek dominion, and published a series of meteorological observations for the years between 1839 and 1841. He resigned in 1855.

The next director of the Observatory, following Vouris' resignation in 1855, is Johan Friedrich Julius Schmidt. The instruments Schmidt found in the Observatory paled in comparison to what he was accustomed to abroad and he also lacked assistance. However he managed to produce substantial scientific work. Following Schmidt's death in 1884, Kokkidis temporarily assumes the direction of the Observatory and in 1896 the latter is replaced by Dimitrios Aiginitis.

The new director sets terms which will upgrade scientific instruments, buildings and personnel of the Observatory. However a change in the government and the dire financial state of the country do not allow for the promised subsidies to be materialized. Aiginitis turns to prosperous Greeks living abroad, asking them to continue Sinas' work. A committee for the collection of funds is established under King George and the funds raised go towards the purchase of a piece of land close to the Observatory, a large equatorial refracting telescope with a diameter of 40cm, a meridian refracting telescope of 16cm diameter as well as other instruments. These funds have been obtained because of Aiginitis policy to offer modern services to the State, such as a meteorological and a seismological department.

THE RECEPTION OF ERNST HAECKEL'S IDEAS IN GREECE

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This paper studies the reception of Ernst Haeckel's (1834-1919) ideas in Greece during the late 19th and early 20th centuries. Ernst Haeckel was a very controversial figure associated with the group of German materialists, such as Büchner, Moleschsott and Vogt (Mitchell 1978). Today is widely known due to his work on the foundations of the science of Ecology in his *"Generelle Morfologie der Organismen"*.

Haeckel was a proponent of physicalism (physiocratic materialism) and a strong advocate of the Darwinian theory of evolution (Gliboff 2008).

During 1890-1891, a series of 21 articles written by Haeckel appeared in the greek scientific journal *"Prometheus"* under the general title *"History of natural creation or on the theory of evolution"*. This is the first extensive written introduction of the ideas of Darwinian evolution in Greece and follows the translation in greek of Büchner's *'Power and Matter'* in 1882. Haeckel's articles charged further an already polemical climate among the greek intellectuals characterized by the intervention of various religious cyrcles associated with the orthodox church. The bastion for the attack on Haeckel was the rival journal *"Anaplassis"*, an antimaterialistic and anti-darwinian publication.

The publication of the articles in *"Prometheus"*, was followed by the publication in greek of two of Haeckel's works: *"Monism"* (1911) and of the *"Descent of Man"* (1911) both translated by Andreas Farmakopoulos and published in Athens by Fexis.

These publications followed by a second round of debates with materialism being the central issue. The debate continued after Haeckel's death. The journal *"Grammata"* (No 40, pp. 99-112) on the occasion of his death in 1919 published an obituary that was rather an evaluation and critique of his ideas.

Even a few years later, when the journal *"Scientific Encyclopedeia"* commenced publication in 1923 the debate over Haeckel's ideas continues with the publication of pro- and anti- articles.

Although a number of different issues arise from the discussion of Haeckel's ideas, this work focuses on the materialism – idealism controversy and the axes on which the controversy is centered. This controversy is still relevant in our days with certain aspects of the science – religion dipole influencing not only scientific research but science education as well.

Gliboff, S. (2008): *H.G. Bronn, Ernst Haeckel, and the origins of German Darwinism*, MIT Press
Mitchell, I. (1978): Marxism and German Scientific Materialism, *Annals of Science* 35, pp. 379-400

THE INTERACTION BETWEEN MATHEMATICS AND GREEK TRADE DURING THE PERIOD OF THE OTTOMAN OCCUPATION

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During the 18th century and the first decades of the 19th, i.e. during the period, where the enlightenment spirit was widespread among Greek intellectuals, a new beginning in the mathematical education of Greeks was taking shape. Moreover, the frequent communication with the European centers, which has started already from the beginning of the 18th century as a result of commercial exchanges, contributed to the transfer of knowledge to the Greek world and to its exit from the intellectual isolation. Within this general framework, it was realized, in even greater degree, the interrelation between Mathematics on one hand and commerce activities and technical thinking on the other. Thus, the writing of appropriate handbooks became imperative, since the "Logariastikes" which were circulating up to then were considered inadequate; to this need the scholars responded by producing a particularly satisfactory volume of handbooks. Only during the three decades preceding the Greek Revolution of 1821, fourteen new commercial handbooks were printed. In other words, a feedback cycle was taking place, where commercial activities strengthened the Mathematical education, which in turn contributed to the development of commerce and the technical thinking. It is generally believed that the commercial activities were an important factor in the intellectual renaissance of the Greek World in the 18th and early 19th century. As Konstantinos Koumas put it: "We are indebted to the Commerce for our present satisfactory literary state; let us hope that Commerce shall bring also our full national redemption".

THE FOUNDATION AND EARLY PHASE OF THE IMPERIAL OBSERVATORY OF CONSTANTINOPLE

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After the Crimean War of 1853-56 that marks the development of the telegraph and the railway networks as well as various industries in the Ottoman Empire, a large number of engineers and university professors - mainly French and British - participate to the great movement of westernization of the Empire initiated in 1839. This movement became stronger after the visit of the Sultan Abdul Aziz at the Paris Universal Exhibition of 1867. Led mainly by the two major statesmen Ali Pacha and Fu'ad Pacha, the reforms were also strongly encouraged by French and British foreign policies. Besides new laws connected to various aspects of the administration of the Empire, several new institutions dedicated to education were created such as the Galatasaray School.

In that context was founded in 1868 the *Observatoire Impérial de Constantinople* under the direction of Aristide Coumbary who was involved in the Ottoman telegraph network. This new institution was dedicated in its first years to collecting meteorological data from a number of stations spread over the Empire. Being an extension of the meteorological network initiated by Le Verrier, director of the Paris Observatory, it received a strong support from France both in terms of organization and instruments.

Based on various archival data (both scientific and diplomatic), I will describe how this new institution was set and what role French scientists played in its organization and development.

LE RÔLE SOCIAL ET POLITIQUE DES INGÉNIEURS DU CORPS DU GÉNIE DANS LE JEUNE ÉTAT GREC : ENTRE L'EUROPE ET LES STRUCTURES TRADITIONNELLES

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La communication présente l'implication sociale du corps du Génie, depuis fondation de l'État grec jusqu'à l'apparition du corps des ingénieurs civils. Il s'agit d'un exemple de modernisation des structures technologiques qui implique la modernisation des structures sociales et le changement des mentalités.

Nous présentons d'abord la physionomie générale du corps du Génie (institutions, structures et effectifs) pour en arriver à cerner le profil et la carrière des officiers du Génie grecs du 19e siècle. Le manque de structures éducatives pour des ingénieurs civils a amené le corpos du Génie à substituer le rôle de ces ingénieurs. Ainsi, les officiers du Génie vont s'impliquer à la construction des nouvelles infrastructures, à l'importation et la maintenance de la technologie européens mais aussi à la conception, création et développement des structures administratives. Ces structures vont développer et gérer les nouvelles infrastructures comme les routes, ponts, ports, adduction d'eau. Le rôle de ces ingénieurs dans l'introduction de la technologie du chemin de fer, des machines à vapeur et de l'industrie navale va aussi être examiné.

Ce rôle modernisateur a impliqué ce corps aux développements politiques et sociaux, à travers notamment l'idéal du Saint-simonisme ou de l'hygiénisme. La deuxième partie de la communication examinera cette implication et ses retombées sociales.

Symposium S13
Darwin Outside Europe: Ideas of Evolution in Comparative and Global Perspective

DARWINISM AFTER 1945: THE STATE AND FATE OF 'EVOLUTION' IN EARLY COLD WAR CULTURE

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Darwinian ideas and principles played a major role in the political ideologies of the totalitarian systems in the 20th century, especially where they could be linked with notions of racial superiority. But whereas the concept of race became, at least officially, discredited and banned from the political discourse after 1945, Darwin's theory of evolution lived on and was still celebrated as a scientific key-stone of modern self-understanding. Thus, the story of Darwinism after 1945 presents a case-study for the general question, if and how a scientific theory can be detached from the ideological contexts it was formerly involved in. By focusing on the cases of Germany, the US, and Japan (with a comparative perspective on the special case of the Sovjet Union) the paper will reconstruct how early Cold War culture reestablished and reenacted Darwinian evolution theory as an anthropological insight not to be questioned, while at the same time excluding a notion of race from the politcial discourse that was cut short of its Darwinian dimensions.

MOVING DARWIN / TALES OF THE TRAVELS OF DARWINISM

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In this paper, we undertake a rhetorical analysis of the recent historical scholarship (c. 1974-present) devoted to mapping and delineating the 'diffusion' of 'Darwinism' in the so-called early period (c. 1860-1900). We start from the observation that what is being described are modes of movement or travel of something labelled Darwinism. Thus we address questions such as, What counts as Darwinism (what elements and configurations comprise this figure)? How are the processes of movement described (diffusion, dissemination, expansion, *mundialización*)? What are the rates and intensities of these movements? What else has to move in order for Darwinism to travel (world-views, skills, texts, people, practices, institutions)? Where are the Departures (at some Centre) and where the Arrivals (at some Periphery)? What boundaries must be crossed (national, geographic, cultural, ideological, psychological)? And what are the effects or results (reception, distortion, resistance, refusal)?

We also examine the historical and epistemic models and evaluations that appear to underlie this scholarship, such as the separation of the contexts of scientific production and justification (Chambers, 1993), the independence of science and society (Latour, 1987), the centre-periphery concept of 'Eurocentric diffusionism' (Blaut, 1993), the colonial/frontier assumption of 'empty lands' (Chambers, 1993), and Mignolo's (2000) 'global design vs. local knowledges'.

References

Blaut, J. M. (1993) *The colonizer's model of the world: geographical diffusionism and Eurocentric history*. New York: The Guilford Press.

Chambers, David W. (1993). "Locality and science: myths of centre and periphery". In: *Mundialización de la ciencia y cultura nacional*. Edited by: Antonio Lafuente, A Elena and M. L. Ortega. Madrid: Doce Calles.

Latour, Bruno. (1987) *Science in action: how to follow scientists and engineers through society*. Milton Keynes: Open University Press.

Mignolo, Walter D. (2000) *Local histories/global designs: coloniality, subaltern knowledges, and border thinking*. Princeton, NJ: Princeton University Press.

YĀDOLLĀH SAHĀBĪ'S DEFENCE OF THE THEORY OF EVOLUTION

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Throughout the Islamic world religious circles reacted negatively to the theory of evolution. Thos who did not reject it completely were opposed to its most controversial aspects, selection and the descent of men. Iran might be a remarkable exception. If this hypothesis turns out as tenable this particularity is not due to a different Shia approach to science but to the writings of a pious scientist.

In the early 20th centuries Iranian Shii clerics rejected the theory off evolution. Around 1970 geologist Yādollāh Sahābī published two tracts in defence of the theory of evolution. He argues on two levels. On the one hand he presents the scientific prove on the other hand he reinterprets verses of the Qur'ān related to creation in order to bring the in accordance with natural history. However, whereas he includes the descent of men in his concept he does not deal with natural selection.

DARWIN IN NON-WESTERN NATIONALIST THOUGHT

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Darwinian ideas were highly influential in non-Western reformist thought from late 19th century to the mid-20th century. Both the nationalist ideals and pan-nationalist internationalism, such as Pan-Islamic, Pan-Asian and Pan-African thinking, shared a set of globally circulating Darwinian concerns about the future of non-Western races, societies, civilizations and religious traditions. For example, debates on the "decline" and "revival" of Muslim civilization in the late 19th century, which were shaped by theories of Darwin, Spencer and Gustave LeBon, became a central component of modern Islamic thought. Similarly, a global debate on black and yellow race, informed by scientific theories and related to a separate Orientalist literature on Asian and African civilizations, determined the content of Pan-Asian and Pan-African thought. What was the contribution of Pan-Islamic, Pan-Asian and Pan-African thinkers to the global debate on social Darwinism? How did pan-nationalist ideas interact with scientific debates and theories of Darwinian theory? This paper will address the global reception of Darwinian ideas in modern Islamic, Asian and African thought with a focus on the relationship between scientific notions and visions of world order from the age of imperialism to the era of decolonization.

Symposium S14
The Commerce of Science: Exchanging Objects, Instruments and Ideas in the Early Modern World

GEORG HARTMANN AND THE BEGINNINGS OF THE PRINTED SCIENTIFIC INSTRUMENTS TRADE

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Of the circa 1,200 early modern astrolabes now extant, Georg Hartmann of Nuremberg (1489-1564) produced 23. In contrast, nearly 200 impressions of 75 different instruments Hartmann designed and printed on paper survive as loose sheets, in albums, and even as constructed instruments. This talk will situate Hartmann's long-neglected printed oeuvre within the context of earlier printed instrumentation, and the instrument trade in sixteenth-century Nuremberg.

Printed instruments began to emerge in the early sixteenth century as a collectable category that complemented luxury instruments in other media. The patrons and humanists involved in their early distribution and popularization were however only part of the potential audience. Indeed, imperial patents from as early as 1512 imply a need to protect printed instruments from being copies as new prints **and** from being used as models for salable metal instruments.

Correspondence between Hartmann and his patron, the duke Albrecht of Prussia, make it clear that Hartmann differentiated between his instruments by material without implying any loss of function. His copious "Instrumentle auff Papir," proudly emblazoned with his name and the Nuremberg arms would inspire numerous instrument makers over the next two centuries to become printmakers as well, among them Philippe Danfrie, Henry Sutton and Daniel Beringer.

As the Nuremberg sundial guild lamented a tactful time after Hartmann's death, sundials were easy to construct from prints—forming a cheap, relatively shoddy substitute for their solid traditional wares. And yet, such a substantial number of printed instruments have survived that they clearly filled a consumer niche that a staid group entity akin to the guild system could never exploit; only the individual maker like Hartmann could be sufficiently enterprising.

TRADING UP: INSTRUMENTS AND ARCHITECTURE IN EARLY-MODERN ENGLAND

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By the mid-18th century London was emerging as the most important European centre for the manufacture of scientific instruments - the place to visit when shopping for new apparatus and equipment. The most prestigious figures in the trade were no longer either mathematical or optical or philosophical instrument makers, but dealt in all three. This new constellation crystallized a commercially-driven vision of the character and range of 'science': buyers acquired not just particular objects but a set of categories with which to organise their practices and perceptions.

In this paper I want to investigate the significance of this new grouping by presenting what was lost, what was excluded, what was marginalised in this process. I take a case study from the English mathematical instrument trade: the production of instruments for the art of building. Measuring instruments for measurement and quantity surveying were a core part of the London trade right from its origins in the mid-16th century. They helped to define mathematics as both useful and pleasurable; while targeted at a craft audience, they clearly also engaged the interests of gentlemen. As London shops became centres of 'intelligence' in the 17th century the range of these devices was broadened to include the ornamental parts of architecture. By the early 18th century the most fashionable and accurate of mathematical makers were offering proportional instruments which embodied a complete system of the five classical orders. These devices presented mathematics as polite, elevated and refined, and reflected back on the enhanced status of the instrument makers. But by the mid-century they had begun to slip from view, now distant from the centre of gravity of a consolidated tripartite business. Following the patterns of manufacture and trade enables us to recover the distinctive contours of both early-modern commerce and the mathematical arts.

"MUTATIONS IN MEANING: COLLECTING AND TRANSPORTING NATURE AS IMAGE, WORD, AND THING IN THE SPANISH EMPIRE"

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This paper will look at the mutability of natural information in medium and meaning as it traveled through the Spanish Empire, considering in particular the role of collecting. Participants in early-modern long-distance networks worked hard to make natural objects and natural facts stable and portable. This was the case whether a particular network was scientific, commercial, or imperial—or, as was most often the case, a combination of all of these factors and perhaps others as well. Moreover, objects changed their meanings as they moved in and out of various exchange networks and value economies, entering different phases of their complex life cycles. From the early sixteenth century, participants in exchange networks in the Spanish Empire devised and refined methods for stabilizing and transporting natural information and natural goods. However, putting nature in motion meant making it highly vulnerable to changing interpretation as it traveled from place to place, from one medium to another, and from one value economy to another. Mobility led to mutability in both medium and meaning.

TRADING PLACES: DOMESTIC WORLDS AND MATERIALS OF SCIENTIFIC EXCHANGE IN EARLY ENLIGHTENMENT DANZIG

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This paper will explore the ways in which, during the late seventeenth and early eighteenth centuries, commercial and domestic worlds intersected to play a crucial role in the shaping of practices of natural knowledge in East Central Europe. Taking as a case study the Baltic port of Danzig (now the Polish city of Gdañsk), the paper will probe the relations between science and commerce in the activities of one particular household, that of the Breyne family, over the course of several generations, as family members pursued various forms of study of the natural world. Though geographically, obviously, somewhat distant from such contemporary centers of scientific life as London and Paris, various members of the Breyne family in Danzig became quite well-known at the time for their contributions to the study of exotic tropical plants, in other words, natural phenomena even further removed from them than those of London and Paris. How did the Breynes achieve this? One answer, of course, has to do with the international commercial networks they cultivated. During the mid-seventeenth century, one member of the family, Jakob Breyne, had studied in the Netherlands, subsequently becoming himself a merchant by profession. He was thus able to draw on Dutch connections of many kinds in obtaining specimens, illustrations, and information about exotic species. But the story is more complicated than that. If we look at the Breyne household as a whole over the century following Jakob Breyne's initial trip to the Netherlands, we can examine many of the complex interconnections between commerce and science during this period: from the relationship between "literary" and mercantile exchange, to the role of such exchange in the household economy, and the role of local vis-a-vis international exchange. Drawing on unpublished manuscript materials surviving from the time, ranging from correspondence and diaries to drawings and financial jottings, the paper will show the ways in which international exchange networks became incorporated into the life of the scientific household.

THE PRICE OF MOBILITY: TRANSPORTING EXOTIC ANIMALS IN EARLY MODERN EUROPE

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The price of mobility was high in the early modern world. While transportation networks between countries and across continents were well-developed, they did not always provide a cheap or secure method for carrying objects to large distances. For example, long-distance booksellers often charged more for shipping than for the book itself. The cost of production was dwarfed by the cost of transportation.

This paper focuses on the travels of heavy and large quadrupeds, like elephants, rhinoceri and giraffes, from exotic countries to Europe. I argue that prohibitive costs of shipping had a strong impact on these animals' scientific reception by early modern natural historians. Because of their scarcity and high value, each individual specimen was considered a representative of its species. While botanists or entomologists could often base their scientific arguments on the careful comparison of multiple observations, students of exotic quadrupeds had to make generalizations from the scrutiny of a single specimen. The differential availability of specimens thus led to the development of two distinct methods of observation and argumentation.

My talk therefore offers a corrective to recent studies on the geographies of knowledge. Scholars have explored at length how the circulation of scientific objects is affected by cultural differences between the countries of origin and destination. It has been studied less, however, how the material conditions of circulation transformed the status and purpose of the objects in motion. Within early modern natural history, researchers have usually focused on small and light-weight plants, seeds, insects or seashells, where these concerns are less pronounced. A study of bulky objects will illuminate how the cost of transportation played a role in the disparate development of the disciplines of botany, entomology, conchology and the zoology of quadrupeds.

COMMERCE AND SCIENCE IN THE DUTCH REPUBLIC

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In their struggle against the Habsburgs, the Dutch depended on wealth from commerce to fund their state; the urban merchants held collective power and even granted to their overseas trading companies the power to make war and sign treaties abroad. They also governed the schools and universities. The values of commerce therefore permeated early modern Dutch society. Engineering, medicine, chemistry, natural history, and mathematics supported their methods of wealth and power. But they also helped to create a system in which efforts in these subjects attracted investment without the prospect of material gain. In other words, the values of commerce did not require all efforts to be devoted to money-making, but they did create the conditions in which materialist investigation of the world could be viewed as good and proper.

A SAMPLING HISTORY OF AUTODIDACTICISM

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For the utopians, the personal experience undergone in the attainment of knowledge is a distinct alternative to the attainment of an impersonal, transmitted knowledge. Through our historical lens, experimentalism thus might be seen, in a certain sense, as having been the nourishment derived from mystical sources that stressed the need to experience Nature and God, and not simply to contemplate and learn about them. Thus, the cultures and the philosophies of these Utopias were not situated in the future and in the West, but actually represented an attempt to transcend time and space, to return to the pre-historical first man and to the early history of human civilization in order to get rid of the burdens of historical tradition and metaphysics and to present a new science. Just like the first scholars who had read the book of nature and gained fresh impressions, the new Utopian scientists bypassed philosophical and historical traditions in order to practice, explore, and experiment with nature.

In this paper I present a web of networks in which an Andalusian utopian text, cabalistic hermeneutic techniques, and mystical practices all circulated in cross-cultural networks and were at hand for use by early-modern writers on utopias, experimentalism, and empiricism. We should look for ways by which utopian writings, and cultures in general, were produced in a long process of exchange with and borrowing from medieval and ancient sources and also from adjacent Near Eastern cultures. To achieve that we should focus on mechanisms of circulation of texts that have slipped off the historiographical radar and are on the margins of the central historical developments.

SCIENTIFIC PRACTICE AS POLITICAL ECONOMY IN THE ENGLISH ATLANTIC EMPIRE, 1650-1688

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Focusing on Jamaica as a case study, this paper argues that the course of imperial development in the seventeenth-century English West Indies was determined in large part by coincident developments in the management of scientific knowledge production. Examining the role played by men of science in building the institutional structures that defined the conduct of commerce in the early English empire, this paper traces how their dominant organizational models were adapted from their experiences as managers of scientific knowledge production. It argues that the application of those models in the realm of imperial governance led to the instantiation of a political economy rooted in the plantation-based production of technologically intensive commodities such as sugar, indigo, and chocolate. In locating the origins of this system in these institutional imperatives, this paper departs significantly from the received historiography on colonial economic development in the English West Indies, which has tended to treat sugar monoculture and the eighteenth-century plantation economy as the inevitable end of a course of development ordained by "nature." On the larger theme of the commerce of science in the early modern world, this paper seeks to answer not how the expansion of commerce reshaped science, but rather how science itself helped lay the groundwork for that expansion in the first place.

Symposium S15
Chemistry in the Aftermath of World Wars

THE IMPACT OF WORLD WAR I UPON JAPANESE CHEMISTRY

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Japan entered World War I (WWI) in August 1914 by declaring war against Germany and other Central Powers under the terms of the Anglo-Japanese Alliance. Its military action was largely limited to the seizure of German colonies in Eastern China and the South Pacific and was minor in comparison with those of European countries and later of the United States. However, the diplomatic impact of WWI on Japan was unquestionable, securing its position as a world power. The socio-economic impact of the war was no less significant.

This paper will examine the manifold impact of WWI upon Japanese chemistry, mainly looking at the drastic changes in the Japanese research system and the international relationships of the Japanese chemical community caused by WWI. I will focus on the role of Jôji Sakurai (1858-1939), the anglophile Japanese chemist who was influential as a "scientific institution-builder" and "scientific diplomat" in interwar Japan. Through involvement in a war-related research project during the Russo-Japanese War (1904-1905), he had been prepared to take advantage of war-time situations politically for raising the profile of Japan as a scientific power, as expressed in his dictum "the war is the enemy of humanity but the mother of progress."

First, the paper analyses how the outbreak of WWI and the embargo of German chemical products, most notably synthetic dyes, gave Japanese chemists an opportunity to lobby for the establishment of the first fully-fledged scientific research institute in Japan, the Institute for Physical and Chemical Research (*Rikagaku Kenkyusho* or Riken) in 1917. Second, it examines how the National Research Council (*Gakujutsu Kenkyu Kaigi* or NRC) was established in 1920 in Japan as part of the International Research Council (IRC), a product of the reconfiguration of international scientific powers triggered by WWI. In doing so, this paper will focus on how Sakurai, by advocating the establishment of NRC, provoked controversy with pro-German Japanese scientists on IRC's policy of German exclusion and yet facilitated Japan's participation (and increased influence) in international scientific associations such as The International Union of Pure and Applied Chemistry (IUPAC) established in 1919.

References:

Chikayoshi Kamatani, *Gijutsu Taikoku Hyakunen no Kei: Nihon no Kindaika to Kokuritsu Kenkyû Kikan* [A hundred-year plan for a technological power: Japanese modernization and the governmental research institutes] (Tokyo: Heibonsha, 1988); James R. Bartholomew, *The Formation of Science in Japan: Building a Research Tradition* (New Haven, Connecticut: Yale University Press, 1989); Yoshiyuki Kikuchi, "Joji Sakurai and His Connections with British Chemists (in Japanese)," *Kagakushi*, 31 (2004): 239-267.

FRENCH CHEMISTS AND THE REORGANIZATION OF CHEMISTRY IN THE INTERNATIONAL COMMUNITY AFTER THE FIRST WORLD WAR

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The International Union of Pure and Applied Chemistry (IUPAC) was born in 1919. It succeeded to the International Association of the Chemical Societies (IACS) created in 1911. Its statutes were written in French, and the Bureau set in Paris. Some of the aims of the old as the new Union was the standardisation of the chemical documentation (normalisation of publications, publication of foreign abstracts in rare languages in French, German or English, nomenclature).

In this new Union, the Austrian and German chemists with their allies were excluded. In 1926, the question of their reintegration was asked. In 1927, at the occasion of the celebration of the centenary of Marcellin Berthelot's birthday, German and Austrians were invited to participate at an international conference in Paris. One of the strong ideas discussed during this meeting was the creation of a common house of chemistry, in Paris, where all kinds of chemical documentation obtained by exchanges would be collected and where there would be international meetings to set in (this project was only realised in 1934).

The period between 1919 and 1927 was an interesting one to study the international contacts and the progress of the meetings of the different commissions that wanted to find a solution to reorganize the international networks as in both academic chemistry and industrial chemistry as between academic chemists and industrials. In this context, the roles of French chemists and specially Albin Haller and Charles Moureu were prominent. The activity of the general secretary of the SCI and IUPAC, Jean Gérard, and his contribution to several national and international committees for example in the international organization of the scientific documentation near the SDN, were essential in these successive events.

In this communication, we should try to present these aspects of the chemistry in the aftermath of the First World War, under the point of view of a will of the creation of an international organisation of all the field of both pure and applied chemistry or industrial chemistry.

SOVIET CHEMISTRY AFTER THE CIVIL WAR

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The Civil War in Russia (1918-1921) consolidated a novel political regime with a unique ideological and strategic commitment to science. Chemistry had been one of the more developed scientific disciplines in Imperial Russia, and, quite naturally, it received particular attention from the Soviet government. Prominent chemists, such as the former general of the Imperial Army Vladimir Ipatieff, were put in charge of the country's science and technology policy, which expanded the R&D system well beyond the current needs of the national economy. New chemical research institutes were established and endowed with generous budgets in spite of the serious economic difficulties, including cases of famine.

Soviet authorities reinforced the two-centuries-old reliance of the country's science of the State and created an "empire of science", which was then unprecedented both nationally and internationally. Developments in chemistry in the first Soviet decade laid the foundations of the vast expansion of the chemical industry during the following decade, the decade of rapid industrialization as of profound militarization of the entire Soviet society.

This paper will examine changes in the chemical research system in the Soviet Union in the first Soviet decade, prior to the fist Five-year plan initiated in 1928. It will compare them along two axes: with contemporary post-war developments in chemical research systems in other countries and with the effects of the Communists' science policies on other scientific disciplines within the USSR.

CRISIS, CHANGE AND CREATIVITY IN SCIENCE AND TECHNOLOGY: CHEMISTRY IN THE AFTERMATH OF TWENTIETH CENTURY GLOBAL WARS

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The purpose of this presentation is to introduce some of the principal themes of the symposium, as it relates to the broader theme of the Congress itself (Ideas and Instruments in Social Context). The presentation begins by considering the historical notion of a general social crisis, and will apply this notion to the global wars of the 20th century, 1914-1945, which were clearly among the most destructive in modern history, as well as among the most far-reaching in their social impact.

There follows a consideration of the relationship of crisis to change and creativity in science and technology, with a critical examination of models on various levels of aggregation from individuals, to research groups and institutions, to nationally and internationally-organized disciplines or "scientific communities." It is argued that the most creative or innovative insights arise among individuals and groups during transitions into or out of crisis. The second of these periods of transition is more likely to produce fundamental, lasting changes, as measures designed to recover from the crisis, to deal with the changed conditions it has produced, or to prevent its recurrence. Hence the emphasis in this symposium is on the aftermath of the wars, rather than the wars themselves.

Furthermore, it is emphasized that analyses of this type may derive their greatest insights from a comparative or transnational perspective, which has been one of the organizing principles in this symposium, though it has not always been possible to fully realize this goal. In conclusion, it is shown that the specific case of 20th century chemistry offers an especially useful opportunity for examining the effects of crisis and its aftermath, as reflected in the particular speakers and topics to be presented here.

WORLD WAR II, THE COLD WAR AND BRITISH WOMEN CHEMISTS

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World War II is frequently regarded as an important turning point in the history of women's employment in Britain. Not only did women gain access to new areas of employment during the conflict itself, but lasting changes such as the removal of the marriage bar in professional employment and the employment of older married women, particularly in part-time posts, became firmly established. This paper draws on a wide range of sources including university and national archives to examine the impact of World War II on the employment of women chemists. It argues that wartime conditions expanded women's access to some areas of employment, particularly in universities and government research establishments, but that these opportunities represented in many ways an expansion of openings that had already been established rather than wholly new opportunities, and not all of them proved permanent. After the war women chemists benefited from increased state expenditure on research and development and the accompanying expansion of research organisations. They secured positions created by the expansion of state welfare and support for agriculture and by the heavy investment in weapons development that accelerated in the late 1940s with the advent of the Cold War. Very few, however, secured positions in industry, despite widespread concerns about the shortage of scientific manpower.

This means that while there was certainly an expansion in the absolute number of women chemists employed in Britain between the start of World War II and the mid-1950s, we should be cautious in suggesting that this was a consequence of the conflict alone or that this represented a significant change in expectations regarding women's role as chemists. Instead we need to recognise that while additional opportunities certainly emerged as a result of the conflict itself, in the long-term postwar developments and the advent of the Cold War were at least as important. This raises the general question of the extent to which we can separate the consequences of World War II from those of other events that followed it so closely.

THE DIFFICULT BEGINNING OF THE GERMAN ISRAELI SCIENTIFIC COOPERATION

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After 1945, there was no open discussion in the scientific community in Germany of the anti-Jewish measures and the active participation of scientists in Nazi politics and crimes. The general tendency was to forget about the past. Despite the fact that there was - in contrast to the situation after the First World War - no official international boycott of German scientists, they were for many years only rarely invited to international conferences, and only few foreign scientists visited Germany. The fact that Germany had lost its leading position in most areas of science – chemistry being an exception – only served to enhance the disinterest of foreign scientists. Impeded by a very poor economic situation, Israel from its foundation in 1948 was keen on establishing scientific relationships with many countries – except, for obvious reasons, Germany. Until the mid-1960s, neither cultural nor diplomatic ties existed between the two countries. For many years Israeli passports were marked as not valid for Germany, and there were no German visitors in Israel.

Against this background the comparatively early beginning, in 1956, of steps aimed at scientific cooperation between the two countries, came as a surprise. It was initiated not on the political or institutional level, but it was the result of initiatives of a few scientists from the Weizmann Institute in Rehovot. Within two years their efforts led to the official beginning of institutional cooperation between the Weizmann Institute and the Max Planck Society, soon followed by the institutionalization of cooperation between Israeli and German science, supported by both governments, many years before diplomatic relations were established. My talk will analyze motives, activities, and research of those German and Israeli scientists, many of them chemists, who played an important role in the early beginnings of this cooperation. Attention will also be drawn to the difficulties the scientists confronted within the different settings in Israel and Germany of the post-Holocaust era. In addition I will elucidate the intricate political events and aims behind the scene, and discuss the importance of this early cooperation for science in both countries.

CHEMISTRY AT THE UNIVERSITY OF STRASBOURG IN THE AFTERMATH OF WORLD WARS I AND II

Pierre Laszlo

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War was a source of modernization and of destruction in the institution chosen for study. My framework is the Alsace as a mindset, a language and a culture—even more, a spirit. The two world wars had highly different consequences, even though Alsatians, with a strong sense of an enduring identity, were at the forefront of efforts in the aftermath. The special talent of Alsatians for institutional building served as a keystone both times.

In 1919, the University of Strasbourg replaced Kaiser Wilhelm Universität. The build-up was swift and impressive. In 1945, the University of Strasbourg faced reconstruction again. The process was gradual and slow. Why such a contrast, even though during the war years leading chemists had moved to Clermont-Ferrand as part of their University's efforts at preserving its existence? However, in 1943 the Nazis arrested and deported the chemist Albert Kirrmann[§] and the physicist (and chemist) Charles Sadron[§] to the Buchenwald and Dora concentration camps. Did their personal ordeal translate into a subsequent devastating blow to French science?

Some of the other questions this paper addresses are:

In the post-World War I period, the University of Strasbourg could have drawn upon its Germanic heritage. Did it assume it or deny it?

World War I had taken its toll among French chemists who, unlike their British or German counterparts, were sent to the front and did not return. Was chemistry in Strasbourg weakened by the hæmorrhage?

During the same period 1919-1939, did the influential Alsatians-in-Paris (such as Charles Andler, Paul Appell, Henri Berr, Lucien Herr) play a significant role in the blossoming of the University of Strasbourg?

In-between the two world wars, university laboratories interacted with local Alsatian industry: was it an added source of strength?

Charles Sadron was a contemporary of Paul Flory's, with similar goals for macromolecular science. Why were his efforts at building an American-style institute frustrated for a long time?

Albert Kirrmann, a chemist from Strasbourg, came to an extremely influential position in French academia. Did he use it to help modernize French chemistry in the aftermath of WWII?

In the same post-WWII decade 1945-55, did chemistry at Strasbourg opt for an American or for a German model in its rebuilding?

Was the CNRS-university synergism vital to chemistry laboratories in Strasbourg?

ISOLATION & INNOVATION: GERMAN CHEMICALS AND AMERICAN POLITICAL ECONOMY AFTER WORLD WAR I

Kathryn Steen

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Prior to World War I, the United States owned a growing chemical industry, and the number of Americans receiving German PhDs in chemistry had peaked, but Germany still held Americans' respect as the preeminent nation in chemistry and the chemical industry. The German dyes industry, in particular, stood out as the pioneer in science-based industry, and Americans imported from Germany nearly all of the synthetic dyes it consumed.

Because of the close identity between the synthetic dyes industry and Germany, Americans' powerful and xenophobic hostility toward Germany during the war led to a strong political and economic movement to establish a domestic industry and establish "chemical independence."

This anti-German sentiment manifested itself in several postwar American federal policies, particularly an extremely high tariff, to help the US synthetic organic chemicals industry. Both the academic and industrial connections between the American and German chemical communities became more distant as Americans withdrew toward economic autarky and isolation. Throughout the 1920s, however, synthetic dyes diminished as the center of attention because new products within the synthetic organic chemicals industry rose to prominence and profitability. Still, the attempt to promote the dyes manufacturing increased the employment opportunities for chemists, helping to enlarge education and expertise, which contributed to the rapid expansion of newer product lines (such as plastics, pharmaceuticals, and various ethylene-based products) in the 1920s.

ROLE OF PRETTRE'S LYONS LABORATORY IN THE POSTWAR DEVELOPMENT OF FISCHER-TROPSCH SYNTHETIC OIL TECHNOLOGY IN FRANCE.

Voillequin Baptiste

Sci. Dvt. Div., TOTAL S.A., France

During WWII, the Fischer-Tropsch technology has become a key stone of the Nazi German oil supply. At the end of the war, the FT process has been one of the target of the wide campaign run by the allied forces to transfer knowledge, know-how, material and personal specialists from Germany (and from the Soviet influence area in particular).

In France, in the very aftermath of the war, the Lyons' laboratory of Prettre has been supported by *Office National des Industries de l'Azote* (ONIA) contracts and rapidly by the rebuilding French *Centre National de la Recherche Scientifique* (CNRS) to hold research on the Fischer-Tropsch issue. First involved in missions to Germany and second being a fellow of the Rockefeller Grant, the team could have gone on further its investigation on the Fischer-Tropsch synthesis. Actually, the scientific core of the "Adsorption et Cinétique hétérogène" seminar held in Lyons in September 1949 as the second part of the Rockefeller Grant was the Fischer-Tropsch science.

Thus, the reshaping of French research on catalysis in the aftermath of WWII was driven by direct post-war inquiries interest but also by a more diffuse US political influence in reconstructing post-WWII western Europe (via the Rockefeller Grant in France in particular) that J.Krige called 'consensual hegemony'.

POSTWAR TRANSFER OF SYNTHETIC RUBBER TECHNOLOGY BETWEEN GERMANY, RUSSIA AND THE USA

Peter J T Morris

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Even before the war ended, the Allies were assiduously collecting information about the German work on synthetic rubber. By the end of April 1945, all the synthetic rubber factories (except Auschwitz) were in American hands. Intelligence teams explored the factories, packed up documents to send to London, and interviewed the scientists. The two key areas of interest were polymerisation at low temperatures (which produced a better rubber) and the work of Walter Reppe on high pressure acetylene chemistry. Numerous reports were published and made available to the public.

The synthetic rubber industry in the United States used this information to develop cold rubber and oil-extended rubber, which used together transformed the economics of synthetic rubber and for the first time made it economically viable in peacetime.

After Schkopau was handed over to the Red Army in July 1945, the Russians dismantled an entire plant and re-erected it in the Soviet Union using deported German scientists to produce Buna S.

Interestingly, the Soviet industry eventually switched largely to the production of polyisoprene (synthetic "natural rubber") which was the result of American and German research unconnected with IG Farben. Lacking the same concern for self-sufficiency the western industry continued to make copolymer rubbers.

Symposium S16
Mathematics in the Austrian-Hungarian Empire

THE MATHEMATICS AND ITS PROFESSORS AT THE MINING (AND FORESTRY) ACADEMY IN SCHEMNITZ

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The Mining Academy in Schemnitz (Selmecbánya – today Banská Štiavnica, Slovakia) established in 1762 was one of the first technical majored university in the world. From the beginning the Mathematics played an important role in its studying programs. What is more the predecessor, higher Mining School "Bergschola" (1735), conducted by Samuel Mikoviny presented high pretension of mathematics tuition. Lectures were mostly focused on those areas of the mathematics that could be essentially applied in the field of mining measuring, mining gadgets constructing, etc. The cooperation between professors and praxis on the solution of various technical issues was very intensive, because some of the mining experts started their careers at the department of Mathematics at the Mining Academy. There were several very interesting attempts of implementing some lectures concerning infinitesimal calculus, descriptive geometry, etc.

During the second half of 19 century in Hungarian Kingdom the Mining Academy in Schemnitz was one of the pillars supporting the trend of increasing general knowledge in the field of mathematical, technical and natural sciences. According to one of the options the Academy was planned to be transferred to a technical university, mostly because the level of mathematical tuition reached these high standards. This study is focused on analysis of the mathematical tuition at the Academy during the historical development and the contribution of most significant professors and other experts in the field. (N. Poda, J. Möhling, J. Schittko, K. Jenny, S. Farbaky, O. Schwartz, K. Walek – matematics; J. Hönig, E. Pöschl, L. Fodor – descriptive geometry) Along the time author shows comparison of the tuition at the Academy with similar school in foreign countries, mostly in Germany (TU Karlsruhe, Berlin, Dresden, Aachen etc.).

MUSLIM IDEAS AND INSTRUMENTS IN THE MATHEMATICS AND ASTRONOMY OF AUSTRIA-HUNGARY

Harald Gropp

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The region of Budapest was governed by Muslims for more than 150 years during the time of the Ottoman Empire. Of course, in this period also Muslim science entered this region of Europe. The Ottomans were driven back to the East by Habsburg establishing again a Christian rule. In the 19th century this empire developed into Austria-Hungary, and after the end of World War I the empire was split up into many different parts.

The wars between the Habsburg and the Ottoman Empire were mainly seen as "religious wars". Apart from the question of political power and influence the defense of the own religion played an important role. Still in the 19th and 20th century this religious difference between the Catholic Habsburgs and the Muslim Ottomans dominated other cultural interactions.

In the last 40 years of its existence Austria-Hungary met Islamic culture by integrating Bosnia and Hercegovina in 1878 and 1908 resp. This meant that in Sarajevo different religious backgrounds like Catholic, Orthodox, Muslim, and Jewish framed the social life of the town and the region.

In this talk the focus will be on the mutual interactions of these different religious traditions concerning ideas and instruments in the development of mathematics and astronomy, e.g. hiow calendars structured the social life. The Ottoman influence of earlier centuries as well as the contemporary situation in the last years of Austria-Hungary will be considered.

In the context of a section on mathematics in Austria-Hungary this "exotic" part of Austria-Hungarian history may demonstrate the huge cultural variation of this empire consisting of many different peoples.

MATHEMATICAL EDUCATION IN THE PROVINCE OF VOIVODINA WITHIN THE HABSBURG MONARCHY

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Voivodina, a multinational and multicultural southern region of the Austro-Hungarian Monarchy and a part of the monarchy's defence zone towards the Ottoman Empire, was regarded as a province by all its citizens except the Serbs. The religious and national communities of Hungarians, Germans and Croats had their cultural and educational centres – Pest, Vienna and Zagreb – where they could obtain higher education and therefore did not feel the need for such institutions in Voivodina. During the late 18th and early 19th century Novi Sad (today the principal city in Vojvodina) gradually emerged as a prospective cultural and educational hub of the Serbs, not only from Voivodina, but also for the Serbs living under the Ottoman rule south of the rivers Danube and Sava. This is the main reason why, in the history of education in Voivodina and the history of mathematics as its part, the Serbs play a most prominent role until the end of World War II.

In the Habsburg Monarchy, and in Voivodina as its province, the school curricula, textbooks, and teaching methods were determined by the monarch's order. With the School Constitution and other school acts dating from the period of Maria Theresa, the teaching of mathematics was in a modest but systematic fashion included in the Serbian elementary school programmes. The main characteristics of mathematics education during this period were that it was not conducted by trained mathematicians and that the prevailing methodology was oriented towards the practice of doing calculations without the theoretical bases in algebra or geometry. The first mathematics book written in Voivodina was New Serbian Arithmetic by Vasilije Damjanović. It was printed in the vernacular in the printing shop of Dimitrije Teodosije in Venice in 1767. Its content does not show particularly high mathematical standards but it had educational and enlightening significance. The importance of books by Avram Mrazovič, Atanasije Demetrovič Sekereš and Jovan Došenović, written in Voivodina during the 18th and 19th century can be viewed in a similar way. These books, together with some other textbooks used in translation, enabled basic mathematic terms and calculations to become an integral part of the instruction process in the existing Serbian schools in Voivodina. However, it was only after grammar schools were established in Novi Sad and the nearby Sremski Karlovci, that the firm foundation was laid for the development of mathematics in Voivodina. From the very beginning arithmetic and 'mathezis' (algebra and geometry) were regular subjects in the grammar school curricula. These were mainly taught using the translated textbooks written by Franc Močnik, a Slovenian mathematician who, as a school counsellor and inspector, played an important role in the development of mathematics education in primary and secondary schools in the Austro-Hungarian Monarchy. At that time the institutions of great importance were the first teacher training school (Norma) founded in Sombor in 1778 by Avram Mrazovič and its higher form named Preparandija, founded in 1812 in Sent Andreja (Hungary) and moved to Sombor in 1816.

GREEK MATHEMATICAL PUBLICATIONS IN VIENNA IN THE 18th-19th CENTURIES

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In the Austro-Hungarian empire, the Greek community played an important role in scientific as well as in social life. Many scientific books and journals saw the light of day in the Hapsburg capital, which contributed to the introduction of the Greek people to the European Age of Enlightment by transferring it to Greece.

Vienna became a scientific publishing centre for the Greek nation which lay under Ottoman rule. Through translations and compilations, the Greeks of the Diaspora tried to spread new scientific theories, in the belief that education constitutes the greatest driving force for a people striving ardently to achieve its freedom. To transmit scientific knowledge was an imperative need, a supreme duty for the benefit of Greeks starved of education.

Mathematical books such as Euclid's Elements (Vienna, 1820) and Elements of Arithmetic (Vienna, 1818) by Benjamin of Lesbos, or the classic translation of Bourdon's Elements of Arithmetic (Vienna, 1828) by I. Carandinos for his students in the Ionian Academy, provided a substantial foundation for mathematical education in Greece. Journals such as Literaly Mercure (Vienna 1811-1821) offered to the Greek reader a panorama of scientific progress and information on new editions.

The following fragment from the Greek review Kalliopi (Vienna 1819-1821) is characteristic of this mentality: "We steal ideas from philosophers and clothes from the erudite to dress our nation. For this reason we came to Europe...to steal from the original sources, from the best sources of what we do not have. "

THE RECEPTION OF BOLYAI'S GEOMETRY IN THE AUSTRIAN-HUNGARIAN EMPIRE

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There is plenty of detailed literature on the history of non-euclidean geometry. I would like to mention some data, such as Euclid, Playfair, Saccheri, Lambert, Bolyai-Lobachevskii-Gauß, Riemann, Klein, Halsted, Beltrami, Hilbert. We know less about the reception of Bolyai's work in Hungary's neighbour countries, in the Austrian-Hungarian empire. With the help of my colleagues I have collected some data: publications, university lectures on the reception of hyperbolic geometry in Vienna, in Prague, in Serbia, and also in Pest-Buda and in Kolozsvár. At the end I will also mention some recent research and workshops on non-euclidean geometry.

FRANC HOČEVAR - TEXTBOOK AUTHOR

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From the year 1886 to 1902 Hočevar wrote the first edition of textbooks for all classes of upper secondary schools. When the school curriculum changed, he quickly adopted the contents of his textbooks to the new one. Therein he was able to find a good balance between theory and practice.

Useful exercises, historical notices, and linguistic remarks were included in his textbooks to keep the attention of the students. As it is now, also in those times there were more than one textbook author – nevertheless, Hočevar's textbooks were the most popular. And we shall tell the reasons.

FRANC HOČEVAR AND HIS SCIENTIFIC WORK

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At the time of the Austro-Hungarian Empire, some mathematicians born on the territory of what is now the Republic of Slovenia made their own important contributions by their professional and scholastic activities, and by numerous published articles and text books. Most of their works introduced some original ideas in education and science.

We will present here two mathematicians who had a great influence in school literature and mathematics in Central Europe: Franc Močnik (1814-1892) and Franc Hočevar (1853-1919).

WILHELM MATZKA (1798–1891) AND HIS POSITION IN THE AUSTRO-HUNGARIAN MATHEMATICS

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The aim of my lecture is to introduce the personality and the professional activities of Wilhelm Matzka who influenced the development of mathematical education at universities and technical schools, as well as the level of competence of teachers at secondary schools, especially in the Bohemia, in the second half of the 19th century.

His pedagogical activities were connected with important places of the Austrian-Hungarian Empire: Vienna (1831–1837 as mathematics teacher in the *bombardier* company), Tárnow (1837–1849 as full professor of elementary mathematics at the philosophical school) and Prague (1849–1850 as full professor of elementary mathematics and practical geometry at the Prague Polytechnic, 1850–1871 as full professor of mathematics at the Prague University).

He was interested in the mathematical topics which were current at his time, and he published a number of textbooks, monographs and scientific works. He was a holder of the gold medal *Literis et artibus*, a regular member of *Königliche böhmische Gesellschaft der Wissenschaften* [the Royal Bohemian Society of Sciences] and a member of the committee for secondary school teachers of mathematics in Bohemia.

CZECH MATHEMATICIANS AND THEIR ROLE IN THE DEVELOPMENT OF MATHEMATICS IN THE BALKANS

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From the sixties of the 19th century, the mathematical works and the number of mathematicians, teachers of mathematics and authors of mathematical monographs and textbooks rapidly increased in Bohemia. This was due to the development of mathematical education at the secondary schools, technical schools and to the establishment of specialized lectures at the university in Prague. These changes were influenced by the political and economic events in Bohemia.

The second part of the 19th century can be characterized by strong efforts to have mathematics taught and written in Czech, in which a major role was played by the Union of Czech Mathematicians (founded in 1862) and by its own journal (Journal for Cultivation of Mathematics and Physics, founded in 1872) and many other publications. From the nineties of the 19th century the mathematics in Bohemia developed in such a way that Czech scientists were able to make their independent contributions to world mathematics.

During the seventies and eighties of the 19th century there were many Czech candidates of teaching mathematics and physics at secondary schools, technical school and university who were without regular position and income. It is not surprising that some of them went abroad (especially to the Balkans) where they quickly obtained better regular positions, and they started to play important roles in the development of "national" mathematics and mathematical education.

In this talk, the most important phenomena from the development of the Czech mathematical community will be discussed and analyzed and their influences on other national mathematical communities will be described.

"THE CRISIS OF INTUITION" – AUSTRIAN-HUNGARIAN CONTRIBUTIONS IN THE QUEST OF DEFINING THE MATHEMATICAL TERM "DIMENSION" FROM THE 1850´S TO THE 1920´S

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When Hans Hahn gave his talk "The Crisis of Intuition" on November 30th, 1932 to a broad Viennese audience, the quest to define the mathematical term "dimension" had already been solved by Menger and Urysohn. The talk will give a brief outline of the mathematical approaches towards "dimension". As a start, we will look at Georg Cantor´s work showing that a square can be mapped a line segment with one-to-one correspondence. Whereas Cantor´s result had merely put the previously unquestioned concept of dimension for the first time in doubt, Giuseppe Peano´s space-filling curves gave it a severe blow. Around the turn of the century, Poincaré proposed a recursive definition of dimension, which was soon taken up by the Hungarian Frigyes Riesz. However, long before Poincaré, Bernhard Bolzano dealt with the problem in the first half of the 19th Century with a useful dimension concept, formulated in the best way possible in his times.

KAREL PELZ AN OUTSTANDING GEOMETER OF THE 19th CENTURY

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The second half of the 19th century was a crucial period for the formation of descriptive geometry as a science. This paper offers notes on the life and work of Karel Pelz, an outstanding mathematician in the field of both synthetic and constructive geometry, who belonged to the first generation of the best cultivators of descriptive geometry in the Austrian-Hungarian Empire. His name is closely connected with the highest development of descriptive geometry that was crowned by Emil Müller and his disciples in the first third of the 20th century. Pelz has excelled in the synthetic theory of conics, curves and surfaces (especially the quadric ones) and has been interested also in other various contemporary problems. His contribution to the developing of the principles of normal axonometry as a method of representation is also highly appreciated.

THE APPOINTMENT POLICY IN THE AUSTRO-HUNGARIAN MONARCHY

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During the second half of the 19th century, in the big region of the Austrian-Hungarian monarchy mathematics started on a very low level and reached world fame, due to a clever policy of supporting and structuring the career of a mathematician. Typically, immediately after having finished his studies, he would spend one or two years in one of the most famous centres of mathematics, meaning Berlin, Göttingen or – for geometers – Milan, thus gaining access to top research and establishing the necessary personal connections, then followed by the *habilitation* and a few years as *Privatdozent,* then a chair in one of the smaller universities at the border of the empire – and then, according to the success, step by step approaching its centre. The final goal was to become professor of mathematics in Vienna (or Prague, or Budapest).

The careers of Franz Mertens (1840–1927), Gustav von Escherich (1849–1935), Leopold Gegenbauer (1849–1903) and Robert Daublebsky von Sterneck (1871–1928) will be examples of this successful approach to encourage mathematical research. After World War One mathematicians had fewer chances to pursue a scientific career.

MATHEMATICS IN LWÓW BEFORE THE FAMOUS LWÓW MATHEMATICAL SCHOOL

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The mathematics in Lwów was developed mostly at two schools, namely the Jan Kazimierz University and the Polytechnic School. At the some time, on should emphasize the essential role of gymnasium for development of mathematics. In the presentation, we will characterize its contribution of mathematicians such as Puzyna, Sierpiñski, Steinhaus e.a. and the influence of gymnasium on the further directions of investigations of the famous Lwów mathematical school. In that way, we demonstrate that the environment of the school was formed at the beginning of the XX-th century. An investigation of this period allows us to find sources of understanding of importance of the set theory and set-theoretic topology in, e.g., Puzyna's famous monograph on analytic functions. It is worth to emphasize that the period under consideration was the last one when the University in Lwów was under the influence of the Austro-Hungarian monarchy.

Symposium S17
Mathematical Discoveries and Demonstrations: East and West

TWO ARCHETYPES OF MATHEMATICAL DISCOVERIES AND DEMONSTRATIONS: ANCIENT GREECE AND ANCIENT CHINA

In Memoriam Prof. Michael S. Mahoney (1939-2008), my teacher of history of mathematics at Princeton

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1. **Two Archetypes of Mathematics: Ancient Greece and China**

Two archetypes of mathematical discoveries and demonstrations can be seen in ancient Greece and ancient China. In ancient Greece, there emerged axiomatic mathematics of which a representative work was Euclid's *Elements*, edited in the early 3rd century BCE. The Greek people idealized mathematical objects and required rigorous demonstrations for propositions. On the other hand, the ancient China people practicised mathematics concretely through and through basically with algorithmic calculations, as can be seen in *The Nine Chapters on the Mathematical Art* of the 1st century BCE. Ancient Chinese mathematics was, in a sense, the highest form of ancient Orient mathematics.

2. **Mathematical Discoveries and Demonstrations in Ancient Greece**

The Hungarian historian of mathematics Árpad Szabó presented how the conception of mathematical demonstrations developed in ancient Greece, arguing that it evolved from simply intuitive through ones with an explanation by words and finally indirect demonstrations, i. e. the proof by *reductio ad absurdum*. The last category of proof was in practice only in ancient Greece. It is said that in the time of Plato the method of analysis as the mathematical art of discovery was formulated vis-à-vis the method of synthesis, or ordinary deductive method. The geometrical analysis was very commonly used as an effective tool-box of solving mathematical problems, as seen in the works of Archimedes.

Not only rigorous demonstrations but also the systematic axiomatic method were formed in ancient Greece. Axiomatic mathematics can be seen in the *Elements* by Euclid of Alexandria. Its first book begins with starting-points such as definitions, postulates, and common notions (or axioms). Szabó contended that the axiomatic method had an Eleatic origin, keeping a vestige of the art of dialectic. But, I think that Szabó's proposal was too narrow.

3. **Intellectual and Social Backgrounds of Axiomatic Mathematics: A New Thesis**

As to the intellectual and social backgrounds of axiomatic mathematics, I propose a new thesis, arguing that the axiomatic style in mathematics emerged to defend its knowledge from charges of the general philosophical trend of scepticism, and that ancient Greek emphasis on 'agôn' (contest) promoted the axiomatic method. We should not restrict the philosophical trend of scepticism to the Pyrrhonians (Pyrrho and his followers) and the Academics. Its broader version was widespread since the 6th century BCE at latest among the intellectuals, including both philosophers and mathematicians. We should remember that the critical spirit of the Greeks had a strong social support as early as the 8th century BCE, as Jacob Burckhardt and Max Weber insisted. The sceptical attitude is witnessed in Plato and Aristotle before the time of Pyrrho and seems to have exerted strong influence upon both philosophical and mathematical antecedents of Euclid.

4. **The Pragmatic Mode of Chinese Mathematics**

I don't believe, however, that the mode of Greek mathematics surpassed any kind of mathematical practices. Traditional Chinese mathematics, for example, has still kept elements which the Greeks didn't appreciate much, i. e. keeping firmly the pragmatic style of mathematical practices. In this juncture, I quote an observation from an Arabic author in 9th-century Damascus: "The curious thing is that the Greeks are interested in theory but do not bother about practice, whereas the Chinese are very interested in practice and do not bother much about the theory." In this sense, I insist that the Greek mode of mathematics and the Chinese mode of mathematics are mutually incommensurable, to use Thomas S. Kuhn's notion. In order to constuct fruitful mathematics, we have to study both archetypes of mathematics, with Leibniz's words "A commerce of doctrine and mutual light."

EARLY GREEK MATHEMATICS AND ELEATIC PHILOSOPHY: A REAPPRAISAL OF A CONTROVERSIAL RELATION

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1. On the Pythagorean arithmetic reasoning

The Pythagorean number theory of the distinctive style survived in later sources has the following features: i) arithmetical reasoning is conducted over a 3-dimensional "domain" that extends indefinitely in the direction of increase. ii) The *monas*, denoted by an alpha, is taken to be a designated object, over which an iterative procedure of attaching an alpha is admitted. Thus, numbers are defined as finite *suites*. Various kinds of numbers can then be defined as suites constructed according to certain rules. iii) Arithmetic is then developed by *genetic constructions* of various finite (plane or spatial) schematic patterns. Thus, Pythagorean arithmetic represents a visual theory of counting over a distinctive combinatorial "domain." iv) Arithmetical reasoning is conducted in the form of *mental experiments* over concrete objects of combinatorial character. Any assertion about numbers utters a law, which can be confirmed in each case by pure combinatorial means. v) Arithmetic concerns affirmative sentences stating something 'positive' that can be confirmed by means of the construction of the corresponding configuration (*deixis*). None kind of 'negative' sentences is found.

2. On certain semantic views of Parmenides

In Parmenides' poem *On Nature* certain semantic views have made their appearance for the first time: a) only what is true is expressible (meaningful). b) a false statement contains a "false term" that is a term that names or expresses nothing (meaningless). These theses form a semantic picture, in which truth is identified with meaningfulness, whereas falsity is identified with meaninglessness. Although this thesis of Parmenides is highly controversial, it is reasonable to raise the question on what grounds such an odd conception could be shaped.

3. Pythagorean arithmetic as a model for Parmenidean semantics

The relation between Parmenides' semantic viewpoint and Neo-Pythagorean arithmetic can be expressed as follows: Parmenides' theory of truth could be obtained by reflexion upon Pythagorean arithmetic if truth is identified with genetic constructability (*deixis*). In this case, the Being is identified with the universe of all arithmetical constructible ('experimental') truths. In other words, Pythagorean arithmetic might have served as a model for Parmenidean semantics.

4. On Szabó's Thesis

Árpad Szabó suggested a conception of origin of mathematics out of Eleatic philosophy and highlighted the role of indirect proof, i.e. proof by *reductio ad absurdum*, in this process. My viewpoint partly rehabilitates Szabó's hypothesis, in the sense that a relation between early Greek mathematics and philosophy is established. However, this relation is not viewed in the axiomatic method and the indirect proof – which is not used and *cannot* be used in arithmetic of the Pythagorean style – but in the genetic method used in the construction of Pythagorean arithmetic and its logical relation with Parmenidean semantics.

My viewpoint restores two weaknesses of Szabó's hypothesis: a) the inversion of the relation between mathematics and philosophy, known to us from the history of science; b) the unsolved problem of origination of philosophy, to which the problem of origination of mathematics is reduced. In my viewpoint, Parmenidean philosophy might have shaped by reflexion upon the mathematical activity of the Pythagoreans, whereas the origin of the Pythagorean arithmetic has its roots in counting, that is in human practical activity. This restores the relation between mathematics and philosophy and terminates the retrospective reduction of origination.

THE TREATISE *ON THE SECTION OF A CONE* OF SERENUS OF ANTINOE AND ITS RELATION WITH THE BOOK XII OF EUCLID'S *ELEMENTS*

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The treatise *On the Section of a cone* of Serenus of Antinoe contains 69 propositions in Heiberg's standard edition. The aim of this book is a comparative study of the sections produced in a cone by planes passing through its vertex. This book is based on the proposition 3 of the first book of *The Conics* of Apollonius of Perga.

Serenus' treatise belongs to the post-Archimedean tradition, because Serenus seeks to find the maximum and minimum triangles established by a plane passing through the vertex of a right or oblique cone, i.e. the minimum and maximum values of a function that depends on whether the sections are axial, parallel or isosceles are sought for.

The book *On the Section of a cone* can be divided into three relatively independent parts. In the first two parts he makes a comparative study of the sections produced in a cone by planes passing through its vertex. In the first part, the propositions 1-14, he works on right cones; in the second, propositions 15-57, he works on oblique cones. The last propositions 58-69, constitute a separate section of the book studying the volumes of right cones in relation to their heights, their bases and the areas of the triangular sections through the axis. With these propositions, he enriches the propositions already established by Euclid in his book XII of the *Elements*. The third group of propositions is completely separated from the preceding propositions as we can observe from their deductive structure. In this section Serenus gives always couples of propositions and in every couple he proves a property and its opposite.

THEORY OF PROOF IN THE 10th CENTURY: WHAT CHANGES? WHY?

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Why, in the 10th century, did the mathematicians of Baghdad, in the wake of the philosophers, seize on the theme of analysis and synthesis and make it a topic of discussion and controversy ? Why this sudden interest in the process of analysis, an integral part of standard geometrical practice, which until then had been the subject of tacit agreement ?

To try and account for this interest, we shall endeavour to examine how and under which influences some chapters of geometry, while remaining formally Euclidian, changed from the 9th century on, how these changes modified the usual practice of some geometers, influenced their theories of proof and led them to question the tacit agreement prevailing amongst them on what a proof should be.

EPISTEMIC ASPECTS OF ALGEBRAIC DEMONSTRATION: EAST AND WEST

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The great divide in mathematical demonstration between the East and West is often characterized by the absence of the axiomatic method in Eastern mathematics. While the axiomatic mode of demonstration indeed takes a unique place in the history of mathematics, the method had no influence at all in arithmetic and algebra before the seventeenth century, either in the West or the East. It was only through the humanist program of Regiomontanus and Giorgio Valla to reform mathematics, that Euclid's *Elements* and the axiomatic method became seriously studied. From the sixteenth century onwards notions of Euclidean geometry, beginning with Proclus's *communes notiones*, were introduced in algebraic works to provide the "barbaric" form of algebra with new foundations and to raise it from the art of problem solving to the analysis of the structure of equations. It is under that process that the epistemic model of truth derived from algebraic reasoning changed. Before Pacioli's *Summa* (1494) there were only little differences in the epistemic models of algebraic demonstration between Eastern traditions and the European abbaco tradition.

As for the Eastern traditions we will look at the later classical period of Hindu algebra by Mahāvīra and Bhāskara II. For Chinese mathematics we discuss the "tien yuan shu" or celestial element method by Li Ye (or Li Shi) from 1248 and Zhū Shġjié around 1300. For *wasan* or native Japanese algebra we limit ourselves to the *tengen jutsu*, the celestial element method as it was refined by Seki and Takebe Katahiro. For Arabic algebra we will account only for the early texts: al-Khwārizmī's *Algebra*, The *Algebra* of Abū Kāmil and and al-Karajī's *Fakhrī fī al-jābr wa'l-muqābalah*. European algebra before 1460 is completely characterized by the Latin translations of Arabic algebra, Fibonacci's *Liber abbaci* and the vernacular abbaco tradition with extant texts starting from 1307.

Keeping in mind the risk of oversimplification, we can discern a common epistemic model for all algebraic demonstration before 1460 to be summarized by Wittgenstein's: "Die Mathematik besteht ganz aus Rechnung" (Mathematics consists entirely of calculations), (1978, 924; 468). The validity of algebraic demonstration is derived from correctly performing accepted operations. There are some minor differences between the traditions mentioned. Chinese and Japanese methods rely on tangible and material means to perform the operations of calculation (or for *wasan* a symbolic rendering of these operations). Hindu, Arabic and abbaco traditions rely on rules which are treated scholastically for Hindu and Arabic algebra, or rhetorically for the abbaco tradition. The Arabic tradition is an exception in that it provides geometrical demonstrations for some of the rules (but not for the analytic reasoning).

From the later abbaco period and Pacioli onwards, algebraic derivations become generalized and function as true theorems within a new epistemic model which mimics the axiomatic nature of Euclidean geometry.

ABOUT THE READING OF DIOPHANTUS BETWEEN THE XVIth AND XVIIth CENTURY

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Abstract: In the second half of the XVIth century and in the first years of the XVII century, the Diophantus Arithmetica was studied with great interest. The manuscripts of Arithmetica were discovered by A.M.Pazzi and were translated by R.Bombelli (1567, 1572), by G.Xylander (1575) and by S.Stevinus (1585). François Viète, taking the Xylander text into account, wrote Zeteticorum Libri quinque in 1593 using his algebraic techniques. Viète's aim was only partially to translate by means of his logistica speciosa the Diophantus's quaestiones. As a matter of fact he proposes other interesting problems. Our goal is an analysis of some aspects of Viète's Zeteticorum libri quinque. In particular, we will examine some zetetici of the IVth book, which concern the indeterminate second degree problems , the relationships with some propositions which we find in the part Genesis Triangulorum of Notae Priores and the pre-eminent role of the zeteticum IV, 2. Furthermore, it is interesting to consider the geometrical interpretation of some zetetici by scholars of Viète (see i.e. J.L.Vaulézard (1630)). Moreover, we will analyze the indeterminate third degree problems by comparing them with some of Fermat's remarks. In this context we will propose an interesting mathematical (philological) result regarding the solution of the indeterminate equation

$x^3 + y^3 = a^3 + b^3$.

LES MATHÉMATIQUES DE NEWTON APRÈS LES *PRINCIPIA*

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Dans les années qui suivent la rédaction des *Principia*, Newton se propose d'écrire un grand traité où les conceptions des mathématiques qu'il a développé dans sa carrière extraordinaire soient exposées en ordre. Ce traité devait contenir une grande quantité de matériaux, en apparence, et peut-être aussi en réalité, hétérogènes : une nouvelle profonde conception (mais tout à fait personnelle) de la géométrie classique ; des critiques sévères envers la nouvelle analyse cartésienne, ou plutôt ses abus ; des éléments importants d'une géométrie que l'on pourrait définir pré-projective. Enfin un exposé rigoureux du calcul des fluxions et de l'usage des séries.

La difficulté de l'entreprise, et peut-être aussi des tensions conceptuelles inconciliables, ont empêché à Newton d'accomplir son projet. Mais les nombreuses tentatives, les changements d'avis, les nouvelles versions qui sont pour la plus grande partie contenus dans le septième volume des *Mathematical Papers* (enrichis par les précieux commentaires de Whiteside) ont un intérêt considérable. Nous pouvons voir comment Newton a repensé son histoire mathématique et au même temps les thématiques qu'il a projeté de développer, mais qu'il a du confier à la postérité.

References

G. Belgioioso, G. Cimino, P. Costabel et G. Papuli, éditeurs. *Descartes: il metodo e i Saggi. Atti del Convegno per il anniversario della pubblicazione del* Discours de la métode *e degli* Essais, Roma, 1990. Istituto della Enciclopedia Italiana.

C. Dollo, éditeur. *Archimede. Mito, tradizione e scienza*, Firenze, 1992. Olschki.

M. Galuzzi : Courbes géométriques et mouvement : Descartes et Newton. À paraître, a.

M. Galuzzi : Newton critic of Descartes. À paraître, b.

M. Galuzzi : I *Marginalia* di Newton alla seconda edizione latina della *Geometria* di Descartes e i problemi ad essi collegati. *In Belgioioso(1990)*, pages 387–417, 1990.

M. Galuzzi : La lettura di Archimede nell'opera di Newton. *In Dollo (1992)*, pages 291–327, 1992.

M. Galuzzi : L'influenza della geometria nell'evoluzione del pensiero di Newton. *In Panza et Roero (1995)*, pages 271–288, 1995.

N. Guicciardini : *Isaac Newton on Mathematical Certainty and Method*. À paraître.

N. Guicciardini : *Reading the Principia*. Cambridge University Press, Cambridge, 1999.

I. Newton : *Mathematical Papers*. Cambridge University Press, Cambridge, 1967-1981. Edited by D.T. Whiteside.

M. Panza : *Newton et les origines de l'analyse: 1664-1666*. Blanchard, Paris, 2005.

M. Panza et C.S. Roero, éditeurs. *Geometria, flussioni, differenziali. Tradizione e innovazione nella matematica del Seicento*, Napoli, 1995. La città del sole.

LEIBNIZ'S PARISIAN STUDIES ON INFINITESIMAL MATHEMATICS

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In autumn 2008, the fourth and the fifth volume of the seventh (mathematical) series of the Academy Edition of Leibniz's Complete Writings and Letters have appeared. Volume VII,4 comprises 905 pages and 51 numbers, volume VII,5 comprises 703 pages and 98 numbers. Both volumes deal with infinitesimal mathematics of nearly exclusively hitherto unknown studies that were written in Paris, that is in 1673 and in the years 1674-1676, respectively. Thus they reveal Leibniz's mathematical ideas that led him to the invention of the calculus. The lecture will concentrate on the fourth volume that was edited by Walter S. Contro and by myself.

1. First of all it will explain Leibniz's different conceptions of ‚infinitely small' and related notions: minimus – smallest, inassignabilis – unassignable, minor assignabili quavis – smaller than any assignable, minor quolibet finito (sc. numero) – smaller than any finite (number), infinitesima pars – infinitesimal part, nulla (erit differentia) – (the difference will be) zero, indivisibile – indivisible, minor qualibet recta quae fingi posset – smaller than any straight line that could be imagined, minor qualibet data (quantitate) – smaller than any given (quantity), unitas constructionis – unity of construction.

These notions are not equivalent, some are not consistent, some of them cannot be defined. Eventually, Leibniz adhered to ‚smaller than any given quantity' or infinitely small that is to a completely consistent fruitful definition of infinitely small. An infinitely small quantity is a variable quantity and can be described in terms of the Weierstrassian epsilon-delta-language.

2. Secondly the lecture will deal with selected problems discussed in this volume. The main issues concern circular segments and the theorem of transmutation; the characteristic triangle; the quadrature of the circle; curves like conchoids, cycloids, cissoids, spirals; paraboloids and hyperboloids; the inversion of the tangent problem; sphere, spheroids; the generalized Keplerian problem; the so-called Collectio mathematica (Mathematical collection); programmatic studies (aim of geometry, imperfection of algebra and theory of series, problems regarding the infinite and the indivisibles).

The two studies, De ductibus' (n. 26 On geometrical products) and, Trigonometria inassignabilium' (n. 27 Trigonometry of unassignables) are of special interest. Therein Leibniz deduces 157 geometrical propositions by means of indivisibles and infinitely small quantities. The heuristic fruitfulness of Leibniz's approach is convincingly demonstrated by this overwhelming richness of results.

HISTORIES OF DEMONSTRATIONS AS VITAL INGREDIENT OF MATHEMATICS

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During the last decades, first-rate results were obtained in several branches of mathematics, such as in ordinary differential equations, dynamical systems, topology and mathematical physics. These results already belong to and have enriched the field of History of Mathematics. But, is History of Mathematics important for mathematics and the mathematicians? Why active mathematicians show growing interest in history of mathematics? I would discuss these questions from pure scientific, historical and sociological points of view, based on the examination of two historical cases.

1. The Riemann-Hilbert Problem.

The statement of this problem is the following: Is it possible to determine the differential equation of Fuchsian type uniquely, if we know the monodromy group and the location of poles in the complex domain?

The history of this problem is extremely impressive and instructive. The problem was stated in the famous Hilbert's lecture at the Second International Congress in Paris on August 8, 1900 and was numbered 21st in his famous *Problems*. In the beginning of the 20th century, namely in 1906, the Slovene mathematician Josip Plemelj (1873-1967) obtained a positive solution to a problem similar to the 21st problem, by reducing it to another of his results. However, by the end of the century, it was discovered that, although this other result is correct, the reduction does not always work. Nevertheless, the mathematicians still continued to believe that the answer to the problem was positive. However, in 1989 these hopes were entirely deceived by the Soviet mathematician Andrei A. Bolibruch (1950-2003), who unexpectedly proved that the problem generally has a negative solution.

2. Poincaré Finiteness Theorem for Limit Cycles.

Poincaré posed the question of whether the number of limit cycles is finite for polynomial vector fields. During the period 1889-1923, Henri Dulac (1870-1955), a student of Poincaré developed the so called local theory of differential equations and presented the first proof of the finiteness theorem in his memoir "Sur les cycles limites" (*Bull. Soc. Math. France* **51** (1923), 45-188). The proof survived for more than 60 years. However, a serious lacuna was found in it in 1981. Only in the 1980s a correct proof was published.

Similar examples are also found in the history of modern research in such fields as the Theory of Knots, Holomorphic Dynamics, the so called Berry Phase technique, Poincaré's Conjecture for three-dimensional manifolds, etc.

PRE-MODERN JAPANESE MATHEMATICS, WASAN AND DEMONSTRATION

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1.Wasan and Ancient Chinese Mathematics

Generally we call mathematics that developed in pre-modern Japan Wasan. It has a root in ancient Chinese mathematics. Wasan accepted mathematical terminologies, expression, computations and so forth of ancient Chinese mathematics and reached in higher level in the latter half of the 17 century than the old Chinese mathematics. Chinese mathematics is a practical mathematics and Wasan succeed its mathematical sprit basically. Japanese mathematicians, Wasana-ka, devoted to get correct numeral value of a given questions as an answer. In such wasan as a successor of traditional mathematics the idea of demonstration never grow up.

2. Approximate Equation for the Length of Ellipse Circumference

In the latter half of the 17th century a question of ellipse curve suddenly was taking up in Wasan. A person who made the question was Yoshinori Isomura and submitted it in his book; *Sanpo Ketsugisho*, vol. 5, in 1659. His requirement was finding the length of ellipse circumference. At the beginning Wasan-ka regarded that ellipse curve consists of combination of segment of circle. And they used approximate equation: $L = d^2$£+kc^2 to calculate it. Takakazu Seki and his successors used different one; $L^2 = 4ab\pi^2+4(2a\ 2b)^2$. However, Wasan-ka did not realize that section which is obtained by cutting a cylinder and a cone with a plane forms same ellipse substantially.

3. A Loaned Demonstration for Defining the Number of Regular Polyhedra

Wasan-ka devoted to calculate the volume of various solids correctly. Naturally they took regular polyhedra and semi-regular polyhedra as an object of their study. Yoshisuke Matsunaga was a mathematician who advanced the study of polyhedra in the first half of the 17th century. In the process of the study of regular polyhedra he believed that Rokuju Tomen (sixtieth semi-regular polyhedra, Stella polyhedra) can be included in the family of regular polyhedra. Sadasuke Fujita strongly criticized that Matsunaga's opinion is irrelevant. Indeed Fujita's judgment that regular polyherda are restricted only five numbers based on Chinese calculator Mei Wending's description in *Jihe bubian*.

4. Wasan as Practical Mathematics

Wasan developed in the no connection with natural science except calendar (or astronomy). On the other hand, Wasan-ka in particular loved the study of geometrical questions. They discussed resemblance questions of geometry repeatedly. In such a process sometimes beautiful theorems were obtained, they did not give any demonstration. Most of them were gained by dealing with resemblance questions inductively. They called them "Jutsu", it was an ancient Chinese mathematical terminology that means procedure for getting an answer.

THE COMPARATIVE STUDIES ON THE DISCOVERIES AND DEMONSTRATIONS IN THE EIGHTEENTH-CENTURY MATHEMATICS IN EAST AND WEST

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The Eighteenth-century sees many prominent mathematicians like Euler, Lagrange etc. However there are many amateur mathematicians too. Among them we distinguish English and Japanese ones at the same century. In England many philomaths, lover of mathesis especially mathematics, were active, and they are counted over two thousands including ladies. There are more lovers of mathematics in Japan. The wasan, a specific name for the traditional Japanese mathematics, was dominant especially in Edo period. The wasan books were written by professional mathematicians or calendar composers or private teachers, however many by amateurs. So we can compare these Japanese lovers of mathematics with English in some points. Both are almost amateurs and loved solving mathematical problems in daily life. In both countries the printing presses were flourishing to publish many mathematical books, high-leveled or very elementary. It is interesting that there were some ladies lovers of mathematics in both. However there are noticed some differences between them: in England they had already some specific journals for science, but in Japan these journals were published after the Meiji Restoration. English books include sometimes not only mathematics but also natural philosophy, gauging and astronomy, but Japanese are usually just for calculation, menstruations, and geometrical figures. The Japanese did high evaluation to the beautifulness and the completeness of geometrical figures. The Most significant among differences is the way of mathematical demonstrations. We will compare the contents of mathematics in both cultures, especially how they found their mathematical discoveries, and consider in details what made differences and similarities between them mathematically and socially.

STYLES OF PROOF IN NATURAL PHILOSOPHY: GALILEO, TARTAGLIA, BORELLI

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While Galileo is the main character in the mathematisation of the natural philosophy, this process does not begin nor ends with his work. In my paper I shall discuss three authors who played an important role in this history: Galileo of course, but also Tartaglia before and Borelli after him. This comparison might throw some light on the path leading from the classical natural philosophy to the modern physics.

DESCARTES AND THE "IMPOSSIBLE" CONSTRUCTIONS WITH RULER AND COMPASS

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The idea of the impossibility of constructions with ruler and compass for problems like trisection of angles and duplication of the cube was deeply rooted in mathematical tradition since long time, but, as far as I know, nobody had ever posed the question of *proving* this impossibility.

Descartes, in the third book of his Geometry, poses directly the problem to decide if a geometrical problem is constructible or not.

In my opinion, even if Descartes' proofs are not always rigorous (but what kind of mathematical reasoning in 17^{th} century was rigorous) there are many innovative ideas in them.

I sketch shortly some of them:

The first, fundamental, idea, is that not only to solve problems, but also to prove geometrical theorems like those related to our question, it is necessary to shift from geometry to algebra. So, it is through a subtle and deep study of the equations related to a given problem we can understand the geometrical nature of it.

Even if he doesn't say this in an explicit way, Descartes proves the impossibility to trisect angles and, moreover he shows how the Eraclitus problem gives rise to an irreducible equation of fourth degree and that it is yet perfectly constructible, as it was well known by geometers since long time.

In my talk I will make a short review of the history of the problem and will concentrate on the way that Descartes chose to prove its impossibility.

ON THE SEKI TAKAKAZU'S SUMMATION FORMULAE FOR OF POWERS OF NATURAL NUMBERS AND ITS CONSTRUCT METHOD

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The research on sums of powers of nature numbers has a long history, but a general formula for sums of powers of nature numbers was not established Before the $l7^{th}$ century. Seki Takakazu (1642?-1708) and J. Bernoulli (1654-1705) independently obtained the general formula for sums of powers of nature numbers. Seki's formula first appeared in Seki Takakazu's posthumous work tiled as Katsuyou Sanpou (the Concise Collection of Mathematical Method),published by his students in 1712. Seki gave various multipliers which are known in modern mathematics as Bernoulli numbers. The aim of this paper is to elucidate the method of reasoning underlying Seki's formulas expressing for sums of powers of nature numbers.

1 Seki's original text written by the Chinese in that time is rendered in modern mathematic language. 2 How did Seki make up his formulas and find Bernoulli numbers? Based on illustration about Seki's method for sums of powers of nature numbers in Tetsujutsu Sankei (Mathematical Treatise on the Technique Linkage) written in1722 by Takebe Katahiro (1664-1739) who was a student of Seki , and other historical, a restoration scheme of Seki's construct method by using zhaocha fa (interpolation) is proposed. 3 The relation between Seki's method and Chinese traditional mathematical method is also studied. It is the linchpin of the Seki's research on the sum of powers of nature numbers to find and erect links between duoji shu (sum of piles) and zhaocha fa (interpolation).

Symposium S18
History of Science and the New Media: Resources for Connecting the Global Community of Scholars

THE WEBSITE @.*AMPÈRE AND THE HISTORY OF ELECTRICITY*

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In this paper I would like to highlight some of the new avenues opened for research in history of science through websites such as *@.Ampère and the history of electricity.* These new possibilities concern both the reader/user of online historical documents and the web-editor of these documents.

Users can navigate through sources by using EAD (Encoded Archival Description) inventories, indexes, or simple browsing (there are about 50,000 pages in Ampere archives). If descriptive metadata of these documents have been properly stored, the documents may be easily found through OAI (Open Archive Initiative) search engines. Various web tools make possible rich, extended environments for these sources, including such things as simultaneous access to manuscripts and transcription with annotations or hyperlinks within documents of all kinds (scientific papers, manuscripts, correspondence, scientific instruments, photographs, and so forth). In the *@Ampère* website, hyperlinks point to textual and multimedia resources, bibliographical or biographical information, and give access to online books from Ampere's library inventory or those listed in his correspondence.

In addition, the historian who is editing online documents is able to launch open-ended editions, a great advantage for editors of correspondence (since new letters often continue to be discovered) as well as for editors of anthologies of texts. The transcription of manuscripts can be made available to passionate amateurs while collective critical editions are made much easier with platforms that allow collaboration. Of course, it is important to remember that online environments sometimes create specific difficulties of their own, including such things as how authorship should be understood in collaborative on-going projects and how to reference online documents.

To illustrate these points as they pertain to a web-based practice of history, I will present some of the applications (including some of the difficulties encountered) of the open source tools from the website *@. Ampere and the history of electricity*.

PHYSICS EDUCATIONAL INSTRUMENTS IN NEW MEDIA: CASE STUDY OF CAPODISTRIAN SCHOOL

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The Capodistrian (Koper) higher studies educational equipment acquired between the school times of famous violinist Giuseppe Tartini (*Colegio dei Nobili*) and the end of 19th century were photographed and adapted for the modern media web use. The work took more than a decade, and as the result web also shows the beauty of those equipment besides its usefulness. The final publication was issued in 2008. The history of physics meets the history of esthetic in web pages of Capodistrian educational equipment. The special concern was put on the Professor Vlacovich, the most important Capodistrian 19th century physics lecturer, and other important scientists, who were still able to use high school educational instruments for fundamental research.

The instruments of the Physics Cabinet of the Capodistria high school of the second half of 19th century were compared with the high schools in Ljubljana and Klagenfurt. We used yearly school journals as the source for the information about the new acquisitions of instruments. The data were similar to the yearly inventories at Capodistria and at Ljubljana. The earliest Jesuit B.F. Erberg's list of 51 educational instruments acquired for Ljubljana Jesuit high school in 1755 marks the establishment of the very first modern physics-mathematical cabinet in the area of modern Slovenia. The next full data about it is available only for the time of Napoleonic occupation (1811). Although those Ljubljana equipment are not in such an excellent shape as Capodistrian ones, several comparison are at hand.

The data about school books goes hand in hand with educational instruments study because both mutually supported each other as two poles of the same school goals. Some older books from Piarist's (Padri *Scolopi delle scuole Pie*) times are still at the library of Capodistria High School. The contents of those textbooks have a lot to say about the early interests of the Capodistian Professors and their students, but also about the educational instruments which used those books as guides.

The towns inhabited with Slovenes developed physical cabinet at Lyceums, which were in Ljubljana, Novo mesto, Klagenfurt (Celovec), and Goricia (Gorica), with some breaks also in Capodistria (Koper) and Trieste (Trst). After the March revolution (1848) they included Lyceums as seventh and eighth class of the Gymnasiums of Ljubljana, Klagenfurt (Celovec), Goricia (Gorica), Trieste (Trst), Capodistria (Koper), and Novo mesto, later also in places without Lyceum traditions.

Key Words: Capodistria (Koper), Slovenia, Vlacovich, History of Physics at New Media, History of Education.

MANAGING THE DISPERSION OF SOURCES ON SCIENCE HISTORY: NATIONAL BIBLIOGRAPHY

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National bibliography, also called a State bibliography intends disseminate information about the published output of the country. Data of national bibliography enables compilation of other bibliographical sources, based on subject or personal criteria.

In the paper main principle of national bibliographies in the world will be covered, followed by the analysis of structure. By chronological coverage national bibliography is: *current* or *retrospective,* by objective: *book titles* (Series A), *periodicals titles* (Series B), *articles in periodicals* (Series C).

The national bibliography will be presented as the supplementary source for the science history; its forte in managing the dispersion of published information will be presented. Audience will be presented with the examples of paper versions of national bibliographies, also with examples of internet addresses.

Major national bibliographies will be presented. Overview will reveal the role national bibliography in the registration of published scientific heritage of certain country. During past decade big part of national bibliographies moved to the digital environment. Information technologies enable the connection between the bibliographical information and full text documents.

Conclusions will suggest the map of the national bibliographies in the Europe and the whole world, also showing the suppositional gaps which could influence the investigation of the science history in certain countries (considering the time limits for the paper).

DIGITAL HUMANITIES IN THE UNITED KINGDOM: ADVANCING COMPUTATION METHODS IN THE DIGITAL HUMANITIES THROUGH THE ARTS-HUMANITIES.NET PROJECT: HTTP://WWW.ARTS-HUMANITIES.NET/

Dr Craig Bellamy

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This presentation will outline many of the developments within the Digital Humanities in the UK as recorded through the Arts-Humanities.net project.

The principal aim of the project is to establish a database containing detailed information on current and recent humanities projects using ICT and in particular, the computational methods and tools employed by them. It is designed to assist arts and humanities researchers build and use standards compliant digital resources and projects within the field of the digital humanities in the UK.

During the first stage of development, the projects populating the database primarily derive from successfully AHRC (Arts and Humanities Research Council) funded projects in the UK. In listing projects that have been created within a funding council context, it is hoped that the community of practitioners will grow that will discuss the issues leading to the creation and critical use of further digital humanities projects.

A particularly important way to accomplish this is through the recording of the major computational methods used within the digital humanities. This is achieved through a methods taxonomy or 'controlled vocabulary' designed to describe and record the methods used for the creation, analysis and dissemination of digital resources. Researchers are asked to choose the terms from the taxonomy that closely specify the methods employed in their project. By gathering information about methods in a controlled fashion, the methods can be communicated to other researchers who may wish to apply them in similar investigations.

In this paper I will present Arts-Humanities.net and outline its present form and planned future development. The site is being developed within a Web 2 framework so as to aid in the discovery and management of the resources that it contains and to experiment with community participation.

DIGITAL MEDIA AT CENTRO SIMÃO MATHIAS

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Centre Simão Mathias of Studies in History of Science (CESIMA), affiliated to the Postgraduate Program for Studies in History of Science at Pontifícia Universidade Católica de São Paulo (PUC-SP), Brazil, congregates researchers and postgraduate students coming from several institutions and representing different fields of knowledge in order to promote and facilitate studies in the history of science. Since its foundation in 1994, CESIMA organizes seminars, lectures and workshops besides promoting active exchange with researchers worldwide, as well as developing intensive publishing activity including Simão Mathias book series and *Circumscribere*, an open-access e-journal specialized in history of science.

In 1995, funded by FAPESP (The State of São Paulo Foundation for Promotion of Research www.fapesp.br), CESIMA opened its Division of Multimedia Documentation, which developed a method of digitalizing original documents for subsequent storage in CD-Rom. In order to be able to manipulate different formats of materials (such as microfilms, microfiches, and extremely fragile old documents), CESIMA team set a pilot project employing low-cost equipment with excellent results. This Division has expanded and today contains last-generation equipment for digitalization of original works in the history of science as well as a significant collection of microforms, currently adding up to about 25,000 titles.

Works in CESIMA collection include copies of ancient and rare books, eventually single editions, published since the beginning of Western printing as well as manuscripts. Digitalization aims to afford to researchers original sources of difficult availability. Documents were initially chosen according to their thematic affiliation with researchers and postgraduate students group and individual projects, including: Encyclopaedism; Books of Secrets /Hermetics; Materia medica and Pharmacy; Mineralogy and Metallurgy; Life Sciences; Visual Representation. Expansion led to include in CESIMA collection documents covering all periods in the history of science and a wide range of subjects, including Arabic science, early Modern science, Medicine and allied fields, Brazilian and South American science, among others.

Besides digitalization, CESIMA is currently focused on two topics. First, a discussion on the most adequate ways to make digital documents available, including: techniques for digital storage and preservation; testing of software for remote access. Second, a discussion on classification criteria that truly mirror the specificity of documents of the history of science.

WORLD HISTORY OF SCIENCE ONLINE: CITATION, STANDARDS AND WEB SERVICES

Gavan McCarthy

The University of Melbourne, Australia

The World History of Science Online (WHSO) is a multi-national, multi-institutional, multi-lingual collaborative venture aimed at bringing significant productivity and community-building gains to the history of science commons world-wide. The ideas behind the project date back two decades and pre-date the emergence of the world wide web. Much has changed since that time, and this is indeed, the major challenge facing the WHSO. In a world of continuous technological change and extension of possibilities, the challenges facing the small dedicated leadership, with its minimal financial resources, has been daunting. What has become clear is that the creation of a persistent and sustainable information framework to support the history of science, technology and medicine must be based on persistence of citation, common standards and rules of behavior, and the modularisation of local systems so that they can be interconnected by web services.

The most recent activity of the WHSO has been to use a standardized web-based information system to record information about the bibliographic and archival directory sources that are known, and to place them in an epistemically rich context. Given the diversity of practice across the globe it is impossible at this point in time to select a technology that will enable all the sources to be interconnected. This is not because the technology does not exist but because the owners and developers of each source have their own past, their own legacies and systems that were build in different technological contexts. This is both a systemic and epistemic conundrum. The challenge, first off, is to build a framework of understanding from which we can start to interconnect those sources. These interconnections will need to meet the fundamental requirements of persistent citation and the standardized presentation of the citation data for harvesting.

The National Library of Australia has been developing a services-based system that will enable data about cultural objects (bibliographic data, entity data, relationship data) to be shared in a systematic way within open networks. The use of standardized technologies, such as OAI-PMH and the Encoded Archival Context XML schema, means that rather than building hub-and-spoke systems where the functional tools only exist at the centre, we can conceive of truly open interconnectivity. This project provides a model for how the WHSO might proceed. The visions of the information-interconnected 21st Century are based on open complex network theories – systems governed by common practices and rules that are open, inclusive and support the emergence of clusters and communities. The WHSO must face the reality of the complexity of its community and the fact that it is continuously evolving. It must be prepared to acknowledge that the cataloguing paradigms and operational business models of the last Century are not adequate to meet our needs as scholars and researchers.

THE COST OF FREE ACCESS: MAKING THE ISIS BIBLIOGRAPHY AVAILABLE ON THE OPEN INTERNET

Stephen P. Weldon

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Since I was hired by the History of Science Society as bibliographer, I have sought to increase international scholarly access to the Isis bibliography, one of the History of Science Society's most popular resources. This paper will discuss a number of possible ways in which more open access was imagined and explain the rationale given for the final decision to make some of the data accessible via the free WorldCat.org system. I will discuss the complex financial picture involving the History of Science Society, the University of Chicago Press, and OCLC (the database provider), that had to be understood in attempting to make a decision about how much, if any, Isis bibliographic data should be made freely accessible. In determining an answer to this question it was necessary to consider the stability of HSS membership and library subscriptions to the print journal and to the online History of Science, Technology, and Medicine database. This experience may help to promote greater understanding of financial concerns for other internet projects.

Symposium S19
Physics and Cold War

THE NOBEL PRIZE AND THE COLD WAR

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The history of the Nobel Prize is a history of using the Prize. From the moment Alfred Nobel's testament became public in 1897, some of those who would likely have an influence on shaping its implementation saw strategic opportunities for advancing a number of goals. The subsequent history reveals a succession of uses for the prize as those persons involved with nominating and with evaluating learned to appreciate its value as a resource for disciplinary, cultural, and national-scientific agendas. The prize does not reduce to such considerations, but these prove essential to be able to make sense of many of the decisions as well as the rise and persistence of the cult of the Nobel Prize.

In my earlier study of the Nobel Prize in physics and chemistry through 1950, I showed how imperfect judgment and interests are woven into the fabric of this history, just as much as the desire to rise above the parochial and to strive toward disinterested impartiality. As with all committees, scientific outlook and intellectual skill do not operate in a vacuum. Although I am just beginning to study the period after 1950 – and recognizing that official archives are now only open through the 1950s – I would like to raise a number of questions regarding the Nobel prizes in the sciences during the early Cold War decades. Significant changes in procedures and perceptions of the Prize were already apparent during the immediate postwar period; further changes accompanied the rise of Cold War practices and culture. I will touch upon both the formal processes of nominating and evaluating in this era as well as the growth of the cult of the Nobel, especially in relation to East-West propaganda purposes and for Swedish positioning as a leading neutral power. I hope to raise questions for general discussion also on the roles of the Nobel prizes within the emergence of postwar and Cold War academic cultures in American and European universities.

THE HABER INSTITUTE IN BERLIN DURING THE COLD WAR

Dieter Hoffmann

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After World War II the Kaiser Wilhelm Society was renamed to Max Planck Society and the majority of its institutes were already moved during the war time from Berlin, the „mother town" of the society, to West Germany. Among the few, which kept in Berlin, was the famous Kaiser-Wilhelm-Institute for Physical Chemistry. Founded in 1911 by Fritz Haber it was directed during the Third Reich by Peter Adolf Thiessen and shaped to a so called „NS-Musterinstitut". Very soon after Germanys capitulation the institute was catched by the very first waves of the up-coming Cold War: Thiessen left Berlin to the Soviet Union and the physico-chemist, member of the anti-nazi Resistance and communist Robert Havemann was constituted as director by the Soviet authorities. This happened with the background that Dahlem, the place of the institute and liberated by Soviet troops first, became in summer 1945 part of the American Sector of Berlin. It started for years a conflict between Havemann and the American respectively West Berlin authorities as well as the General Administration of the new founded Max Planck Society in Göttingen. These conflicts reflect in a specific way the general Cold War in the field of science; in particular it had a strong impact of the post war history of the institute as well as for Havemann's life, since he left Dahlem in 1950 and continued his career in East Berlin.

THE SPY WHO CAME IN FROM THE LAB: A COLD WAR TALE BASED ON REAL PHYSICISTS

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This paper focuses on “atomic espionage” as historical episode regarding especially the beginning of the Cold War, and centering on the life, career and political conviction of, amongst others, illustrious physicists. For example Klaus Fuchs and Bruno Pontecorvo were portrayed as spies because of their communication of classified scientific information to Soviet Union secret agents before, during and after WW2. Pontecorvo’s defection to the USSR -in 1950- seemed to epitomize the success of the ‘Soviet spy system’ in attempting to infiltrate the Western atomic research facilities.

But was atomic espionage really a threat? And if yes, in what ways? In this paper I aim to show that the accusation of espionage was often based on sensationalist depictions of events rather than sound evidence. And that -at the same time- the portrayal of physicists as spies served a hidden agenda as evidence could be used to silence dissent in the Western physics’ community.

BETWEEN EAST AND WEST? AUSTRIAN NEUTRALITY, COLD WAR AND NUCLEAR PHYSICS

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At the end of a report about the engagement of the 2nd Physical Institute of the University of Vienna in the German “Uranverein” the authors stated, that for a continuation of large-scale experiments for the uranium machine about two tons of uranium metal, one ton of paraffin and possibly 500kg heavy water are needed (G-Report 345, p. 23. Archive of the German Museum, Museumsinsel 1, 80538 München). Considering the end of World War II and the defeat of the German Reich and its allies, from today’s perspective these claims of the Austrian physicists seem unrealistic. Indeed, more than ten years had passed until the State Contract was signed and shortly afterwards the Austrian Council of Ministers decided to build a research reactor with American support. Furthermore, it took another seven years until the research reactor of the Austrian universities finally went into operation.

This all happened in the context of Cold War, where Austria regained its sovereignty and became formally a neutral state. This context cannot be ignored. In difference to many other states Austria had also offers from the Soviet Union to build a reactor and offers from the Republic of Yugoslavia for scientific cooperation. The Austrian government took note of these offers from the East but in the context of the country’s silent integration into the Western Bloc these offers were denied and two reactors were built with support of the American “Atoms for Peace” program with strong support of the US European Recovery Program.

PHYSICS IN SPAIN UNDER FRANCO

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This paper deals with the development of physics in Spain under general Franco’s dictatorship (1939-1975). Building on the preliminary results of research in progress on the development of Physics in Spain in the 20th century, we argue that the development of the discipline in Spain was shaped by the totalitarian nature of Franco’s regime, the industrial constraints of the autarchy, and the diplomatic games played by Spanish political and scientific elites to gain American support by providing them an anti-communist stronghold in Western Europe. These factors are exemplified by three short case studies: the development of large scale research and development institutions related to nuclear energy (JEN) and aeronautics (INTA); the French government support to Spanish postgraduate students in the field of theoretical and nuclear physics; and the development of the theoretical physicists’ community in connection with Spanish membership (and withdrawal) of CERN.

WHEN LATITUDE AND/OR ALTITUDE MATTERS INTERNATIONAL COLLABORATIONS IN COLD-WAR TIME COSMIC-RAY PHYSICS

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The results obtained in the researches on cosmic rays depended from the very beginning also on the characteristics presented by the radiation itself in the different parts of the earth's atmosphere. In particular, geomagnetic latitude and altitude played an important role.

Before WWII, those groups of researchers who were taking into account these two variables, were mainly based in Europe and the U.S. For some of their researches they happened or needed to travel, as it was the case of Clay's journey to the Netherlands colony of Java, the great campaign (mainly in South America) of mapping the isocosmic curves by Compton, or the east-west measurements by Rossi in the Italian colony of Eritrea.

The necessity of making measurements at higher and higher altitudes to study new different kinds of particles, and at very low/high magnetic latitudes, increased in the '40s and '50s. The Cold War time corresponded to two partially overlapping time intervals used in the periodization of the history of cosmic-ray physics: the second particle period, and the space or astrophysical period.

Astrophysical researches needed detectors flying on rockets or satellites; they were quite obviously affected, in several cases even supported, by non-scientific aspects due to the Cold War. Latitude and altitude mattered in the researches classifiable under the second particle period. How did Cold War affect instead these researches?

The study of latitude effects favoured co-operations with geomagnetic-equatorial countries, mainly Latin American countries and India, with a working support to the establishment of new "autochthon" groups of research. The study of new particles at high altitude also favoured the establishment of local groups on high mountains such as the Chacaltaya laboratory on the Bolivian Andes, and of international collaborations such as the ICEF (International Cooperative Emulsion Flight).

Industrial secret prevented the immediate diffusion of the results obtained in the technical developments of the devices used to detect cosmic radiation. Military (both air-force and navy) assistance was requested in the flights of stacks of emulsions on balloons, a fact counterbalanced by the military interest in those aspects strictly connected with the very flying operations such as the study of high altitude wind of interest for military flights.

East-west, north-south, and centre-peripheries geopolitical relations, with their different levels of restrictions or supports, concurred to establish or prevent international co-operations and the establishment of new groups of research in cosmic-ray physics.

THE DOUBLE TRACK FOR SUPERCONDUCTIVITY DURING THE COLD WAR

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"Now that war work is coming to its conclusion, I am thinking again of good old peacetime problems, like supraconductivity " wrote Léon Brillouin to the physicist philosopher Fritz London on November 1st, 1945 in exile at Duke University. Indeed, since 1933, which is also the discovery year of the Meissner effect (perfect diamagnetism of superconductors in low magnetic field), the course of research in that domain had never been isolated from the European turmoil in spite of its total lack of applications during this period. Its Cold War regime, with the exception of murders, was not so much peaceful. To reduce it to an East-West competition between two scientific communities towards the same objective would be extremely naïve: neither the starting line not the goal were the same. Even the recognition of the Meissner effect as <u>the</u> essential feature of yje superconducting phase was not accepted by Landau before the war and again by Heisenberg after it.

The evolution of this complicated epistemological situation was going to be strongly influenced by social constraints. Because of the Nazi persecutions the USA, almost absent of the field before the war, were becoming a major partner. Kharkov, for years to come was erased from the scientific map. The dubious social prestige of physicists after Hiroshima helped raising money for pupils of Pauli to accept positions in Sydney. The programs for atomic weapons and the radar techniques offered new tools in the West (isotopes, radar components) for crucial experiments in the US and UK but prevented soviet theoreticians to be fully involved in superconductivity.

Last but not least, ideological pressures had lasting consequences. The polemic against quantum mechanics in Soviet Union boiled up to the negation of the very concept of solid state. In the US, McCarthy witch-hunt offered a major contribution when the issues of Soviet JETP in which the phenomenological theory by Ginzburg and Landau was published, were dumped overboard in the waters of the Hudson river. It will take four years for the first quotation of this paper to appear in Physical Review…. in a Sydney Group's paper. John Bardeen learned about it only five years later from the microfilm of a mediocre translation that he obtained from David Shoenberg (who had made the link between Moscow and Cambridge when Kapitza was in the USSR). Three years later the Bardeen-Cooper-Schrieffer "microscopic theory" which interprets quantitatively all the experimental data about superconducting state was thus the second "exact" theory of superconductivity. The bridging of these two approaches was made easier by a formalism developed by Bogolioubov with whom the Landau group was not in good terms according to Sakharov.

With the "détente" these extreme social tensions upon the development of superconductivity will decreased, until the 1968 soviet intervention in Prague

THE RECOMMENCEMENT OF ELECTRON MICROSCOPY AFTER WORLD WAR II IN THE TWO GERMAN STATES

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During the late 1930s and early 1940s electron microscopy was established as a new research technology in Germany. The development was fostered by a fierce competition between research groups at the two major electro technical companies, Siemens and AEG. After the end of the war members of both groups tried to recommence the development and production of electron microscopes in both parts of Germany. In this paper, I will focus on and compare the further development of electron microscopy in Germany mainly from an East German perspective with an emphasis on the Institute for Solid State Physics and Electron Microscopy of the Academy of Science in Halle. The GDR was placed between the Soviet Union and its allies on the one and the Federal Republic of Germany on the other side. GDR scientists cooperated and competed with scientists from both camps. These relationships were of course influenced by the general political climate. They provided positive as well as negative patterns for the development of arguments and strategies in dealing with government officials and therefore played a decisive role in discussions on the proper application of electron microscopy, appropriate cooperative structures, and institutional integrations, on forms of specialization and possible ways to develop a characteristic research profile.

INTERACTING FIELDS–QUANTUM FIELD THEORY AND THE CONCEPTUAL BORDERLANDS BETWEEN SOLID-STATE AND PARTICLE PHYSICS DURING THE COLD WAR

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In the 1930s and 1940s, the theory of solids entered a state of quasi-hibernation, as many physicists abandoned their work in the field. Already during the 1930s, emigration forced some to reorient themselves toward different fields of study, while others later joined war-related projects that were only rarely connected to solid-state physics. In many scientific biographies, the War triggered a permanent shift of attention toward nuclear physics and related areas. Only slowly did the field of solid-state physics regain momentum after the War, whereas other areas, such as nuclear and particle physics, blossomed.

In my talk, I will show that the relative stagnation of early postwar solid-state theory with respect to many of its fundamental problems was not only due to the challenging nature of the many-body problem, but also to external factors, such as the severely limited interaction between researchers from East and West during the early stages of the Cold War, and McCarthyism. The standstill was overcome in the mid-to-late 1950s by knowledge transfer from a different area of theoretical physics–the quantum field theory of elementary particles. The interaction with particle theory fundamentally reshaped solid-state physics and provided a firm ground for its extremely fertile development until today.

While solid-state and particle physics are usually viewed as largely disconnected fields of research who share little more than quantum mechanics as their conceptual basis, I will show that, quite to the contrary, the history of both fields is intertwined to a large extent. I will study the dynamics of interactions between the two fields and examine the topology of the conceptual borderlands between both fields of research. During the 1950s, key notions (quasiparticles, collective excitations) and methods (diagrammatic perturbation theory, charge renormalization) of modern condensed-matter theory emerged from the transfer to the nascent field of solid-state physics of quantum field theoretic methods which had their origins in particle physics. During the early 1960s, novel concepts emerging from the quantum field theory of solids (spontaneous symmetry breaking, renormalization group) were able to cross-fertilize back into the field of particle physics. Even today, interactions between condensed-matter and particle physics are not uncommon, especially at the frontier of research. I will trace the formulation and transformation of these concepts, their far-reaching heuristic and ontological consequences for both fields, and comment on the role of external factors such as the Cold War in this development.

PICTURES WITHOUT PROBLEMS: THE RECONSTITUTION OF AN INTERNATIONAL PHYSICS COMMUNITY IN THE 1950s

Elvira Scheich

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A famous representation of physics after WWII portrays it as an essential part of the world’s transformation to peace, democracy and universal humanist values. However, this hopeful picture is deeply gendered. The paper analyses the strategies used in MoMA’s photography exhibition *The Family of Man* from 1955 to set a playful and innocent masculinity at center stage. Further it will be asked, how physicists themselves contribute to this picture by concealing the tensions within the scientific community that range from the involvement with the military, disguising the collaboration with totalitarian political regimes and disappointment about the inefficacy in the efforts to change directions through democratic pacifist commitment. These unresolved contradictions bear on severe misconceptions about the relationship between physics and politics. Do the ideas concerning the outside boundaries of physics correspond to the inner re-organization of the scientific collective after its the disruption during war and forced emigration at the cost of women scientists?

Symposium S21
Questions of Reflexivity: The International Circulation of Knowledge and Techniques

TEACHING MEDICINE AND LEARNING HOW TO CURE: THE CIRCULATION OF EUROPEAN AND INDIGENOUS KNOWLEDGE IN 19th CENTURY PORTUGUESE COLONIES

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The analysis of the relationship between indigenous healing knowledge and the academic-metropolitan medicine in the colonies has led to different conceptual developments that either emphasize hybridism and mutual borrowing between the two streams of knowledge or otherwise highlight the repressive mechanisms of colonialism. Based on empirical research in the Portuguese colonial archives for India and Africa, I will analyse the institution of the military hospital and several of its elements – the layout of infirmaries, the contents of the pharmacy, and the development of in-house medical teaching – in order to argue that (1) the very existence of European-based medicine was negotiated locally at all levels, (2) the colonial devices to annihilate local medicine co-existed with the actual use of elements of local knowledge, and (3) the legal and political efforts to create boundaries between the two fields reveal the existence of a broadly shared commonality of practices.

THE CONSTITUTION OF TROPICAL MEDICINE IN 19th CENTURY BRAZIL: FROM CLIMATOLOGY TO MEDICAL PARASITOLOGY

Flavio Coelho Edler

PPGHCS - COC / Fiocruz

This work seeks to contribute to the understandig of the institucionalization process of tropical medicine in 19th century Brazil. Initially, it focuses upon a cartography of the medical science in Europe, and underlies the jurisdictional conflict generated by the emergence of Medical Geography. Since the mid-19th century, this field of knowledge consolidated a system of authority related to the tropical pathology that questioned the scientific competence of European medical centers to produce a sound knowledge regarding other regions of the world. As part of this countercurrent of ideas, the parasitology of helminths was inaugurated by the German-Portuguese parasitologist Otto Wucherer, working on this subject in Brazil since the 1860s.

This work deals with the building of this field of knowledge – basically clinic and experimental – in the Brazilian province of Bahia and in the national capital of Rio de Janeiro, culminating in its professional institutionalization in the last decade of the 19th century. The scientific debate about the helminths started a new paradigm of medical discourse in Brazil, and in many ways mirrored the conflict of ideas that shook the European medical sciences in the nineteenth century. By this time, the consolidation of alternative fields of legitimate medical knowledge was a clear trend, both in Latin America and abroad.

THE INTERNATIONAL CIRCULATION OF MEDICAL KNOWLEDGE ABOUT MALARIA

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In this paper I will explore how Portuguese doctors responded to international research on malaria and to control measures issuing from these research. I will relate these topics to political, scientific and medical agendas, during the last decades of the nineteenth century and the first decades of the twentieth, presenting international trends on malaria in the context of these agendas' intersection. Thus, I try to identify some of the agents involved in the process, their reasons, goals, drives and actions, as well as factors influencing their choices.

The international trends on malaria influenced the Portuguese doctors attempts to produce local knowledge about the disease and its control, as well as their efforts to incorporate this knowledge in national public health policies and health administration. I will argue that these attempts responded to personal and professional interests, as well as international indirect pressures. However, doctors' initiatives were hampered by political, economical and social events that postponed the institutionalisation of malaria research and control in Portugal.

THE CIRCULATION OF MEDICAL KNOWLEDGE IN MEXICO, DURING AND AFTER THE FRENCH INTERVENTION, 1860s-80s

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This paper will explore the circulation of medical and anthropological knowledge and know-how among French and Mexican scientists and institutions during the colonial setting of the 1860s (France occupied parts of Mexico from 1862-67) and the postcolonial decades that followed. Many medical practices initiated by the French during the occupation—the registration of prostitutes, the creation of a National Academy of Medicine, and physiological studies of the effects of high altitude—were continued by Mexican physicians as exemplars of a specifically Mexican medicine, attuned to local realities. These medical practices had already had transnational lives, however, since they had been filtered through decades of overseas and domestic settings. Moreover, even as they rejected French control in 1867, Mexicans once again regarded Paris as the medical capital of the world by the 1880s. Insofar as "the circulation of knowledge" implies ongoing exchanges in constantly evolving political and cultural contexts, it helps describe the implementation, adoption and modification of medical knowledge in Mexico from the French intervention through the 1880s, a process traversing colonial and independent periods, and shaped by both conquest and more pacific transatlantic interaction.

FROM RACE-CROSSING TO OVER POPULATION: SCIENTIFIC DISCOURSES ON THE POPULATION OF JAMAICA (1929-1945)

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Between 1929 and 1945 Jamaicans endured social unrest, inadequate public health and education for the lower classes, and retained a class hierarchy stemming back to slavery. The Afro-Jamaican population was in dire need of economic opportunity and social services and in 1938 the island erupted into labor strikes that paralyzed Jamaica for weeks and spread to other parts of the British West Indies. As a part of the British Empire, the British West Indies provided the metropole with sugar, coffee, bananas and other agricultural products. It became a source of international contention as outsiders pointed to the poor conditions of the lower classes as evidence of the failure of the British imperial project and civilizing mission. The study of the island's Afro-Jamaican and mixed-race population had a long history but achieved apogee in the late nineteenth and early twentieth centuries. This paper examines research produced by 'experts' in the field of demography, genetics and colonial administration. Its purpose is to assess the efforts of the international experts who examined the poor of Jamaica and to make these various scientific and administrative experts the Object of inquiry.

My research analyzes studies produced by Charles Davenport, Robert Kuczynski and the Royal Commission on the British West Indies and range from 1929 to 1945 (the release of the Royal Commission Report). It contextualizes a history of colonial research that stretched from India to Trinidad and included the urban slums of England itself. The work was pluridisciplinary and included study by anthropologists, geneticists, demographers and various social reformers. Most believed in a rationalism appropriate to the era and the power of science to ameliorate or even solve the ills of society. My research situates these studies within the larger contexts of scientific inquiry about colonized peoples and explores how these studies reflect changing understandings of biology, demography, race and social organization.

CONSTRUCTION OF MEDICAL HEGEMONY: AN EXPLORATION INTO COLONIAL ENCOUNTERS IN ANATOMICAL KNOWLEDGE IN INDIA

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Western medicine has passed through epistemological and paradigmatic shifts from Bedside Medicine to Hospital Medicine to Laboratory and Techno-Medicine. But, till the end of the 18th century or the beginning of the 19th century it was guided, in essence, theoretically by ancient humoral theory which was not essentially much different from Indian medicine with regard to disease perception. But, unlike India, European medicine underwent some indelible changes: – (1) rise of institutionalized medical education and hospital setting, (2) mandatory acquisition of anatomical knowledge, (3) rise of medical professional authority, (4) hierarchical division between physicians, surgeons and apothecaries, (5) study of post-enlightenment scientific logic and reasoning to produce both "capable enquirers" and "capable practitioners" in a pluralistic, free market of industrial society, (6) mapping of the body within three-dimensional anatomical space of the body, and construction of linear clock-time consistent with physiological swings, and, finally, (7) an altogether different paradigm of patient-physician relationship – patient-physician-service marked by clinical detachment. Anatomical and tissue pathology played a central role in this transformation. The singular act of dissection and, consequently, organ localization of disease unquestionably configured the authority of "colonial" or Hospital Medicine over Indian medical knowledge system. It reconstituted the philosophical matrix of Âyurveda through "modernization" of Âyurvedic anatomical knowledge. Post-Vesalian anatomical concepts insinuated into the interstices of classical Âyurvedic concepts reconstituting their meanings. Lived experience of the body was made to be measurable and repairable. This paper shows the metamorphosis of the "community" body in India into the individualized "medical" body and its consequences. Medicine in India was all set for a new paradigm of knowledge and knowing of the body. "Healers" were transformed into learned and equipped doctors to repair the faulty parts of the body. The person of the patient was reconstituted merely as a patient – a diseased person or, otherwise, non-person.

WORLDLY VISIONS: SCIENCE AND MODERNITY IN COLONIAL INDIA

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Do social processes reflecting scientific rationality in colonial India convey the picture of the colony as an enclosed space that was the exclusive preserve of influences out of colonial relations? Or, do the discourses and empirical processes of science mirror the impact of forces that overreached the metropolis-colony axis? This paper argues for the latter by insisting that conceptions of modernity in South Asia invoked "multiple" centers among scattered nationalities. Metropolitan and colonial frameworks ensconced spaces within which cosmopolites, economic entrepreneurs with an interest in global trade, and missionaries with belief in ethical universalism engaged in the construction of social on a world scale. This paper focuses on the social processes that illuminate the engagement of such multivalent forces with the certitudes of colonial society and knowledge. In the process it makes connections between the consolidation of empiricist attributes in nineteenth century science and the process through which the latter became constitutive of rationality and liberal humanism in the social order of South Asia.

WESTERN SCIENCE IN LATE 19th-EARLY 20th CENTURY HINDI-LANGUAGE PRINT MEDIA

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Nineteenth century marked an unprecedented spread of western science in South Asia, largely through the educational system. The process of this diffusion and its reception in the subcontinent was made complex by a preexisting body of scientific knowledge, religious implications of indigenous versus European science and the simultaneous cementing of the British colonial rule.

In order to access a window to this specific intersection of knowledge, religion and power and get a sense of the response to western science in this context the present work explores the representation of scientific ideas in Hindi-language periodicals of northern and central India. An analysis of the contents of the articles studied reveals a multifaceted reaction among the educated elite of the region at levels of epistemology, religious belief, social welfare, nationalism and ontology. The response entails neither an absolute acceptance nor an absolute rejection of the new body of knowledge. The encounter is in fact one of negotiation very much situated in the specific historical moment. The nature of the response in periodicals anticipates significant junctures in how the practice of science developed in South Asia.

SCIENTIFIC CORRESPONDENCE FOR THE GLOBAL DIFFUSION OF THEORY: THE CASE OF F. MESNIL'S LABORATORY OF TROPICAL ZOOLOGY AT THE INSTITUT PASTEUR (FIRST THIRD OF THE 20th CENTURY)

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Felix Mesnil (1868-1938) played an essential role in the global community of parasitologists. His laboratory at the Institut Pasteur appears to have been a Parisian platform of information dissemination and scientific correspondance, which had a far-reaching influence on the field of parasitology. Much of this correspondance, currently housed at the Archives of the Institut Pasteur, focused on trypanosomiasis research.

Many of the letters that Mesnil received concerned results confirmation, strains supplying, experimental information demands, bibliographical demands. Mesnil's correspondants were frequently very active and prestigious scientists from all over the world. His relationships with British parasitologists and institutions seemed especially salient. His correspondence files include letters from the official Board of Advisers of the University of London, requesting Mesnil's advice about the nomination of Edward Minchin to the Chair of Protozoology ; from Ronald Ross (Liverpool School of Tropical Medicine), Arthur Bagshawe (Royal Society, Sleeping Sickness Bureau), Andrew Balfour (Wellcome Bureau of Scientific Research), David Bruce (Mpumu, London), and Aldo Castellani (Londres, Colombo). Correspondence from other renown scientists include G. Sanarelli (Institute of Hygiene, Roma university), Paul Ehrlich (who wrote 26 letters from 1908 to 1910), Swellengrebel (Institute of Tropical Hygiene, Amsterdam) J. Rodhain (Anvers) and Prowazek (Sarajevo). His correspondence with Brazilian researchers was extensive as well. Scientists like Carini (Sao Paulo Institute Pasteur) and Oswaldo Cruz (Manginhos Rio de Janeiro) corresponded with him.

Mesnil's position in this international network reveals much about interactions between members of the parasitological community. Just as the reading of congress proceedings and journal articles, an analysis of the letters received by Mesnil allows us to appreciate the development of parasitological knowledge and politics during first several decades of the twentieth century knowledge. A deeper study of this correspondance highlights epistemological convergences and divergences between scientists. A comparative approach of the different theories and methods also enables us to tackle the problem of scientific behaviors in the construction of national identities.

Symposium S22
Learning, Producing and Using Medical Knowledge in Colonial Settings

POLITICAL CRISIS, EXILE AND THE CIRCULATION OF MEDICAL CONCEPTS: M. J. HENRIQUES DE PAIVA BETWEEN PORTUGAL AND BRAZIL (1800-1829)

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CEFET-RJ, Brazil

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When prosecuted by the Portuguese Inquisition by religious motives, the physician- pharmacist-botanist-writer Manuel Joaquim Henriques de Paiva (1752-1829) was forced to leave for good his prestigious position in Lisbon. He found exile in Brazil, at the time a Portuguese colony where political and religious repression was looser than at the mainland. In spite of his condition as a political convict, he kept his work of research and writing. Due to the political and cultural changes brought by the brief period in which the capital of the Luso-Brazilian world moved to Brazil (1808-1821), Paiva achieved the royal pardon and was able to restore his medical career in full. He became a professor at the prestigious Medical School of Bahia. The analysis of Paiva's peculiar life and scientific achievements shows that amidst the political turmoil and behind the stereotypes of backwardness there was an intense traffic of scientific concepts and medical practices between European and colonial settings at the time

LEARNING TO HEAL IN THE SANTA CASA DA MISERICÓRDIA´S HOSPITAL (RIO DE JANEIRO, FIRST HALF OF THE 19th CENTURY)

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In 1808 the Portuguese Court went to Brazil because of Napoleon´s invasion of Portugal. Therefore, many institutions had its headquarters transferred to Rio de Janeiro and others were created. Among them were the School of Anatomy, Surgery and Medicine of Rio de Janeiro and the School of Surgery of Bahia. Several of the early teachers were born in Brazil, but studied and practiced surgery in Portugal. Apart from small compendiums that were published for their students, the teachers adopted French authors in their courses. These schools of surgery were transformed into Medical-Surgical Academy in Rio de Janeiro (1813) and Salvador (1815), and after some years the academies were named Schools of Medicine (1832), offering courses in medicine, pharmacy and for midwives.

Until 1813, the practical lessons of the Rio de Janeiro´s Academy had taken place in the Military Hospital, but that year began to be taught in the hospital of the Santa Casa da Misericordia of Rio de Janeiro. Each year, the government ordered that some patients or a ward should be studied and treated by a teacher and his class. Its pharmacy was also available for the study on medicinal products. The hospital was become, in fact, a place of education - and fundamental in the process of transformation of the therapeutic exercise.

The School provided an increasing number of surgeons and doctors available, and with the intention of working in the hospital for obtaining more experience. Although it was far from resolving the situation, the ratio of doctor/hospital patients was improving, which could mean better care and less time in hospital, reducing expenses. However, these changes did not occured without conflict, often related to the way of view about the hospital´s role and the functions that each group should play in that establishment. Besides the internal hierarchy, the conflicts were permeated by the social position and involved patients, doctors, teachers, students and administration of the brotherhood and employees in general.

In this communication we intend to analyze the relationship among the groups that worked in the Misericórdia´s hospital in Rio de Janeiro, for which the hospital had different functions during the first half of the 19th century. This paper try to pay attention to the different conceptions of disease and cure that circulated in that area. For this, we analyzed primary sources like Santa Casa´s records and official correspondence, in addition to the literature on the subject.

MEDICAL KNOWLEDGE APPLIED TO THE EDUCATION: THE MUTUAL TEACHING IN NINETEENTH CENTURY

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Imported from England, the method of "mutual teaching" was successful in the Brazilian classrooms during the nineteenth century. Developed in England, separately, by the Anglican doctor A. Bell (1753-1832) and the quacker J. Lancaster (1778-1838), that demanded, each one of them, the primacy in the application of their beginnings, it was a method for the education in an industrial society, that it incorporated the recent ideas of the medicine, as the higienism, for instance. Being taken into account some medical prescriptions, the teacher should worry about the posture to sit down, the way to hold the feather to write, etc.

In Brazil, the oldest reference to the application of the method of the mutual teaching is dated from 1817, when the government of King John VI requested to *Societé pour l'Instruction élementaire* a teacher to introduce the method in Brazil. The method was implemented officially at the public schools only in 1822, after the Independence of Brazil, when the War Business Bureau created an elementary school inside the Army Arsenal in Rio de Janeiro. The Brazilian government recognized the importance of the method of Lancaster when turned obligatory its implementation in every populous place (Law of Primary Instruction of the Empire, October 15, 1827, 4th article).

The historiography registers that the conservatives from Rio de Janeiro specially preferred that method, exactly by its notion of hygiene, hierarchy and order, that was convenient to their political objectives as the maintenance of the public order and preservation of a hierarchy feeling in the society.

In this paper, we intend to present the relationship between medicine and education, during the period in which the Portuguese court was in Brazil, and the application of those ideas along the nineteenth century, more precisely in the imperial period of the history of Brazil.

BRAZIL AND TROPICAL MEDICINE FROM THE 1880s TO THE GREAT WAR

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The greatest public health challenge in Brazil between the mid nineteenth and mid twentieth centuries was yellow fever. It was because of this challenge that Pasteurian medicine reached Brazil. A number of physicians "converted" to the germ theory, discovered microorganisms, serums and vaccines that had a great impact at the time and greatly influenced the discussions and practices concerning how to tackle the disease. The clarification of how malaria was transmitted in the 1890s, the proof of Finlay's discovery in Cuba and the delegations from the Liverpool School of Tropical Medicine to northern Brazil caused a shake-up in the way yellow fever was handled. Public health in Brazil was effectively taken over by a new generation of physicians who were skilled in microbiology.

Yellow fever was the main catalyst in the institutionalization of Pasteurian medicine in Brazil, and Instituto Oswaldo Cruz provided the backbone for the country's experimental medicine between the 1910s and 1930s. The Institute pushed back frontiers in three important directions: the manufacture of biological products, research and education – just as was the case at Institut Pasteur in Paris. Human, animal and, to a lesser extent, plant diseases formed the bond between the institution and a wide variety of customers and research communities. And the pushing back of frontiers was not only scientific, but also geopolitical, in much the same way that institutes from Europe operated in Africa and Asia. Scientists would set off from the coastal cities for the heart of Brazil's semi-arid *sertão* to study and fight disease, especially malaria. As they put their expertise at the service of railroads, hydropower, farming and logging projects, they had the chance to study unfamiliar or unknown pathologies and collect biological material, which greatly enriched the institute's collections and the horizons of tropical medicine in Brazil.

So began the golden age of medical entomology. If, previously, anthrax, followed by cholera and typhoid fever, had served as models for the microbe hunters, it was now physicians dedicated to clinical medicine and bacteriology, zoologists who had studied other groups of animals, vets, botanists and even laypersons enticed by the study of nature who contributed to and competed in the quest for the winged transmitters of diseases akin to malaria and yellow fever, completely transforming the nature of the web of actors involved in such activities. One of the biggest obstacles they faced was a general dearth of knowledge on this area. In the nineteenth century, just 42 species of culicid had been described. In the first decade of the twentieth century alone, over two hundred were discovered, mostly by Englishman Frederick Vincent Theobald, American Daniel William Coquillett and Brazilian Adolpho Lutz.

One of the areas that received most attention in the early days at Instituto Oswaldo Cruz was entomology, headed by Arthur Neiva and Carlos Chagas, among others, who devoted themselves to the study of malaria transmitters. There is as yet a limited historiography that discusses concomitantly the work of Brazilians, French, English and Germans, taking a synchronic perspective. Existing studies would indicate that until the outbreak of the First World War, Brazil's biomedical institutions had a special relationship with three European countries: France in the realm of microbiology, serums and vaccine therapy, Germany in the field of protozoology and chemotherapy, and England in entomological research. What I intend to do here is to build up a synchronic and diachronic picture of the relationships established in the area of tropical medicine from a Brazilian viewpoint.

FOLK HYDROTHERAPY AND THE SCIENCE OF MEDICAL HYDROLOGY IN BRAZIL AND PORTUGAL

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Mineral waters have been used for healing purposes for centuries by a wide variety of peoples. Folk notions like those of "holy waters", "miraculous waters", along with the concepts like "gift of nature", or "liquid medicine", developed as ways to refer to those practices. That sort of knowledge co-existed and prevailed during the development of a scientific-based "knowledge of waters". The new field of medical hydrology and its efforts to describe their chemistry – and establish a relationship between chemistry and therapy — developed against, as well as along, the folk knowledge and practices regarding mineral waters. The tension remains up to our days in the field of hydrotherapy.

Using the medical journals of the Royal Academy of Medicine of Rio de Janeiro and the Journal of Medical Sciences of Lisbon, plus medical dissertations presented in Portuguese and Brazilian universities in the nineteenth and twentieth centuries, we will analyse in this paper the ways in which the field medical hydrology established itself as authoritative knowledge and the basis to discipline and regulate the uses of mineral waters for healing. We will also analyse the different processes of medicalization of spas that emerged from those attempts.

PHARMACIES, INDUSTRIES AND OVERSEAS: CINCHONA AND QUININE (18^{th}-20^{th} CENTURIES)

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This paper will (1) briefly outline the history of the uses of cinchona in mainland Portugal and (2) address the industrial investment on cinchona plantations in Portuguese colonies in Africa and the development of a quinine industry. In section (1) we will overview (a) the production of medicines in the pharmacy of the Hospital of the University of Coimbra (18th and 19^{th} centuries), (b) the controversy between scholars from Coimbra and Lisbon (1810-1812) regarding the isolation of the cinchonine of Bernardino António Gomes – who isolated a product (the cinchonino) that was the first alkaloid extracted from the cinchona and eventually, the first discovery of quinine; (c) some of the major works on cinchona in Portugal (18th-20th centuries), including those of Francisco Tavares, Júlio Augusto Henriques, Joaquim dos Santos e Silva, José Cardoso do Vale, Aloísio Fernandes Costa. In section (2), we will discuss the industrial investment in cinchona plantation in the portuguese colonies (S. Tomé, Cabo Verde, etc.) and of the implantation of a quinine extraction industry in Portugal and its relationship with colonial issues. Just as in other European countries, cinchona was a drug of great importance in medical therapeutics. In addition, it was object of extensive and intensive botanical and chemical studies and of commercial and industrial investments. The success attained with the isolation of quinine and the preparation of medicine based on quinine salts was decisive to increase the investment in the cinchona plantation for the industrial exploration of. In the course of the second half of the 19th century studies were done on cinchona and quinine.

BABEL OF RACES: CLASSIFICATION AND ANTHROPOLOGY IN 'PORTUGUESE TIMOR'

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This paper explores how problems of race classification interacted with anthropological science and colonial claims to power over specific geographic spaces and human populations. By focusing on the case of East Timor, the paper looks in particular at the significance of scientific classificatory practices in the Portuguese empire. Throughout the nineteenth and twentieth century, the ethnogenealogy of the East Timorese constituted a problem of difficult taxonomic solution for European scholars. 'The Timorese' configured a continuum of fuzzy boundaries, resistant to neat and straightforward orderings. As much as they could resemble 'Malays', they could well be classed as 'Papuans', or maybe Polynesians, or perhaps Negritos… Timor's disordering heterogeneity seemed to defy racial anthropology at the core of its syntax, challenging the language of the taxonomic project.

In this context, colonial anthropologists in Portugal struggled to provide the populations of 'Portuguese Timor' with a neatly defined racial category. By the early twentieth century, however, some were convinced they had found the solution. This paper examines the solutions proposed in relation both to the broader context of ethnological debates in Europe, and the political project of East Timor as a clearly bordered territory under Portuguese rule.

FROM HOSPITALS TO BUSH CLINICS: THE POLITICIZATION OF HEALTH CARE IN PORTUGAL'S AFRICAN COLONIES

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The establishment of a colonial administration in Portugal's continental African colonies (Angola, Mozambique and Guinea) after conquest between 1910-1915, brought the population at large into contact for the first time with 'European' health services. However, far from providing health care, the latter became a bone of contention between the different constituent parts of the colonial administration, dogged by competition for scarce resources and personal rivalries. At the same time, both colonial civil servants and health personnel circulated throughout the 'empire' bringing their bureaucratic habitus and professional knowledge and experience with them. The chronic lack of resources, the attempt to capture tax-payers and political ideology motivated the implementation of 'free' health care facilities for African populations in rural areas with low operating costs and minimal human inputs. Thus new concepts and cures were slow to reach patients but for countrywide vaccination campaigns. As a result, the attempt to import village clinics, despite an auspicious beginning and being hailed as a new panacea based upon a 'clean copy' of indigenous life initially failed. After WWII these basic infrastructures appeared to benefit from development plans and scientific expertise, only to become the site for renewed confrontation with stark colonial realities and ambivalent policies.

ROLLING BONES OR PROBABILISTIC SOFTWARES: DETERMINISTIC CHAOS IN MOZAMBICAN HEALING AND IN RISK ANALYSES

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Coexisting with colonial administration under an ambiguous situation, the Mozambican divination and healing practices are usually seen as activities based on deterministic principles and worldviews. This paper argues that, in fact, they are not. Their logic ratter follows the principles of deterministic chaos, according to which their outputs are uncertain, due to the complexity, mutability and agency of the social factors involved: the 'accurate' conclusions of a divination session are not the future, but the present and mutable conditions for the future events, and the 'correct' treatment doesn't automatically implies the cure, because this one depends also from social negotiations. For that reason, although their clients usually expect them to control the uncertainty, it is an ethical duty of the diviner-healers to clarify the practical limitations of their knowledge, while guideline for the action over reality.

The nature of such limitations is, in fact (like the paper will demonstrate), similar to the limitations faced by the management of hyper-complex technological systems, or by the probabilistic risk analysis. However, such activities allow or stimulate a public image which presents them as if they were deterministic and would have an effective control over uncertainty – with negative cognitive, political and safety effects.

The paper states that this situation is both dangerous and irrational. It suggests that risk experts and technology managers should learn from the humble epistemological position of the arrogant Mozambican diviners – and share it.

Symposium S23
A Change in Empires: European and North American Influences in Latin America's Scientific World in the Nineteenth and Twentieth Centuries

NATION, NATURE, AND NATURALISTS: EXPLORING U.S.-COLOMBIA SCIENTIFIC RELATIONS IN THE EARLY TWENTIETH CENTURY

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Few people realize that museums of natural history in the United States hold hundreds of thousands of birds in their collections. Understanding how these collections were formed reveals an amazingly rich story of imperialism, international scientific relations, and power structures throughout the nineteenth and twentieth centuries. United States-Colombia relations have had a special role in this story. Colombian birds first came to the attention of North American natural historians at the turn of the twentieth century. At the time it became very fashionable to use exotic feathers and even small birds to decorate hats for women. With the help of native collectors, traders shipped hundreds of thousands of birds from Bogotá to New York. These bird skins ended up adorning not only women's heads but also museum collections. Between the 1920s and 1940s, the millinery trade stopped completely but through expeditions as well as the invaluable help of the Colombian scientific community, thousands of skins continued to be shipped and extracted from the country to natural history museums in the U.S. These birds became cherished by North American and Colombian ornithologists who constructed Colombia as the nation with the most number of bird species in the world.

This paper recreates this story in dialogue with recent literature on U.S. cultural imperialism and the history of science in imperial contexts. Research on the connections between imperialism and science has largely focused on the interactions between European countries and their colonies in Latin America, Africa or Asia. The United States has been largely absent from such scholarship. This paper argues that science is an important historical variable to understand the expansion that North Americans successfully carried out south of the Rio Grande in the twentieth century.

However, the paper also argues that Colombians were no mere puppets of North American interests. Taking into account recent literature on Latin America's cultural politics of the 1930s and 1940s, I study the rise of scientific communities in the country as part of a strong nationalistic context when many Latin Americans began to see nature as a national treasure. The study of birds became as important as preserving the indigenous past or the popular folklore in defining what it meant to be Colombian. This relation between imperialism and nationalism, as well the different meanings that North Americans and Colombians attached to birds proves important to understand not only how science supported U.S. expansionist interests over Latin America, but also the different levels involved in the study of U.S.-Latin America relations.

THE REBUILDING OF GERMAN INFLUENCE IN LATIN AMERICA THROUGH MEDICAL SCIENCE BETWEEN THE WORLD WARS

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After the First World War (1914-18), Germany initiated a medical-scientific movement towards Latin America with the purpose of restoring the cultural, scientific, and economic positions it held earlier in the region and which were interrupted during the war. In order to compensate for the loss of its colonies in Africa, special attention was driven to the study of tropical diseases common to the New World , in much the same way the USA were doing at the time, mainly through the Rockefeller Foundation. The Institute for Maritime and Tropical Diseases in Hamburg and the Medical Faculty of the University of Hamburg played crucial roles in building bridges with counterpart institutions in Latin America. As a consequence, Ibero-American medical associations emerged in some German cities, and a scientific journal was created in Spanish and Portuguese languages, the *Revista Médica de Hamburgo*, which first appeared in 1920 and was renamed eight years later as *Revista Médica Germano Ibero-Americana*. This journal divulged clinical and therapeutic practices and scientific breakthroughs developed and accomplished by German and Latin American physicians. Friedrich Fülleborn, Peter Mühlens and Bernhard Nocht, all important names at the Institute for Tropical

Diseases in Hamburg, were active in such engagement. Their expeditions to Central and South America in the early 1920s were not just study trips, but had also political and cultural aims. Local doctors were invited to visit German institutions and give lectures and courses on their specializations, and students were encouraged to take courses at German institutions. Among the Latin American countries that received key attention from the Germans were Argentina and Brazil. A number of Brazilian physicians and scientists got involved in the scientific network created by Germany, as did top names from Argentina, who worked in cooperation with researchers of the Hamburg Institute for combating parasitic diseases in that country. In the context of the creation of the *Revista Médica de Hamburgo* in 1920 and the beginning of the Second World War in 1939, the present study intends to review the development of scientific relationships between German and Latin-American researchers – investigating the flow of ideas, institutional models and common research agendas - and how such interaction was fundamental for expanding German cultural and scientific influence in South America, especially in Argentina and Brazil, which were countries traditionally opened to German culture.

THE ROCKEFELLER FOUNDATION AND THE INTRODUCTION OF GENETICS IN MEXICO

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The emergence and development of Genetics in Mexico have traits similar to the development of this science in the United States, but it acquired specific features due to the Civil War of 1910. Agricultural research was an area that could significantly contribute towards an urgently needed agricultural recovery. Previous revolutionary governments had expressed interest in this recovery, but it was not until the late 1930s that plant breeders became aware of Mendelism, understood as a practical tool, and used it as a means to transform the art of plant breeding into a scientific enterprise, with the improvement of seeds like maize, sesame, potato, and wheat. Among the most important researchers were agronomists Edmundo Taboada and his collaborators, who focused on solving the technical and economical problems faced by small farmers: share-croppers, peasants, and indigenous communities. In the 1940s, conflicts in post-revolutionary governments resulted in two separate research programs, one led by Taboada, and the other by the Rockefeller Foundation of the United States. This last one led to the "green revolution" in Mexico.

"BUILDING BRAZILIAN BRIDGES: GLEB WATAGHIN AND PHYSICS AT THE UNIVERSITY OF SAO PAULO"

Shawn Mullet

Harvard University, United States

This paper examines the efforts of Gleb Wataghin from 1934 to 1949 to develop the nascent physics program at the University of São Paulo (USP) and connect it to the larger physics community around the world. In accepting a position at the new formed university Wataghin faced a monumental challenge. Born in the Ukraine and arriving in Brazil by way of Italy, Wataghin was principally charged with the task of creating, effectively out of nothing, a program in physics in a country which was far outside the traditional loci of research in the discipline and did not enjoy a reputation which seemed likely to attract other physicists from Europe or North America. The focus here is on one of the primary ways in which Wataghin sought to improve physics at his new university, international exchange. Building on the network of contacts he established prior to arriving in Brazil, Wataghin offered extensive assistance to young and promising Brazilian physicists, such as Cesar Lattes, Jayme Tiomno, and Mario Schenberg, in their efforts to receive advanced training abroad. Wataghin efforts on behalf Brazilian exchange also worked in the opposite direction as he sought to make the country a desirable destination for foreign researchers particularly in the field of cosmic ray research. In promoting this two way flow of scientists Wataghin did more for physics in that country than any other individual and is rightfully considered to be the father of Brazilian physics.

CONTINENTAL BRIDGES: GLOBALIZATION OF GEOLOGICAL CULTURES FROM A SOUTH AMERICAN PERSPECTIVE AT THE TURN OF THE 20th CENTURY

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This paper deals with how Hermann von Ihering (1850-1930) – the German naturalist, Brazilian by naturalization, who directed the Museu Paulista in São Paulo between 1894 and 1916 –, built his global theories on continental bridges. Based on his voluminous collections of shells, his international cooperation networks, his participation in scientific controversies, his insertion in the discussion about the origins and mapping of continents and oceans, Herman von Ihering attempted a globalizing narrative about Earth's history by means of a paleogeographical reconstruction of modern South American, African and Australian continents.

Between 1890 and 1927, date of publication of his last book, Herman von Ihering dedicated himself to the history and formation of the South American continent. Integrating the mainstream current that took position along Eduard Suess and Emile Haug, Hermann von Ihering directly confronted Wallace's biogeography as one of the central obstacles to the interpretation of the geological history of the Southern hemisphere. These debates, intended to synthetize globalizing knowledge about the Earth, that were taking place in the transition to the 20th century deserve special attention in the realm of scientific cultures. George Sarton published, in 1919, in ISIS a paper "Synthèse Géologique de 1775 a 1918", dedicated to the work of Eduard Suess, where he outlined the importance of geological maps, of national and international organization to such endeavour.

To problematize the discussion advanced by Sarton, this paper presents aspects of the construction of Herman von Ihering's *oeuvre* in the period he acted as a director of a museum in the south of America. It correlates the operations and negotiations involved in the publication and circulation of his scientific articles, the controversies with his opponents, the conquest of scientific status in relation to his collaborators. It discusses how Hermann von Ihering would use his correspondence – especially the exchanges with the Argentine paleontologist Florentino Ameghino–, his position of editor and manager of Revista do Museu Paulista, his prolific international production, his affiliation to several European Scientific Societies and his wide network of scientific sociability in South America, as strategies in search of an international scientific reputation.

Symposium S24
Global Visions? The Telescope between Competition and Collaboration

INTRODUCTION: THE TELESCOPE BETWEEN COMPETITION AND COLLABORATION

Sven Dupré

Ghent University, Belgium

In 1609 Galileo began the telescopic observations which would result in the publication of *Sidereus Nuncius*. The 400th anniversary of this event is an excellent occasion to devote a session to this instrument that changed the way we see and think about the universe. However, from the very beginnings of the astronomical use of the telescope, this instrument also questioned the ways in which astronomical research was organized. On the one hand, telescopic observations demanded collaboration. The instrument urged the use and adaptation of existing networks, such as that of the Republic of Letters, the creation of new networks to allow for the circulation of telescopes, skilled instrument-makers and observers and the telescopic observations themselves, or the establishment of institutions, such as observatories, in which instruments, persons and observations could be gathered in one place. On the other hand, astronomical observations with the telescope were from the beginning caught in a spirit of competition – a race to have the best instrument and to establish priority and monopolies in celestial discoveries by creating obstacles to the circulation of instruments, skills and observations – which appears antithetical to the demands of collaboration. This session welcomes papers in which, across the four hundred years of history of the telescope, this tension between competition and collaboration around this instrument is discussed by looking at the interaction between ideas of internationalism and nationalism, the transfer of telescopes and instrumental skills, and the establishment of observatories or the creation of networks.The main text should be single-space, in 12 pt Times Roman. New paragraphs should be indented by four spaces, except for the first paragraph in this abstract.

GALILEO’S SHOPPING LIST: AN OVERLOOKED DOCUMENT ABOUT EARLY TELESCOPE MAKING

Giorgio Strano

Istituto e Museo di Storia della Scienza di Firenze, Italy

In December 1609, Galileo improved the Dutch spyglass up to a magnification of more than 30 times. In the “Starry Messenger” and in Galileo’s regular correspondence there is no information on the making of this telescope. However, possibly by the end of November 1609, Galileo had received a letter from Ottavio Brenzoni dated November 23. The letter is not important for the content: a mere attestation of respect. Perhaps for this reason, on the occasion of a planned trip from Padua to Venice, Galileo took the letter and used the unwritten part of it near his own address to jot down a list of items to look for while in Venice. Such a list - just transcribed in a foot note in Antonio Favaro’s National Edition of Galileo’s works - contains adhesives and abrasives, as well as some basic instruments to grind and polishing lenses. It also contains the rough materials to produce lenses and, finally, the moulds to be used to create the concave or convex surfaces of the lenses. An attentive analysis of the document reveals its great significance for the construction of Galileo’s best telescope.

JOHANN WIESEL ´S TELESCOPES AND HIS CLIENTELE

Inge Keil

Germany

We know only a few names of telescopemakers from the first years after 1608. Johann Wiesel opened his workshop in the Free Imperial City of Augsburg in Germany in 1621. Product- and pricelists are known from 1625. In about 1630 Wiesel sold telescopes to German dukes and to king Gustav Adolf II of Sweden. They used them above all in the battles of the Thirty Years War, which had begun in 1618 and which brought a lot of misery to the citizens of Augsburg. Together with the Capuchin Monk Anton Maria Schyrl de Rheita Wiesel developed the compound eyepiece in 1643/44. His terrestrial telescopes with four or more lenses showed a great field of view and reduced the colour aberration. After the war he sold them all over Europe not only to princes but also to scientists like Riccioli, Huygens and Hevelius and to the Royal Observatory in Copenhagen. When Wiesel died in March 1662, his compound eyepiece was adopted in England by Richard Reeves who had worked as an optician since about 1640 and in Italy by Eustachio Divini who had sold optical instruments since 1646.

ASTRONOMICAL SITES IN THE DUTCH REPUBLIC, OR THE CHANGING USE OF THE (ASTRONOMICAL) TELESCOPE IN INSTITUTIONAL AND PRIVATE SETTINGS DURING THE 17th AND 18th CENTURIES

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The oldest astronomical observatories in the Northern Netherlands were founded in 1633 (Leiden University) and 1642 (Utrecht University), respectively. Surprisingly, the telescope, which in 1608 was presented in the Netherlands as an instrument which, among others, could make visible 'even the stars which ordinarily are invisible to our sight and our eyes', was at first hardly used on these observatories. Only from the second half of the 17th century onwards, when the telescopic concept had been improved by De Rheita and others, this instrument was introduced on Dutch astronomical facilities as a device useful for performing observations of the heavens.

In our presentation, we will reveal what the archives have learned us about the use and role of the telescope in various institutional and private settings in the Dutch Republic during the 17th and 18th centuries. How were the telescopes used, in which configurations, on which sites, with what kind of purposes? Who ordered the instruments to be installed, and do we know who made them?

In our presentation we will highlight the diverse roles of the telescope in the period under consideration, as a gadget for amazement, a device for contemplation and a machine for astronomical discovery.

THE ART OF POLISHING: PRACTICE AND PROSE IN 18th-CENTURY ENGLAND

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'This Art of polishing will be better learn'd by repeated Practice than by my Description.' In his 'Opticks' of 1704 Newton described his method for polishing telescope mirrors by hand, while admitting that it was not a skill that could readily be captured in words. The working of metal mirrors was often described and attempted through the 18th century, among senior mathematicians and astronomers and as well as instrument makers, culminating in the very individual skills of practitioners such as James Short and William Herschel and their success respectively as a commercial maker and an observer. This paper examines the role of hand polishing in astronomical practice in 18th-century England and the relationship between tacit skill and its codification as text.

NETWORKS OF TELESCOPE MAKERS AND THE EVOLUTION OF SKILL: THE EVIDENCE FROM OBSERVATORY AND MUSEUM COLLECTIONS

Gloria C. Clifton, Ph.D

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Published records of telescope observations give a partial picture of the evolution of telescope-making skill and its role in the development of astronomy. The examination of Observatory and Museum Collections, both instruments and manuscripts, can provide much additional evidence about the interaction between makers and users, networks of makers and other craftsmen, and the links between masters and apprentices, to provide a much fuller picture of the evolution of a new craft and a new discipline.

A further question is whether the problems involved in improving the accuracy and resolution of telescopes were solved by collaboration, competition between makers, or some mixture of the two. This paper will attempt to address these questions using the instruments and records connected with the Royal Observatory, Greenwich, in London.

ASTRONOMY IN THE FIELD: MASON, DIXON AND THE GREENWICH OBSERVATORY, 1763 - 1768

Nicky Reeves

University of Cambridge, UK

The Englishmen Charles Mason and Jeremiah Dixon surveyed a political boundary in colonial America between 1763 and 1768, an unprecedentedly large scale and expensive endeavour using the most advanced British astronomical and surveying instruments available. Mason and Dixon were furthermore directed, as a supplement to their boundary survey, to measure a degree of latitude in modern day Delaware. This direction came from the Royal Society of London and Nevil Maskelyne, Astronomer Royal from January 1765.

Novel techniques and novel instruments were employed by Mason and Dixon. These crucial techniques, using instruments manufactured largely by the instrument maker John Bird, were being developed at exactly the same time for use in meridian observations at the Greenwich Observatory. In this paper I will characterise Mason and Dixon's astronomical observations in the field as a dramatic test of the ingenuity and skill of Maskelyne as manager of an observational regime at Greenwich, and a dramatic test of the ingenuity and skill of Maskelyne's collaborator, John Bird. I will attend closely to one key instrument, the zenith sector, which was extensively trialled by Mason and Dixon: its success in America led to it being adopted as a crucial instrument at Greenwich.

By linking Mason and Dixon's field science to observations at the Greenwich Observatory, I will furthermore make connections between the American field and the field of the Greenwich Observatory. Rather than contrasting on the one hand the Greenwich Observatory as a reliably fixed and stable place, and on the other hand the American field as an uncertain and unstable place, I will emphasise similarities between the two 'fields'. Greenwich was being constructed as a fixed and stable reference point by Maskelyne at this time. Greenwich's stability had to be argued for: walls subsided, and instruments were distorted by their own weight. Greenwich's later success as a fixed reference point should not obscure the fact that it was a fragile and remote site in the 1760s. Hence I will discuss the need to reconsider notions of a contrast between periphery and centre, or a contrast between field and centre of calculation.

DOLLOND OR FRAUNHOFER: INSTRUMENTS AND PRACTICES FOR EARLY NINETEENTH CENTURY STAR CHART OBSERVATIONS

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The nineteenth century can be described as the age of the great star chart surveys. Choosing the right telescope for the right task was crucial for observers who wanted to contribute to these surveys. Whereas the positions of reference stars were normally determined with high precision instruments by established observatories, every-day practice could differ significantly for the majority of the contributors. This paper tries to illuminate some of the observation procedures and instruments employed by early nineteenth century star chart observers. Based on my reconstruction of these instruments and observations I will analyse the choices local observers faced, both with regard to their observational practice and to the telescopes they used.

THE LIMITS OF THE UNIVERSE AND THE LIMITS OF THE TELESCOPE: A CONTROVERSY ON STELLAR DISTANCES IN THE NINETEENTH CENTURY

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University of Oxford and Centre for the History of Science of the University of Lisbon

The effective measurement of stellar parallax remained above the technical possibilities of astronomical instruments until the nineteenth century. Values presented in 1838-39 by Friederich Bessel (1784-1846), Wilhelm Struve (1793-1864) and Thomas Henderson (1798-1844) are cited as the first reliable results for the determination of stellar distances. However, the technical consistence of the underlying measurements was not consensual among the astronomical community of the time.

In 1847, Wilhelm Struve, director of the Observatory of Pulkovo, was involved in a controversy with Herve Faye (1814-1902) of the Observatory of Paris, on the measurement of the parallax of a star in the Great Bear. The controversy developed throughout the following years, involving measurements carried out in Paris, Pulkovo and Konigsberg, and involving different methods and instruments, namely the heliometer, the transit circle and the equatorial refractor. By 1850 a consensual result had still not been ascertained. The contenders agreed to support an extended observational programme to be carried out in Lisbon, which was favourably located for the purpose. Struve and Faye aimed to solve the controversy and redetermine established parallaxes to define solid grounds for the dimensions of the stellar system. The project ultimately resulted in the foundation of the Observatory of Lisbon, but its original goals and expectations remained unfulfilled.

This case reveals a re-contextualisation of the telescope with regard to the measurement of stellar distances. Initially framed by the individual pursuit of scientific prowess at local institutional settings, it became a mobile tool in an extended network of observers compelled to cooperate in order to overcome the inherent difficulties of this kind of measurement and to gather a substantial amount of data.

TOPOGRAPHY AS INSTRUMENT: HIGH-ALTITUDE TELESCOPE OBSERVATIONS AND THE ROCKY MOUNTAIN ECLIPSE OF 1878

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The total solar eclipse of 1878, which occurred over the Rocky Mountains, was an important event in the development of high altitude astronomy. The United States Naval Observatory was considering establishing observatories in the western US, believing that dry air and greater elevation would provide better observing conditions than the humid, lower regions of the east coast. Of course, such expansion would require convincing Congress to fund it. The 1878 eclipse offered the perfect opportunity to make the case.

This is a discussion about scientific fieldwork, and the way in which scientific instruments (in this case, telescopes) were demonstrated—scientifically and culturally—to have been enhanced by their placement in the field. The location of a telescope modifies its capabilities, and thus landscape becomes—if only temporarily—part of the instrument. During the 1878 eclipse, Rocky Mountain observing sites in thin, pure atmosphere became as much a part of instrumentation as the ‘brass and glass’ components of the telescopes that observers brought with them. So too in the public imagination: “We don’t know a great deal about eclipses; but should suppose there would be special advantages in observing them from high altitudes," reported one Denver newspaper, concluding that in mountainous Colorado “each rival astronomer can have a peak to himself.”

In this presentation I will show that placing telescopes at high altitudes for the 1878 eclipse did not automatically guarantee “better” results than lower altitude observations, but instead that the results obtained by different parties first had to undergo a process of interpretation and negotiation (over technique and equipment) before being accepted as “better.“ Only after this collaborative analysis was complete did the advantages of high altitude observation become generally accepted (professionally and popularly) as providing “better” astronomical observations, thereby establishing the advantages of high-altitude astronomy.

THE SMITHSONIAN INSTITUTION'S CONTRIBUTION TO GLOBAL NETWORKING IN ASTRONOMY

Teasel Muir-Harmony (MIT) and David DeVorkin (Smithsonian)

USA

George Ellery Hale created the International Union for Cooperation in Solar Research in 1904 to establish a worldwide program of monitoring ever-changing solar activity and a forum for "the encouragement of individual initiative." [Hale, "Co-operation in Solar Research," ApJ 1904, 310] Hale knew all too well that to make his scheme acceptable, he had to relieve fears that he was trying to create yet another "central bureau" that could exercise strict control over globally dispersed networks of observers. Among the observatories committed to Hale's vision, none became more dedicated to the network concept than the Astrophysical Observatory of the Smithsonian Institution in Washington, D.C., headed by Samuel Pierpont Langley and soon by his assistant Charles Greeley Abbot. Between 1900 and 1940 Abbot built a worldwide series of observing stations to monitor solar activity, but also supplied standardized instrumentation to scores of observatories to spread the Smithsonian's program and its technical expertise to any country desiring it.

After World War II, the program was intact but had fallen into a routine that was looked upon with disfavor by central Smithsonian officials, who searched for a means to realign its solar program with the postwar ascendancy of the modern research university. Finding a willing host in the Harvard College Observatory, the Smithsonian closed its Washington facility and relocated in name and funding line to Cambridge, under the direction of the astronomer Fred L. Whipple, a senior Harvard staff member with broad interests in meteoritic astronomy, aeronomy, geodesy and comet studies infused with the dream of spaceflight. Whipple and Harvard assured the Smithsonian that it would continue its tradition of solar studies, but soon dropped the remnants of the far flung network, exchanging it for another form of cooperative activity to extend Whipple's growing network of meteor cameras to track the motions of artificial satellites that he firmly believed would be flying by the end of the 1950s. From this came two vast international programs: the volunteer-based visual Project Moonwatch, and a photographic network of super-fast wide-field Baker-Nunn Schmidt cameras.

Both the Abbot and Whipple's programs were well-funded and highly visible symbols of scientific cooperation and collaboration, and both fostered world-wide communities of workers and helped to diffuse new astronomical technologies far and wide. But both engaged in "central bureau" practices, those Hale claimed he wished to avoid. Here we will explore aspects of both Smithsonian programs and will ask why they deviated, and in fact had to deviate, from Hale's vision, and what the nature of the deviation says about the way we see and think about a global community of science.

THE MAKING OF SPACE ASTRONOMY

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The history of observational astronomy can be divided into four main periods: the age of pre-telescopic astronomy (from the earliest times to the early seventeenth century); the first era of the telescope (from the early seventeenth century to the mid-nineteenth century); the combination of the telescope with spectroscopy and astronomical photography (from the mid-nineteenth century to the mid-twentieth century), and the modern era (from the mid-twentieth century on) and the opening up of all wavelength ranges of the electromagnetic spectrum to astronomical investigations. In this paper, I will focus on the central part played by the development of space astronomy to the fourth of these periods. In particular, I will examine not just the changing cognitive content of astronomy, but also the shifting scale of space astronomy enterprises, the remaking of the relationships between astronomers and their patrons, and what it means to talk of space astronomy as a product of the Cold War. In so doing, we will see that the development of space astronomy resulted from a complex mix of cooperation and competition.

Symposium S25
Science as a Matter of Identity and Modernity in Latin America: 'Positivism' and 'Positivisms' in the Late XIX and Early XX Centuries

PORFIRIATO, PISCICULTURE ET PROGRÈS

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Facultad de Estudios Superiores Iztacala de la UNAM, México

La fin du XIXe siècle mexicain se caractérise par l'énorme influence de la philosophie positiviste comme directrice de la pensée scientifique . La vision comtianne qu'il a eu pour devise : l'amour pour principe, l'ordre pour base, et le progrès pour but. a souffert d'une opération de traduction (dans le sens de la sociologie de la traduction de Latour et Callon) qui l'a transformé dans : la liberté, l'ordre et le progrès, qui, pendant le Porfiriato dans une nouvelle opération de traduction ce sera seulement un ordre et un progrès, maintenant sous la lumière de la visión spenceriana de la philosophie positiviste. L'ordre sera le composant lié avec la politique et le progres avec la science, dans cette rubrique, l'exploitation des ressources naturelles que dans un pays comme le Mexique, avec de grands littoraux et corps d'eau (une rivières, un lacs et une lagunes) il aurait la pêche et le piscicultura pour des activités dignes d'attention. Il a été donc entre 1883 et 1885, le Secrétariat de Promotion, à dont la charge était Carlos Pacheco, il a été conforme "2e. Un inventaire de Recours De pêche", et en 1886, le Congrès de l'Union il a autorisé l'incorporation du piscicultura comme l'activité productive, en plus de laquelle en 1884 était publié le texte "Piscicultura Mexicana" du député de l'époque Esteban Cházari.

Celles, et d'autres activités qui incluent un cours de piscicultura dans l'École d'Agriculture, ils façonnent la structure de cette nouvelle discipline scientifique. Bien que l'on puisse détacher que le piscicultura surgit comme une pratique tecno-scientifique parallèle au développement de l'Histoire Naturelle et de la biologie naissante.

À ce travail on explore la vie de Cházari et son texte "Piscicultura Mexicana" ainsi que son impact dans le développement postérieur du piscicultura au Mexique.

THE NEW VISIONS OF VENEZUELA IN THE LATE XX CENTURY: THE CONTRIBUTIONS OF THE POSITIVISTS

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The present image of Venezuela, as was that of the past, is a mixture of fantasy, reality, wealth and the quest for wealth or prosperity. Venezuela formed part of the legend of 'El Dorado, when Walter Raleigh reported that a rich kingdom - 'Guiana' – existed in what would become Venezuela's Amazon territory. The Welser bankers of Germany, taking advantage of the debts owed to them by the emperor Charles V, explored this territory, searching in vain for El Dorado. Later, in the eighteenth century, Alexander von Humboldt contributed to a greater awareness in Europe of the Captaincy-General of Venezuela, with reports on its natural resources and their potential. This was the image seized upon by the nascent republic organised in 1830, through which it tried to attract foreign capital and European immigrants. It was not until the advent to power of Guzmán Blanco, in the context of the Positivist vision in the imaginary of the political elite, that it was realised that instruments and concepts other than natural resources were necessary in order to 'sell the country' as a suitable country for foreign investment. The natural resources exhibited in the International Expositions (of the late-XIX century) were duly catalogued scientifically, in part to reveal their exotic uniqueness for Europe, as well as their utility. We review the catalogues prepared by Adolph (Adolfo?) Ernst, Professor of Natural History and one of the promoters of positivism in Venezuela, who was entrusted by its government with these tasks in the International Expositions. WE also examine the catalogue for the |Exhibition of Hannover, celebrated in 1883, the year of the centenary of the birth of the Liberator Simón Bolívar.

SCIENTIFIC UNIVERSALISM AND CONTROVERSIES WITH A POSITIVIST PERSPECTIVE IN BRAZIL

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Positivism played a major role in the history of science and of the Brazilian Republic, but its spread was surrounded by paradoxes – some of the principal defenders of Auguste Comte`s ideas in Brazil were military with a pacifist vision and mathematics teachers who proposed sociology as the main science and that it was one of the most important in the realm of science – and its effects are still rather controversial.

Based on a scientific perspective, Positivism guided the wishes of political, economic, and cultural modernization of Brazil, which, unlike other Latin American countries, had a slavery monarchical regimen until the 1880`s. The spread of scientific and technological culture was the result of a political attitude that combined local groups` interests with broad social and cultural projects, promising to accelerate the progress of Brazil and to enable it to participate in universal history.

In contrast to other political and cultural movements that followed, the construction of Brazil's identity under Positivism was not based on a common origin, either ethnic or territorial, but on the stage of social development. Even though they had taken their symbols from France, they actually built their representation and projects around scientific universalism: a fellowship of men of science around the world that would result from the spread of the positive spirit. The belief in the universality of science that poised them against the romantic and nationalist perspectives that valued the indigenous, the local nature, or the agricultural "vocation" of Brazil.

The positivists did not make a homogeneous current and they were not the only group in the period seeking a solution to problems of underdevelopment through modernization, but the common view of social development rooted in scientific education and industrial growth became one of the concepts that endured decades.

Although acknowledges their strong influence, historiography, save rare exceptions, keeps an evolutionist bias that frames the early 20th century Positivism as an hindrance to the progress of science in Brazil. Besides the dogmatism, the opposition to microbiological medicine, to relativist physics, the progressive specialization of sciences, and mostly, the pure and universitarian science, are pointed as signs of the positivist reactionism. The positivists opposed the obligatory vaccination movement in the early 20th century and, in the 1920's, they fought against the newly founded Brazilian Association of Science and its campaign for university research. These two events are generally considered landmarks of the development of science in Brazil and as evidence that Positivism was outdated.

In our work, we attempt to discuss and shed new light on the classical interpretations of Positivism in Brazil, departing from these two scientific controversies and their unfolding in the press. We seek to show how the decline of the positivist symbols in Brazil was associated with the consolidation of a new model of scientific culture and national development, based on basic and specialized science.

IS THERE A LATIN AMERICAN PHILOSOPHY OF SCIENCE? NOTES UPON LATE-XIX AND EARLY-XX CENTURY MEXICO

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Since its independence in the early-XIX century, Mexico has been seeking an identity, which allows it, simply, to be. This search has passed through different military and intellectual historical moments, including revolutions which have sought to construct a 'modern' country.

Science has occupied an important place in all the governmental projects, though from different perspectives. The Porfirian period saw the birth of to born the modern European science. The apparent possibility of explaining almost everything was one of the most important reasons for Mexico's infatuation with French culture and its attempts to become a modern country, through the adoption of French ideas and, of course, science.

These processes have attracted many different interpretations. However, a historical-philosophical framework is still lacking. The Mexican community of scholars is still exploring the careers and possible contributions of Mexican scientists, in order to demonstrate that they also had participated in the construction of 'modern science'; and it is possible that Europe does not have a suitable philosophical framework for the interpretation of scientific influence in Latin America, because most of its literature, explores relationships with its former Asian and African possessions which, unlike Latin America, were still colonies during the blossoming of modern science.

From this perspective, it seems important to explore, from a philosophical point of view, the phenomenon of the transmission and acculturation which science experienced in Latin America, and the changes in the conception of the cultural self in the different countries of the continent.

LE DÉBUT DU POSITIVISME AU VENEZUELA. ADOLF ERNST ET RAFAEL VILLAVICENCIO: DE L'HISTOIRE NATURELLE À LA PHILOSOPHIE DE L'HISTOIRE 1863-1898

Juan José Martin Frechilla

Universidad Central de Venezuela, Venezuela

En 1840, une bibliothèque publique de Caracas, reçut une donation : les premiers tomes du *Cours de Philosophie Positive*. A cette époque, dix ans après la dissolution de la *Grande Colombie*, le Venezuela était confronté à trois défis majeurs : la construction de routes, l'immigration et l'instruction. Dans le domaine de l'instruction publique, la doctrine positiviste se répandit à tous les niveaux des institutions, surtout durant le dernier tiers du XIX siècle. Mais il fallut attendre la fin de la guerre civile (1859-1863) pour que le projet de modernisation pût être mené à bien et se traduire en programme politique, à partir de 1870, sous la présidence d'Antonio Guzmán Blanco (1829-1899), qui avait été auparavant vice-président et à plusieurs reprises chef du pouvoir exécutif.

Si les sociétés de sciences physiques et naturelles furent les premières associations d'intellectuels fondées au Venezuela, c'est à la médecine que s'intéressèrent davantage les défenseurs du positivisme si l'on en juge par les articles qu'ils publièrent dans les revues de ces associations. Cependant, en 1863, à la fin de la guerre civile, l'une d'entre elles adopta, du moins sur le papier, le modèle de l'Institut de France, avec des sections correspondant aux différentes branches du savoir.

Quelques temps auparavant, était arrivé au Venezuela Adolf Ernst (1832-1899), un prussien qui avait fait des études de sciences naturelles, de pédagogie et de langues modernes à l'Université de Berlin et possédait des connaissances approfondies en philosophie positive. Il trouva à Caracas un terrain fertile pour la diffusion de la doctrine positiviste et fonda, en 1866, la Société de sciences physiques et naturelles de Caracas afin de faire connaître les études portant sur l'histoire naturelle au Venezuela. Pour sa part, Rafael Villavicencio (1838-1920), qui était docteur en médecine, pharmacien et philosophe, prononça, en 1866, au nom de la raison, un discours sur le cercle unitaire du savoir et l'esprit incontestable de la philosophie positive.

Mon intervention porte sur la rencontre qui eut lieu entre Ernst et Villavicencio autour du « positivisme naturaliste » ainsi que sur leur contribution à l'histoire de la science au Venezuela. Elle se centre en particulier sur les responsabilités publiques et académiques qui leur furent confiées par le président Guzman Blanco durant ses deux mandats, de 1870 à 1877 puis de 1879 à 1884, mais également sur les politiques menées par les gouvernements vénézuéliens entre 1889 et 1895, année où Villavicencio fut nommé, pour trois ans, Recteur de la *Universidad Central de Venezuela*. A travers ces trois périodes sont abordés différents aspects: l'instruction publique, obligatoire et laïque face aux débats sur l'évolutionnisme et au catholicisme; l'organisation de l'enseignement supérieur et les chaires d'histoire naturelle et d'histoire par rapport à la place des sciences exactes à l'Université; la fondation d'institutions -le Musée, la Bibliothèque et l'Observatoire nationales et le Ministère d'Instruction Publique- ayant pour but de favoriser l'émergence d'une communauté scientifique nationale. Cet élan initial du positivisme au Venezuela allait s'avérer décisif pour l'essor de cette doctrine auquel on assista dans les années vingt.

Symposium S26
Interactions between Mathematics and the Natural Sciences: Scientific Realities and Social Representations (1750-1950)

LES PREMIERS TRAVAUX DE D'ALEMBERT EN HYDRODYNAMIQUE (1745-1750): UNE NOUVELLE PROBLÉMATIQUE

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Ce travail vise à présenter la nouvelle problématique qui se fait jour dans les années 1740-1750 dans le traitement du mouvement des fluides. Dans cette décade, d'Alembert accomplit un pas décisif. Dans son mémoire *Réflexions sur la cause générale des vents* (qui reçoit le prix de l'Académie de Berlin de l'année 1746), il considère la vitesse *v* d'une particule de fluide comme une fonction de plusieurs variables d'espace. Utilisant l'expression de la forme différentielle exacte d*v* et son principe de mécanique, il parvient ainsi à un système d'équations aux dérivées partielles. Ne pouvant le résoudre, il donne dans la troisième partie de son mémoire certains types d'équations dont il décrit la solution. D'Alembert montre à la suite que quelques problèmes d'écoulement des fluides peuvent être caractérisés par des équations de ces types.

Dans le mémoire sur la résistance des fluides qui concourait pour le prix de l'Académie de Berlin de 1750, d'Alembert utilise les mêmes méthodes pour parvenir à de nouveaux résultats (équations aux dérivées partielles caractérisant le mouvement d'un fluide à la rencontre d'un solide de révolution, dans le cas d'un écoulement stationnaire).

Mais deux autres savants ont aussi contribué à l'élaboration de cette nouvelle problématique. Clairaut, dans son étude du problème de la figure de la Terre en 1743, représente la résultante des forces qui s'exercent sur les particules d'un fluide comme fonctions de plusieurs variables et donne le premier une condition d'équilibre local.

Dès 1745-1749, Euler, comme rédacteur des sujets des prix de l´Académie des sciences de Berlin, pose clairement le problème de la détermination du mouvement des particules dans toutes ses directions, c'est-à-dire qu'il considère déjà la vitesse comme une fonction des variables d'espace. Puis, dans ses travaux à partir de 1750 jusqu'aux traités de 1753-1755, Euler donne les fameuses équations qui portent son nom, en généralisant les méthodes de d'Alembert et en introduisant le concept de pression d'un fluide en trois dimensions.

Cette nouvelle problématique de la dynamique des fluides s'applique par ailleurs à d'autres milieux continus et elle est aussi présente, dans la même période, chez d'Alembert et Euler pour le problème des cordes vibrantes. Ce sera l'un des moteurs de l'élaboration de la mécanique analytique et des développements mathématiques de la théorie des équations aux dérivées partielles.

« L'HYDRODYNAMIQUE ET LE CALCUL INTÉGRAL À PLUSIEURS VARIABLES DANS LA SECONDE MOITIÉ DU XVIII^{e} SIÈCLE »

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Les contributions successives de D'Alembert et Euler au processus de construction théorique de l'hydrodynamique entre 1745 et 1755 leur permettent d'établir les différentes formes des équations aux dérivées partielles (EDP) gouvernant le mouvement d'un fluide parfait compressible, à savoir ce que nous appellerions l'*équation de continuité*, l'*équation d'Euler* et l'*équation de vorticité de Helmholtz*. A l'orée des années 1760, s'ils disposent ainsi des équations les plus générales, les savants se retrouvent néanmoins confrontés à un problème mathématique des plus délicats. Il leur faut en effet, pour s'assurer du bien-fondé des théories qui les sous-tendent, parvenir à résoudre les équations obtenues afin de pouvoir en comparer les résultats avec l'expérience. Les mêmes D'Alembert et Euler s'y sont déjà bien essayés, le premier dans sa *Cause des vents* (1747) et son *Essai sur la résistance des fluides* (1752), le second dans un mémoire de 1755, mais malheureusement sans succès, ce que D'Alembert résumait en 1752 en avouant que « du moins en certains cas la solution du Problème se refusera entièrement à l'Analyse ».

Malgré un pessimisme certain quant à la possibilité de venir à bout du problème, D'Alembert n'en poursuivra pas moins ses recherches en la matière, éveillant ainsi l'intérêt de Lagrange pour la question à partir du début des années 1760. Les deux savants échangeront dès lors une intense correspondance sur le sujet, non sans conséquence sur leurs travaux respectifs. Leurs discussions tournent, d'une part, autour du rôle et du statut de ce que nous appellerions aujourd'hui les conditions aux limites du problème, autour de la question consistant à savoir si le problème peut être résolu et, par là-même, autour de la notion de solution. Elles concernent d'autre part une méthode initiée par D'Alembert en 1747 et consistant à passer dans le champ complexe afin d'intégrer les EDP gouvernant, en termes modernes, un écoulement potentiel bidimensionnel incompressible – ces équations coïncident avec ce qu'on nommera *les conditions de Cauchy-Riemann* au siècle suivant. D'Alembert et Lagrange mettent notamment à jour, dans ce cadre, un ensemble de méthodes d'intégration et de concepts – la vitesse complexe, la fonction de courant, le potentiel de vitesse, le potentiel complexe – annonçant l'une des approches les plus couramment utilisées pour venir à bout des équations relatives à ce type particulier d'écoulement : l'application de la théorie des fonctions de la variable complexe.

Cependant, ces recherches conduites par D'Alembert et Lagrange sur la résolution des EDP ne permettent pas de dépasser le principal enjeu du développement de l'hydrodynamique après 1755 : l'obtention de solutions permettant la confrontation de la théorie avec l'expérience. Elles constituent en revanche une parfaite illustration des nombreux progrès qui ont été accomplis au cours de la seconde moitié du XVIII^{e} siècle dans le domaine du calcul intégral à plusieurs variables grâce aux interactions avec le développement de la science du mouvement des fluides.

LES ÉQUATIONS AUX DÉRIVÉES PARTIELLES CHEZ D'ALEMBERT, EULER ET LAGRANGE: DES MATHÉMATIQUES MIXTES AUX MATHÉMATIQUES PURES

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D'Alembert est généralement reconnu par les historiens comme étant le premier à avoir appliqué le calcul aux différences partielles à des problèmes physico-mathématiques. Ses *Réflexions sur la cause des Vents* (1747) et son mémoire sur les cordes vibrantes publié dans les recueils de l'Académie de Berlin de 1747 marquent en effet l'avènement d'une première théorie des équations aux dérivées partielles (EDP) digne de ce nom. Par la suite, Lagrange, Euler, et l'encyclopédiste lui-même, vont faire appel à cet outil mathématique dans bien d'autres domaines : écoulement, équilibre et résistance des fluides, propagation du son…

Mais, progressivement, et surtout à partir du début des années 1760, ils vont rencontrer dans leurs recherches des EDP d'une complexité croissante du fait de leur volonté d'appréhender des phénomènes physiques de plus en plus variés : ondes sphériques, recherche sur les courbes tautochrones, problèmes dans des milieux résistants… De surcroît, parallèlement, des savants comme Fontaine et Condorcet développent une approche consistant à procéder à une étude systématique, programmatique, et hors de tout contexte physique de certains objets mathématiques. Condorcet adopte en particulier cette démarche vis-à-vis des équations différentielles ordinaires et de l'intégration en termes finis. C'est dans ce contexte que D'Alembert va entreprendre dans le Mémoire 26 du tome IV de ses *Opuscules Mathématiques* (1768) une étude systématique de plusieurs classes d'EDP d'ordre 1 et 2 en les extrayant de tout cadre physique. A la même époque, Lagrange et Euler adoptent à leur manière une démarche semblable. On évoquera les mémoires d'Euler liés à ses recherches sur la propagation des ondes sphériques, ainsi que « Les Nouvelles recherches sur la Nature et la Propagation du son » de Lagrange. Bien entendu, l'approche de chacun de ses savants a ses spécificités.

Une des conséquences de ce glissement des EDP des mathématiques mixtes vers les mathématiques pures est que le calcul aux différences partielles devient progressivement à partir de cette période une branche de l'Analyse à part entière. Nous terminerons par un examen de l'impact de cette dynamique sur les travaux de Condorcet, Laplace, Monge, Cousin etc… dans les années 1770 et 1780.

« CHOOSING AND MEASURING PHYSICAL PARAMETERS FOR MATHEMATICALLY MODELLING PHYSICAL PHENOMENA: THE CASE OF ENERGY CONSERVATION »

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The measurement and the choice of physical parameters in a mathematical model often appear as important questions (a matter discussed by Lord Kelvin), occurring at the same moment as the last element in a theoretical process, which is responsible for the scientific point of view, and at the same moment as the beginning of important new conceptual point of view. The establishment of the principle of conservation of the energy is incompatible with this linear approach. It might be interesting to study the place and the stakes bound to each of the stages which represent the measure and the choice of the physical parameters to understand the intricacies of these stages in the elaboration of a unifying concept of the physics at the turn of the XIX and XXth centuries. We will discuss this, considering in particular the introduction of the separation between heat and temperature. The nature of the physical parameters to be chosen and the necessity of this distinction for the constitution of the principle are the most important questions.

In order to do this, we will discuss in detail the mathematical context, that is, the link between mathematical and physical which is at the origin of the principle's emergence.

Finally we will place all these matters in their philosophical, institutional and social contexts which are necessary to understand the purposes of the concept of energy.

FRENCH GEODESY IN 19th AND 20th CENTURIES. CONTEXT, ACTORS AND MATHEMATICAL PRACTICES IN THE FIELD

Martina Schiavon

Archives Henri Poincaré – Nancy, France

Geodesy in the nineteenth century, was a branch of astronomy concerned with the determination of the mathematical figure of the Earth, but also with questions of geoscience (cartography, geology and geophysics). This science played a crucial role in military and colonial endeavors, and provides an example of the way in which mathematical techniques were developed and mobilized in the service of the state.

Who were the main practitioners of 19th-century geodesy, and what significance should we attribute to geodetic operations, such as the measurement of a meridian or parallel arc, or the determination of the astronomical position of geodetic stations? Geodesists were often not scientists but military officers, and historians have tended to treat them as followers rather than innovators. I will show that the ``terrain'' of geodesy favored collaboration between scientists and military officers, as in the case of François Perrier, Léon Bassot and Robert Emile Bourgeois, all military officers of the French Army Geographical Service who worked with Hervé Faye and Henry Poincaré.

I will examine examples of geodesy as material and theoretical knowledge mobilized in the field or developed in scientific institutions such as the French Bureau des longitudes, where academicians, military officers and precision instrument makers worked together. One of the Bureau's directors, Henri Poincaré, considered geodesy to be useful for the French State, not only for cartography, but also for the general education of students at the Ecole polytechnique. Poincaré also helped determine latitudes, the gravitational constant, and the nature of gravitational action.

On a larger scale, my aim is to illuminate the evolutions in geodetic science before WWI.

HENRI POINCARÉ'S APPROACH TO ASTRONOMY

Scott Walter

University of Nancy/H. Poincaré Archives, France

The French mathematician and philosopher of science Henri Poincaré (1854-1912) was credited in his lifetime with having opened a new chapter in celestial mechanics, while in more recent times, he is hailed as the founder of the modern theory of dynamics of systems. Intellectual fertility such as this has few parallels, if any, in the history of science, and quite understandably, Poincaré's published writings have attracted significant historical attention. Recent studies at the Henri Poincaré Archives have focused on Poincaré's unpublished correspondence with astronomers and geodesists, which offers a new and detailed perspective on Poincaré's contributions to mathematical astronomy. My talk will provide an overview of new research on Poincaré's path to the study of problems in celestial mechanics, and an analysis of his interaction with contemporary astronomers, including G. H. Darwin, A. M. Lyapunov, and A. Lindstedt.

INTEGRAL EQUATIONS BETWEEN THEORY AND APPLICATION, 1900-1920

Thomas Archibald

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In 1900, Ivar Fredholm presented a method for the solution of a certain class of integral equations that was at the same time a device for the solution of certain kinds of boundary-value problems in mathematical physics. Fredholm's method also offered the possibility of a profound reconceptualization of problems concerning the existence and solution of partial differential equations. The impact of his paper was rapid, almost explosive; and the transition of Fredholm's approach from his own hands to different institutional contexts elsewhere took up different themes according to the context in which it was read. In Germany, Hilbert responded to the paper by elaborating a theory of infinite determinants, a theory soon to be sharply remodelled by his students E. Schmidt, H. Weyl, and others into a nascent functional analysis.

In France and Italy, a different track was to emerge. In 1906, Emile Picard published an important article in the Rendiconti di Palermo that provoked a series of applications of Fredholm's methods to mathematical physics, notably by many Italian mathematicians.

In this paper, we examine both the effects of the institutional/contextual transition and the resulting transition of research patterns in analysis, arguing that this bifurcation was a key moment in the split between a more classical "hard" analysis and the more modern and structural approach of the Hilbert school. The paper describes joint work with Rossana Tazzioli of the Université de Lille I, France.

DIFFERENT VIEWS ON APPLIED MATHEMATICS IN GERMANY IN THE 1920s

Birgit Bergmann

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Richard von Mises became Professor of the second university chair for applied mathematics in Berlin in 1920. Shortly after he had gained the chair, von Mises launched the journal Zeitschrift für Angewandte Mathematik und Mechanik (ZAMM), the first German journal for applied mathematics. He also played a crucial role in the foundation of the first society for applied mathematics the Gesellschaft für angewandte Mathematik und Mechanik (GAMM) one year later in 1922. The foundation of the GAMM shows, that the “Hinwendung zur Anwendung” the movement towards application in Germany, was led by different intentions and aims. The prominent scientists involved in the foundation had different opinions on what the society could bring to the discipline.

Richard von Mises and Ludwig Prandtl, who was also a founder member, argued about the motivations and aims of the society. Ludwig Prandtl wanted to emphasize mechanics and its applications. He wanted to concentrate on practical work and to avoid the domination of the society by mathematics. Von Mises had a different concept in mind. He emphasized, that mathematics was the most important tool for the work of the scientific engineer. These two concepts were discussed during the process of foundation of the society. This conflict led to the fact that neither a definite name for the society nor articles of association could be agreed upon in the first approach.

The debate continued in later years. Richard Courant and Richard von Mises discussed their concepts of applied mathematics in the journal “Die Naturwissenschaften” in 1927. Courant emphasized in his obituary for his father in law, Carl Runge, that it was Runges most important credit that his mathematical work prevented separation of the applications in mathematics and helped to retain the unity of the discipline. Courant´s statement provoked the protest of Richard von Mises. He stressed in a reply, that the efforts to strengthen applied mathematics as an independent discipline should be increased. An argument emerged between Richard Courant and Richard von Mises.

The two short episodes show, that the establishment of applied mathematics in Germany, which looks straight forward at first sight was a competitive field. Prominent scientists expressed their views and argued about the aims of this development.

GROUP THEORY AND QUANTUM MECHANICS: VAN DER WAERDEN'S CONTRIBUTION

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In close contact with physicists, the young mathematician B.L. van der Waerden (1903-1996) became involved in the 'application' of group theory to quantum mechanics in the late 1920s and early 1930s. This approach had been developed by Wigner and Weyl in 1926/27 and was met by scepticism and resistance by many physicists. Van der Waerden's contributions ranged from the development of spinor calculus (in the context of special and general relativity) to a monograph on the group-theoretical method in quantum mechanics (1932) that included a chapter on diatomic molecules.

In my talk, I will focus on the various contexts in which van der Waerden's works were created, drawing attention to van der Waerden's scientific networks which were – this is my hypothesis – decisive in bringing these works into existence.

Symposium S27
Spectroscopy: Science and Society

SPECTROSCOPY IN IRELAND IN THE LATE 19th CENTURY

D Weaire

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Se O'Connor

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Irish physicists and chemists were active in developing, exploiting and interpreting spectroscopy in the late 19th century. Among notable contributions are those of Grubb in instrumentation, Hartley in measurement, and FitzGerald in theory. The new Royal University (1879) was equipped with state-of-the-art spectroscopic facilities, which were used by Preston to discover the Anomalous Zeeman Effect. The untimely deaths of Preston (1900) and FitzGerald (1901), together with a general decline of science in Ireland, brought an end to these promising developments, for the time being, just as the quantum age dawned.

SPECTROSCOPY IN GREECE: THE EARLY DAYS

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Spectroscopy in Greece developed in the framework of the Physics and Chemistry Laboratories of the University of Athens during the last quarter of the 19th century.

Though the evidence of relevant systematic experiments are sporadic and uncertain we argue that the Greek academic community of the era became aware for the usefulness of the method and used it in certain cases.

Of particular interest for the introduction of spectroscopy in Greece is the contribution of Anastasios Christomanos, professor of Chemistry in the University of Athens, and Bunsen’s student himslef. He, and Timoleon Argyropoulos, professor of Physics in the University at the same time, bought also a number of scientific instruments, including instruments for spectroscopy to be used by them for research and education purposes.

Furthemore, we’ ll study also how spectroscopy was used for practical reasons in the developing Greek industry at that time.

THE SCIENTIFIC NETWORK OF ROBERT W. BUNSEN, FOUNDER OF SPECTROSCOPY, IN THE LIGHT OF HIS PRIVATE LIBRARY

Rudolf W. Soukup

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Robert Wilhelm Bunsen collected about 10.000 books during his long life as a scientist. After Bunsens death (16th of August 1899) the books, special editions, articles and notebooks from Bunsen’s estate in Heidelberg were bought by the second-hand bookshop Gustav Fock in Leipzig, and in July 1900 they were offered for sale for 12,500 marks. Bunsen’s student, the well known chemist and inventor Baron Dr. Carl Auer von Welsbach acquired the library. The printed works were transported in 75 packing cases first of all to the factory in the Atzgersdorf district of Vienna and from there to Treibach in Carinthia where they were stored in the attic of the research institute on the factory grounds of the Treibach Chemical Works. The library was more or less forgotten for nearly 100 years and remained largely untouched in the packing cases. Soon after the Auer von Welsbach Museum was founded in Althofen in 1998 the library was housed in the museum rooms.

When the cases were opened, a remarkably large number of mostly unbound special editions were found in this library. It was obviously not the library of a bibliophile book collector, but a hand library of a scientist, a researcher and academic teacher. Anyone who takes just a glance at the list of authors of the printed works will realise that on the one hand it is a Who's Who of science in the 19th century, and on the other this library offers the possibility of finding out about totally unknown scientists, who wrote perhaps only one or two papers.

Bunsen's correspondence during his activity in Heidelberg appears to have been largely destroyed. For those particularly successful years his library opens up a new chance of researching Bunsen's unexpectedly comprehensive network of colleagues and fellow scientists. The main subjects of the books and papers are: inorganic and organic chemistry, spectroscopy as a new method in astronomy, geology/mineralogy, physiology, and last but not least geography and glaciology. Hitherto not so well known but well documented by many specimens in his library is the perpetual interest of Bunsen in mountaineering and alpinism.

Now, for the first time since the death of the great scientist, his library is publicly accessible. Besides a catalogue and about 1,420 brief biographies of the authors of the works in this library are available online: R. W. Soukup, A. Schober, Eine Bibliothek als beredte Zeugin eines umfassenden Wandels des wissenschaftlichen Weltbilds. Teil I: Die Autoren der Werke der Bibliothek des Robert Wilhelm Bunsen in Kurzbiografien (17. 8. 2008):
http://www.althofen.at/AvW_Museum/Materialien/Autoren_der_Bunsenbibliothek.doc

HISTORICAL DEVELOPMENT OF THE SPECTROSCOPY OF PLANETARY ATMOSPHERES

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In 1904 the Dutch astronomer Anton Pannekoek published a theoretical paper about the effects a planetary atmosphere will have on the light of a star if it is occulted by the planet. This gave the starting signal for star occultation studies of planets and their moons.

But it took several more years till Rupert Wildt of the University of Göttingen, Germany, studied the spectra of the outer planets and could thereby identify several gases including ammonium in Jupiter's atmosphere in 1930ies.

The development of (high-altitude) rockets during Second World War and their subsequent scientific use after the war at Alamogordo, USA, opened the way for spectrographs to be flown above the Earth's atmosphere. The first one was flown on a V-2 rocket in October 1948 and was used for solar physics studies. The Sun was the only target for several years due to the accuracy of the pointing devices.

The first Infrared Interferometer Spectrometer (IRIS) to measure atmospheric temperature, water vapor, and ozone in the vertical was flown on the Nimbus-3 satellite in 1969.

During the Seventies and Eighties several spacecraft (to the inner and outer planets) carried spectrometers as payload and the knowledge about the atmospheres of our neighboring worlds increased dramatically. The next step was to investigate exo-planetary stars and planets (and their atmospheres) with these high-sophisticated measurement techniques.

COMPUTER SIMULATIONS: A NEW WAY TO APPROACH NATURE

Are they „thought experiments“?

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What is the exact position of computer simulation in contemporary science? What is its relation with the „objective word“, i.e. with the fundamental reference of any science?

Various conflicting answers are possible although some conclusive indications can be given and are helpful. With only sixty years of existence, it is impossible to give a definition of computer simulation acceptable for the entire scientific community. However there is no doubt that we are in presence of a new paradigm of scientific research, appealing to more and more scientists. Complex systems, which do not permit a direct visualisation of their microscopic behaviour, can be «seen» using models for which exact solutions may be obtained by computer simulation. There is some analogy here with thought experiments, which help «visualizing» experimental settings although having only a virtual existence.

Let us restrict our investigation to one particular case of application: computer simulation of the liquid state. The gas and crystaline state of matter are well represented with a gas model with complete disorder and lattice model of a crystal, respectively. These were the starting points of the kinetic theory of gases and the solid state theory. There was no such an Archimedian fixed point for the theory of the liquid state, and mutualy divergent approches were in competition.

After the Second World War, when the computer simulation techniques came into being, the situation changed drasticaly in the field of the liquid state physics. There was finally a way to approch the microscopic level of liquids and to relate it with the spectroscopical data. It was one of the major achivements in the post-war physics.

Computer simulations of atomic liquid does not play the same role as for instance the ideal gas model does in the gas theory. After defining the model potential of interaction between particles we just apply the brute force method of resolving the Newton's equation of motion for each particle. When we change the conditions, or the parameters of the model, we have to wait to the end of the „experiment“ to know the results. The system is too complex to be able to predict the results in advance. On that aspect computer simulation innovates with respect to the standard approach of theoretical physics. However the computer power is part of the new game and, relying on that, we are back to standard theoretical physics: calculation and, then, predictions!

APPLYING THE DOPPLER PRINCIPLE TO THE AMICI PRISMS–A THINK-DIFFERENT IN ASTRONOMY GIVING BIRTH TO ASTROPHYSICS

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From 1845 onwards, Doppler (1803–1853) dealt intensely with photography and photometry, which did constitute the tools of evidence that would reach great importance for the confirmation and applications of his principle, yielding fresh impetus to astronomy to such an extent as only the invention of the telescope had previously caused. In 1846, Doppler had already constructed a simple photometer to determine the pattern and distribution of brightness of very remote so-called fix stars. Yet all his attempts had failed. Even Huggins (1824–1910) and Maxwell (1831–1879) gave up their search for a solution. In 1868, Maxwell noted resignedly: "It cannot be determined by spectroscopic observations with our present instruments, and it needs not to be considered in the discussion of our observations."

Only in 1869, when Zöllner (1834–1882) had constructed his reversion spectroscope wherein he ingeniously arranged two Amici prisms in opposite directions, dispersing the light in opposite directions and displaying the two spectra side by side, his student Vogel (1841–1907)–director of the Observatory near Potsdam, Germany–became the first to succeed in making visible the Doppler shifts of individual lines, thereby demonstrating eventually that Doppler shifting applies to light, to sound alike. Applying the Doppler principle Vogel could determine the radial velocities of the stars, moreover, in 1889, he could eventually wrest the ancient secret from the 'ghoul' star *Algol* about its variations in brightness. The present paper reports on this pioneering beginning of astrophysical measuring and, moreover, on the construction and the operating of the reversion spectroscope by Zöllner.

Symposium S28
Visual Languages (and Representations) of the Sky: Frameworks and Focal Points in Social Context

SOCIALIZING THE SKY: BRITISH SKIES IN POPULAR CULTURE, 1780-1880

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From 1780 to 1880, in England, sky-science, beginning with William Herschel's boundless universe and expanding with Luke Howard's clouds, overturned religious belief, reduced human beings to trivial, powerless, vulnerable figures in the landscape. These discoveries were delivered at philosophical societies, published as transactions, celebrated by poets and painters. They coincided, however, with a new popular culture, popular press, a new public life with ceremonies and events, a visual culture with an enhanced literacy and communication consisting of theatricals, newspapers, magazines, exhibits, parades and festivals. This popular culture was adaptive, assimilative, giving human beings comfort with the new sciences, a place in the alien world of time and space, possession of the sky. My paper traces this early transition during which popular culture shaped the way human beings see and deal with the new sky-sciences, the mediators, the artists, performers, inventors, and scientists who socialized the sky into an extension of human geography and prepared the way for space. The sky, neither sacred not humanly attainable, was familiarized with airborne and flying things depicted in cartoons, children's literature, magazines, the theater, parades, fireworks, balloons, kite festivals, eclipse parties, domestic experiments with lightning, a new iconography of flying human-angels, vampires, and dragons Before anyone had climbed higher than Mt. Blanc or ascended higher than a balloon, the visible sky served as the outer limit of human experience, captured in the phrase "sky high" which first appeared in 1818, a term describing the height that could be attained when ordinary beings and experiences had exceeded their terrestrial boundaries.

LA NIÑA, STELLAR PORTENTS, AND THE EXTINCTION OF EASTER ISLAND'S BIRDMEN, 1862-1866

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This paper will examine the historical circumstances surrounding the near destruction of an indigenous society in the South Pacific: the Rapanui of Easter Island. Historical climatology of the El Niño-Southern Oscillation (ENSO), astronomical reconstructions of the night sky, marine ornithology, and ethnohistorical data provide a multidisciplinary basis for reconstructing the Rapanui's indigenous knowledge system and practices, and their visual interpretation of a changing sea and sky.

The demographic and cultural collapse of the Rapanui during the 1860s has usually been blamed on a conjuncture of historical factors: the enslavement of half the island population by Peruvian labor traders, the transfer of epidemic smallpox and tuberculosis by repatriated laborers, and the island's subsequent colonization by French and Chilean missionaries and ranchers. Environmental historians, moreover, have often portrayed the Rapanui as a culture already in rapid decline because of their own destructive environmental attitudes and practices.

Critical events during Easter Island's colonization cannot be explained without accounting for the Rapanui's intricate understanding of marine birds, celestial motions, and other portents of a changing environment. This understanding was the hallmark of a vibrant, flourishing indigenous civilization that had adapted to degraded environmental conditions of its own making. The Rapanui's initial recruitment into the Pacific labor trade and vulnerability to microbial epidemics were profoundly influenced by the presence of a long, powerful La Niña event in the region and by the Rapanui's interpretation of ominous portents in the night sky. Anomalous environmental conditions and their own decisions played an unfortunate role in determining the Rapanui's tragic fate.

INSTRUCTIONS FOR CLOUD OBSERVATION AT METEOROLOGICAL STATIONS IN GERMANY BEFORE THE INTERNATIONAL YEAR OF CLOUDS 1896/97

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Meteorological observations were made in the Duchy Saxony-Weimar-Eisenach from 1822 to 1832 at a number of stations, including those at Weimar and Ilmenau. Special attention was given to the observation of cloud formation. As suggested by J. W. von Goethe, the classification method of the Englishman Luke Howard was used. At the Prussian stations the meteorological observations were made using the scheme of W. Mahlmann after 1848. The Saxonian measuring-network which was created in 1863, followed the Prussian model. Special instructions for meterological observations for forestry purposes were issued in 1881. The different instructions for the observation of cloud formation which the respective observers had to use will be presented in this lecture.

VISIBLE IMPRESSIONS FROM WORLD WAR II REALITY OR ARTISTIC INTERPRETATION?

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Landscape paintings convey a special impression that consists of natural topography, time, light as well as the artistic eye and manner of realisation. Described in more scientific terms, landscape paintings are defined by the location depicted, date and time of the day, meteorological conditions, focus and style. When an artist mutates to a soldier during World War II, he is excited and seeks - as far as possible - to capture impressions of for him unknown regions in foreign counties. His personal perspective, nature, and colours are the salient ingredients of his pictures. Without knowing it he also includes the time dimension when painting special scenes in the course of the advance of his military division, for example upon arrival at a special emplacement or depicting scenery at changing seasons. A photo reporter also records the same event, like the advance of the division, but his lens is used more often to focus on snapshots of people, soldiers moving forward or enemy's positions while the portrayal of landscapes as such is much more rare.

Looking at pictures of the 4th Mountain Division marching towards Russia the differences in perception between artist and reporter is obvious. This is because the painter shows his vision, as distinct from singular events or pure facts recorded by the camera-carrying reporter. His water colour paintings can be combined with a written account, military charts and weather charts of that period to document natural features of the broader context and topographic reality of the scenes as well as depictions of weather phenomena like "boran" (icy wind with snow drift) or a clear winter sky during high-pressure weather in the Caucasus. Moreover in the period taken up in the present paper photographs were still black and white in contrast to the coloured rendering of scenes in paintings.

A HOLE IN THE SKY? A VISUAL HISTORY OF OZONE DEPLETION

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The key images of my talk are all linked to graphical animations NASA scientists first proposed in the mid-1980s. The animations depict decreasing ozone values occurring each year during austral spring over Antarctica and they are referred to as the "ozone hole". However, the first announcement of stratospheric ozone destruction was not published by American scientists, but by Farman, Shanklin and Gardiner of the British Antarctic Survey in Cambridge. They were the first to make this groundbreaking discovery, but, interestingly enough, they never evoked in their now famous 1985 *Nature* paper the powerful metaphor of a "hole" in the sky.

A detailed historical comparison of the British context of discovery with the American development of a powerful animation technology suggests that the employed instrumentation preconfigured on both sides in a substantial way the scientific visual output. A closer look at Farman's and Shanklin's paper reveals that their Dobson measurements could never have suggested any such thing as a "hole", because the collected data allowed only simple graphical renditions of a single line. The American animations are based on the famous isoline tradition and proved to be a far more powerful graphical tool, allowing surfaces to configure in the shape of what American scientists could intuitively refer to as "a hole". Moreover, the use of the powerful "hole" metaphor proved to possess something like a metaphorical "surplus", reaching far beyond scientific discourse by inscribing it into a larger cultural context, evoking a whole myriad of negative associations that Western culture unconsciously attributes to it.

/CLOUD/ ... BLUR

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This paper will examine the exceptional function of the signifier of the cloud (informed by Hubert Damisch's book */Cloud/)*, within the spatial logic of landscape representations in modernity, and specifically how the nostalgic and anachronistic repetition of cloud-forms within early modernity become heavy and saturate the visual field in the blurred landscapes of artists including Mark Rothko, Francis Bacon, and Gerhard Richter. From this analysis of the condensation and displacement of the cloud-signifier, the argument traces how ephemeral clouds become a new landscape, an ambient environment of "blurred space" (as defined by architect Toyo Ito). Finally, this paper will try to fix the modernist spatial logic of the cloud-becoming-landscape in reciprocity with a inverse movement - specifically in the tendencies of the forms of modern architecture and urbanism to become light, transparent, de-solidified aerial projections of desires... as cloud-like evaporation.

Symposium S29
Perspectives on the Rise of Climate Science

HANS AHLMANN'S COLLABORATIVE GLACIAL FIELDWORK AND THE EARLY DISCOURSE OF CLIMATE CHANGE, 1920 TO 1950

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Stockholm geographer Hans Ahlmann was among the founding fathers of modern glaciology and also one of the early discoverers of climate change. Ahlmann started glaciological work on Jotunheimen glaciers in Norway during WW I and continued work on a number of field sites in Scandinavia and the North Atlantic through the 1930's. Disrupted by WWII his research program on the mass balance of glaciers could continue only after the war and was then focusing on a designated long term research site in Swedish Lapland, the Tarfala station, which he founded in 1945, and in Antarctica, where the Norwegian-British-Swedish expedition, "NBSX", was performed 1949-1952. These steps marked the fullfilment of a research line of glaciology that had also comprised Kårsa glacier in Lapland in the 1920's, on Spitsbergen 1931 and 1934, on Iceland 1936, and North East Greenland 1939. The research secured results that helped Ahlmann construct his theory of the mass balance of glaciers and, in the 1930's, his theory of "polar warming", a forerunner of – but also a source of criticism against – theories of climate change.

This paper will analyze the field work that Ahlmann conducted on his research sites, with an emphasis on the North Atlantic sites. A particular focus will be on his collaborative work style, involving local informants and partners among native Sami and Icelandic farmers. He demonstrated a sincere interest in what has later been called Traditional Ecological Knowledge, and was able to utilize local skills and technologies for the benefit of scientific understanding of climate change that he contributed to scientific and political discourse through his role as diplomat and advisor. A main thrust of the paper is that ideas of climate change must be seen as a product also of a co-production of local and scientific knowledge and methods.

FROM POLAR WAR AND COD FISHERY TO GLOBAL CLIMATE CHANGE

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Ice core research is today one of the most important fields of paleoclimatology, and the study of polar ice cores contributes significantly to our knowledge of past climate and understanding of the mechanisms of climate change.

Historically the techniques for drilling kilometer-long ice cores and the methods for extracting detailed physical and environmental information from the cores were developed in local contexts, partly motivated by specific military and economic interests in Greenland. In the 1950's and 1960's American Cold War interests in the Arctic motivated the establishment of new research institutions with an integrated approach to the Arctic environment, and the ample funding for military research enabled the first penetration of the ice sheet and recovery of a continuous core in 1966. Meanwhile a Danish physicist developed a method to reconstruct paleotemperatures from the isotopic composition of Greenland ice, and he was personally motivated and officially encouraged by the possibilities of predicting Greenland's future climate, crucial to the cod fishery, which had prospered as a result of the early 20th century warming.

Ice core research in Greenland is typical of modern research – and climate research in particular - in its interdisciplinary character, and the early history of this field exemplifies how new research problems are taken up in local settings on different backgrounds and a coherent research field is formed in negotiations among these local programs and a reframing of research agendas.

NUCLEAR ARMS, COLD WAR, AND THE RISE OF CLIMATE SCIENCE

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Richard Turco of the R&D Associates in Marina del Rey in California, a defense think tank, coined the term "nuclear winter," in a 1983 article, written in collaboration with Owen B. Toon, Thomas P. Ackerman, and James B. Pollack, from the NASA Ames Research Center, and Carl Sagan at Cornell University. Turco et al. came up with the first calculation of the possible impact on climate of a nuclear war due to soot and dust in the atmosphere caused by fires that would reduce sunlight for weeks or months, suggesting a temperature drop of 25 to 35° Celsius etc. in the Northern hemisphere during the summer months, hence the term "nuclear winter." This term linked nuclear with meteorological considerations, thus embedding climate concerns firmly within the sphere of military strategy and defense policy. My talk suggests that an important part of today's concern over man-made climate change has evolved in close linkage with military research on the effects of nuclear weapons, and thus emerged within the Cold War context. The debate on nuclear winter brought a new twist by challenging the standard argument that nuclear arms, despite their long-term environmental consequences, were a worthwhile price for peace. Now nuclear war was no longer about unprecedented, though ultimately local, destruction of cities and military installations, but about the possibility of global long-term disruption of the whole earth and its climate.

THE PROJECT OF MECCA
A CASE STUDY ON ENERGY-INDUSTRY FUNDED CLIMATE SCIENCE IN THE EARLY 1990's

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"The Model Evaluation Consortium for Climate Assessment" (MECCA) was an industry dominated consortium which was formed in 1990 and from 1991-1995 funded climate modelling and analysis. The consortium was formed due to efforts of the National Centre for Atmospheric Research (NCAR) and the Electric Power Research Institute (EPRI) and members joined from industry organisations from the US, Europe and Japan as well as public institutions.

For the first time, industry-groups showed a strong interest into funding basic science on climate change and entering into close collaboration with climate scientists. The rationale behind was the interest to improve knowledge on climate change as well as on climate politics which the industry may have to face after the increasing public interest in climate change and the formation of the IPCC.

The paper will discuss the establishment and development of the MECCA project and analyse, which difficulties the collaboration of industry institutions and scientists caused and how these difficulties were managed. Parts of the scientific community were not keen on major CO2-emitters funding their research. The MECCA policy-committee, the formal leadership of the consortium, on the other hand, was not familiar enough with the scientific state-of-the-art.

These difficulties diminished the ability of the policy-committee to guide the work in the way it initially was planned. Instead, participating scientist became the major drivers of the projects. The case-study investigates the different driving ideas of MECCA from the initial phase beginning in 1985 to the final evaluation in 1995-1996.

MODELING CLIMATE PROSPERITY

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Recent discussions on economic costs of climate change have a rich ancestry. They stretch back to the eighteenth century analyses of John Peter Purry work to minimize the Dutch East India company's transport losses by finding out a 'the best climate of the earth' to Adam Smith comparing climate with taxes in terms of scarcity to which they might lead to branches of political economy involving insurance, public health, urban planning, or domestic ventilation. During the nineteenth century, Stanley Jevons in Manchester wrote on the seasonal impact of leisure markets on the Bank of England's decisions to raise interest rates. During the twentieth century, Sir Napier Shaw and H. Stanley Jevons worked on the correlation between the onset of seasons and crop yields, William Beveridge on links between the export index and changes in the barometric pressure and Henry Clayton on the correlation between commercial 'panics' and rainfall deficit in the Ohio Valley. During the 1970s the Yale economist William D. Nordhaus used a simple 'energy model' to simulate the market allocation process involved in curbing the emission of GHGs. Nordhaus's latest model (DICE) is just one in a series of modern analytical and numerical simulations of economic futures taking into account the anthropogenic change in global climate patterns.

In this paper I wish to (1) contextualize economic modeling within the twentieth-century environmental economics and world system modeling and (2) explore the modeling architecture used in the projections of climate-sensitive economic scenarios, using Nordhaus as a case study. I will pay special attention to the decisions made in the choice of modeling parameters as reflecting on the model's ability to – among other things – (a) determine the pace of emission reduction, (b) time profile of emission reductions and (c) global distribution of such reductions. Because such issues represent vital policy concerns, it is of critical importance to understand the assumption behind the existing modeling practices and assess their relevance in the context of the emerging market of 'climate prosperity.'

HOW GLOBAL WARMING STIMULATED OCEAN RESEARCH IN GERMANY

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Global warming means a gradual increase of average temperatures in the Earth's lower atmosphere and its oceans. This has happened many times during Earth's history. But now human inhabitants are responsible for it by industrial production of greenhouse gases – especially carbon dioxide. The effect is global and the oceans play a dominant role in controlling the heat budget around the earth. Besides this aspect global warming affects almost all processes – physical as well as biogeochemical - in the ocean. Therefore, it has not only stimulated ocean research but also its interdisciplinary approach, to which research funding agencies and institutions have started to respond.

In 1962 – two years after Keeling's measurements of CO_2 increase, the German Research Foundation (DFG) stated the importance of research on the interchange of atmosphere and oceans due to increasing carbon dioxide in a memoir on marine research ("Denkschrift zur Lage der Meeresforschung"). In DFG's most recent memoir this topic is treated with priority in the first chapter: 'Climate variability: the role of the oceans'. I will present how the increasing awareness of anthropogenically caused climate change during the past 50 years of scientists, institutions, government and the public in Germany has spawned the formulation of relevant ocean research programmes and projects and how the funding levels have increased for such research. In 1962, ocean research institutions in Germany were concentrated at Hamburg, Kiel and Rostock-Warnemünde with about 100 scientists involved. Today the number has tripled with other locales in Bremen/Bremerhaven, Oldenburg and Potsdam. The role that global warming played in this growth will be discussed.

CLIMATE AND CLIENTELISM IN BRAZIL

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The creation of the Division of Meteorology and Astronomy a century ago, in November 1909, will be celebrated this year in Brazil as the starting point of scientific meteorology in this country. The new institution was part of a governmental project of widening the Brazilian National Observatory functions in order to encompass atmospheric as well as the traditional astronomical observations, following the model of nineteenth-century European institutions such as the Paris Observatory. Meteorological activities were already being held, since the last decades of the 19th century, in many Brazilian scientific institutions, including the Geographical and Geological Survey of São Paulo State, the Naval Meteorological Bureau, and the National Observatory itself. However, none of these aimed at the same national scope pursued by the new institution. In fact, between 1909 and 1921, when astronomy and meteorology were again dissociated, around two hundred meteorological stations have been spread all over the territory, from the developed Southeastern coastal cities to the unexplored North inland covered by the Amazon Forest.

In this paper I intend to bring up to discussion the historical role attributed to the Brazilian Division of Meteorology and Astronomy. Firstly, I will focus on the major organizational differences existent between this institution and the earlier initiatives mentioned above. Secondly, I will analyze the social and ideological backgrounds of its expansion from the populous coast to the "uninhabited" inland of Brazil. Finally, through the procedures actually adopted in the creation of the meteorological stations and the nomination of their employees I aim at exploring the political commitments inherent to the specific features given to the new scientific institution by its mentor, Henrique Morize (1860-1930). My hypothesis here is that the nineteenth-century organizational model followed by Morize in terms of concentrating meteorological and astronomical activities in the same institution as well as leaving the stations in the hands of local authorities contributed to reinforce less the territorial integration of the Brazilian nation than the political "clientelism" prevailing during the so-called "Old Republic" (1889-1930).

Symposium S31
Les Ingénieurs au Service des Princes et des Etats: Un Regard sur la Mobilité Professionnelle en Europe, XVe-XIXe Siècle

LES INGÉNIEURS POUR LE *RISORGIMENTO* ITALIEN : UNE CONTRIBUTION « INTERNATIONALE » POUR LA CONSTRUCTION DE LA NATION

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Le procès politique qui a s'est achevé avec l'unification des différents États de l'Italie en 1860, a trouvé dans les parcours des savants un lien avec le milieu international. Ce dernier processus était tributaire, d'une part, de l'ouverture de ces experts au dialogue au delà des frontières, et d'autre part, de l'habitude des cabinets à considérer les ingénieurs et les architectes comme des collaborateurs indispensables pour se conformer au standard de qualité des structures au niveau européen.

La coutume d'envoyer à l'étranger les "intellectuels" pour apprendre les techniques et pour se mettre au courant a eu comme pendant les fréquentes visites des architectes et des ingénieurs européens en Italie, pays du *Grand Tour,* mais aussi laboratoire d'expérimentation, étant donnée la nature articulée et complexe de son territoire. L'échange des expériences, la diffusion des textes, la circulation des idées, l'élaboration de langages spécifiques ont trouvé un moment de formalisation pendant les Congrès des Savants, qui se sont réunis des 1839 à 1847 dans différentes villes d'Italie, avec le consensus des gouvernements.

Ils ont été le moment de certification des connaissances et du professionnalisme évolué des ingénieurs, leur apport à la construction de la nation.

L'ÉTAT LIBÉRAL PORTUGAIS ET LA FORMATION À L'ÉTRANGER DE CADRES TECHNIQUES MODERNES (1851-1900)

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Avec le nouveau cycle libéral initié au Portugal avec la *Régénération* (1851), en ce qui concerne la formation de cadres techniques modernes dans les secteurs de l'ingénierie et de l'architecture, grâce à la formation à l'étranger de certains de nos meilleurs jeunes professionnels, l'évolution dans ces métiers a été significatif. Avec des pensions accordées par l'Etat depuis 1865, ou par des riches protecteurs, ceux-ci ont parti pour compléter ses études à l'étranger (majoritairement à Paris), en cherchant à compenser les insuffisances esthétiques et techniques de l'enseignement qu'ils avaient reçu dans les académies de Beaux Arts et dans les écoles Polytechniques de Lisbonne et du Porto. Les architectes ont cherché surtout à augmenter leurs compétences techniques à l'égard de la construction et aux nouveaux matériels; les ingénieurs concernant des secteurs et des typologies réservés par convention à l'architecture. De ce processus né une génération détentrice d'une culture techno-artistique qui a su faire une synthèse entre les deux domaines professionnels et, par conséquent, plus préparé pour répondre aux défis que la modernité industrialisée plaçait à l'art de construire.

Un cas d'étude exemplaire dans ce processus d'assimilation de la culture techno-artistique a été Luís Caetano Pedro d'Ávila. Né à Goa, il a initié sa formation à l'École Militaire et des Mathématiques de Pangim, ensuite il a continuée ses études d'ingénierie à l'École Polytechnique de Lisbonne, mais en 1866 il se rend à Paris avec une bourse du Ministère des Œuvres Publiques de l´État libéral portugais qu'il a accompli dans la qualité d'élève d'architecture à l'École Impériale des Beaux Arts de Paris.

Par sa formation et pratique il a été capable de faire une synthèse entre le savoir de l'ingénieur et celui de l'architecte. À travers les projets, la direction des chantiers et la modernisation des édifices, qu'il a faits autant pour des clients privés comme pour l'État, Pedro d'Ávila a maintenu une continuité engagée dans ses options. Il a conçu un langage propre, inscrite dans une matrice classique, simultanément, cosmopolite et éclectique.

TRAINED IN EUROPE TO SERVE THE STATE: PRELIMINARY REMARKS ON OTTOMAN ENGINEERS OF THE 19th CENTURY

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The last decades of the 18th century witnessed a radical reformation of the Ottoman military, which also led to the organization and modernization of the technical education in Turkey. Military colleges to train naval engineers, and civil engineers were founded in Istanbul. The graduates of both schools, the so-called 'military engineers' served the Empire in various fields, such as fortification, gun casting, surveying, mining, shipbuilding and public works. As the creation of a civil school of engineering was realised only a century later, the 'military engineers', together with their numerous European colleagues, undertook most of the engineering work in the Ottoman lands. From 1830 on, the Ottoman government began to send the locally trained engineers to Europe to improve their knowledge in military arts and technology. The first group of engineer-students were sent to Paris. Ibrahim Edhem (1818-1893), a member of this group, graduated from the École des Mines, and subsequently served as foreign minister and Grand Vizier. Four years later a second group, consisting of officers and graduates from Military Engineering School, left for Great Britain. Later in the century, other Ottoman students were sent to Austria, Belgium, France and Great Britain, respectively, to improve their knowledge and technical skills. Back to Turkey, they served in diverse state institutions for the modernization of technical education and the execution of engineering works.

The present paper aims to present notes gathered from primary sources so far regarding the Ottoman engineers trained in Europe in the 19th century. The expectations and the policy of the state in sending the young engineers abroad, the fields they studied, the schools they attended and the work they were entrusted on their return will be reviewed.

ARISTOCRATES EN ECOSSE – INGÉNIEURS EN RUSSIE: LA FAMILLE BRUCE AU SERVICE DE LA COURONNE RUSSE, FIN XVII^{e}- DÉBUT XVIII^{e} SIÈCLE

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L'histoire de la famille Bruce que je me propose d'esquisser ici dans les grandes lignes offre une matière richissimes pour étudier la mobilité des experts en Europe car elle permet de suivre, sur cinq générations au moins, l'étonnante carrière des aristocrates écossais devenus "les étrangers moscovites" au service des tsars. Cette carrière, militaire pour la plupart d'entre eux, a permis aux Bruce russes de forger leur excellence dans les domaines tels que l'artillerie et le génie mais aussi de se distinguer dans les sciences, dans l'enseignement et dans l'organisation des grandes administrations techniques. Leur courage en temps de guerre, leur efficacité en temps de paix, leur loyauté et le sens du devoir ont valu aux hommes de cette famille des postes de confiance les plus haut placées et la position sociale extrêmement élevée. L'indépendance d'esprit et la dignité innée se pliant difficilement devant l'arbitraire ont parfois rendu la tâche difficile, en attirant sur certains la disgrâce. Jacob W. Bruce, le troisième du nom, est le plus fameux de tous : diplomate, guerrier et savant, il a fait une carrière d'ingénieur particulièrement fulgurante sous le règne de Pierre I, et son nom est entré dans la légende (le « Faust russe ») : le parcours de cet expert sera donc au centre de mon exposé. Mais dans l'ensemble, du fondateur de la dynastie James Bruce venu en Russie en 1647, à son dernier représentant (associé par mariage), Valerian Musin-Pushkin-Bruce éteint sans descendance au début du XIXe siècle, la famille de ces experts a inscrit une page haute en couleur dans l'histoire de la civilisation russe et de sa culture technique.

LES INGÉNIEURS FRANÇAIS ET FLAMANDS ET LES PROJETS DE FORTERESSES DE L'ALENTEJO, PORTUGAL, AU XVII^e SIÈCLE

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Portugal, a partir du XVIème siècle, a connu plusieurs initiatives a propos de la confirmation de la frontière, comme les travaux de Duarte d' Armas, en 1509. Les circonstances politiques, pendant la Guerre de Restauration (1641-1668), ont signifié le renforcement de la frontière, avec des interventions dans le réseau médiéval fortifié, ce qui ne signifie pas toujours une révision approfondie. L'ascension au trône du roi Jean IV signifie, dès 11 Décembre 1640, la création d'un Conseil de Guerre et d'un Comité des Frontières, pour inspecter et traiter des sujets sur les fortifications. Six provinces militaires ont été créées, et Alentejo est l'un d'eux (la plus extensive, avec 26.158 km2). Compte tenu de leurs caractéristiques topographiques, cette province était très vulnérable, d'où la forte concentration des places de guerre, et aussi la priorité, au cours de cette période, du renforcement défensive des villes de l'intérieur, comme Évora et Beja. Les interventions au XVIIème siècle ont été synonymes d'exigence constructif, impliquant la connaissance de nouvelles techniques et tactiques militaires. C'est dans ce contexte qu'on parle de Luis Serrão Pimentel, auteur de l'œuvre M*éthode Lusitano*, chargé depuis 1647 de la Classe de Fortification et de l'Architecture Militaire, pour formation des ingénieurs, au moment ou qui travaillait sur les fortifications étaient des ingénieurs étrangers. Serrão Pimentel s'inspirait, théoriquement, sur Adam Freitag, Mathias Dogen, Goldman, Marolois, Coheorn Stevin. Les constructions militaires de cette période ont été principalement conçues par les ingénieurs Européens (français, italiens, néerlandais), en connaissant de scènes de guerre aux pays d'origine depuis de nombreuses années (la Guerre de Trente ans, des révoltes religieuses aux Pays-Bas et en France). Leur travail reflète l'adoption du modèle nordique (le néerlandais et l'allemand), avec des fortifications conçues pour l'intérieur des polygones, des profils adaptés, l'abondance des travaux extérieurs, en relèvent le niveau scientifique de la fortification. Nous trouvons en Alentejo au XVIIème siècle, entre autres, John Pascácio Ciersman (flamand), prêtre jésuite, connu sous le nom de Cosmander, Nicolau de Langres (français), Jean Gillot (flamand), P. Sainte-Colombe et Manesson Masset, tous sous la direction de l'ingénieur-responsable Lassart Charles. Au cours de la longue période de conflit entre le Portugal et l'Espagne, beaucoup de ces ingénieurs on travaillé pour les deux royaumes (Langres, P. Sainte Colombe, Cosmander). L'influence étrangère serait prolongée, dans le siècle suivant, quand le marquis de Pombal, a demandé en 1762, les services de Guillaume de Lippe-Schaumbourg, aussi en Alentejo (Elvas, Olivença), selon les enseignements de Sébastien Vauban ; ce projet a été achevé, avec quelques ajouts, par le colonel Luiz Guilherme de Antón Valleré, jusqu'en 1792.

Le degré de spécialisation technique, les hommes et les matériaux utilisés dans les systèmes de défense a atteint un niveau tel que seules les grandes monarchies peuvent se permettre de dépenses somptuaires de forteresses et de matériel militaire, aussi que payer les différentes tâches à des experts dans l'art de la fortification, comme ce fut le cas pour les ingénieurs militaires.

LAMÉ ET CLAPEYRON EN RUSSIE, 1820-1830

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Pendant la période napoléonienne, l'Empereur s'était servi de l'Ecole polytechnique en faveur de ses aventures militaires. Ensuite, la Restauration des Bourbons provoqua d'énormes difficultés dans le domaine des sciences, et 250 polytechniciens furent licenciés. L'Empereur Alexandre 1^er de Russie admirait la France et, en 1820, le gouvernement russe s'adressa à ce pays dans le but de la provision de personnel pour son Institut des voies de communication. L'Ecole polytechnique lui recommanda de jeunes ingénieurs dont Gabriel Lamé (1795-1870) et Benoît-Pierre-Emile Clapeyron (1799-1864), qui joueront un rôle important dans le développement du génie civil en Russie.

LES PÉRÉGRINATIONS EUROPÉENNES DE L'INGÉNIEUR-CONSTRUCTEUR RUSSO-POLONAIS, STÉPHANE DRZEWIECKI (1844-1938)

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Fils d'une famille noble, Stéphane Drzewiecki est né citoyen russe en terre polonaise aujourd'hui ukainienne. Après une scolarité effectuée à Paris, il aurait intégré l'École centrale des arts et manufactures (aucune source ne l'atteste cependant) où il se serait lié d'amitié avec Gutave Eiffel. Sa formation achevée, il opte pour la profession d'ingénieur civil. C'est à l'exposition internationale de Vienne en 1873 que le Grand duc Constantin Nikolaïevitch le sollicite comme conseiller technique auprès de la marine de Saint Petersbourg. Mais en 1876, l'ingénieur s'engage dans la marine marchande armée de Russie avec en tête le projet de concevoir un sous-marin pour la défense des côtes et trouve à Odessa les moyens de réaliser son idée d'un sous-marin à pédales qu'il dénomme « podascaphe ». Un second prototype conçu à Saint Petersbourg retient l'attention du tzar qui ordonne en 1881 sa construction en série pour la défense de Sébastopol et de Cronstadt. Mais au fil des ans l'intérêt pour ces sous marins de poche décline et l'attention de l'ingénieur se tourne vers l'aviation et, en 1885 gagne Paris où il s'installe définitivement, fasciné par l'effervescence qui agite le milieu des ingénieurs parisiens. Là il déploie une activité inventive, toujours dans le domaine des sous-marins mais aussi dans celui des hélices marines et aériennes dont il établit la théorie à la fin du XIXe siècle. Avec les débuts de l'aviation, Drzewiecki se rapproche de Gustave Eiffel qui jette alors les bases de l'aérodynamique expérimentale, et collabore avec lui au laboratoire d'Auteuil à la mise au point d'un aéroplane à stabilité automatique. Pendant la guerre, il est mobilisé par Paul Painlevé, ministre défenseur du « plus lourd que l'air », à la traduction du cours d'aérodynamique du théoricien russe Dimitri Joukowski et présente à l'Académie des sciences ses recherches sur la théorie des hélices aériennes pour lesquels il reçoit le prestigieux prix Montyon. Alors qu'il a 76 ans, cette distinction marque le point culminant de sa carrière d'ingénieur civil.L'itinéraire de l'ingénieur Drzewiecki avec ses particularités n'en est pas moins représentatif d'un courant de migrations scientifiques et techniques de la Russie vers la France qui concerne au début du XXe siècle le cercle des disciples du théoricien Joukowski, tels Wladimir Margoulis, Constantin Chilowski ou Dimitri Riabouchinski qui eux aussi seront associés à la moblisation scientifique de 1915-1918 par le ministre mathématicien Paul Painlevé.

BETWEEN EUROPE AND AMERICA. E. TERRADAS (1883-1950) AND THE NEW ENGINEERING IN SPAIN

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E. Terradas trained as an engineer in Barcelona. He graduated in Mathematics and Physics (1904) and also in Industrial Engineering (1909) and Civil Engineering (1918). As a child, he lived in Germany, where he completed his primary and secondary education. On his return to Barcelona, this German education allowed him to complement the official university syllabus with studies he undertook on his own with German books and journals. In 1906 Terradas became a university professor, combining his teaching with engineering projects. In 1915 he joined the Industrial School of Barcelona and in 1923 he supervised the construction of a line of the underground railway in Barcelona. He travelled to France, the Low Countries, Germany, Great Britain and Italy, buying books, visiting factories and research centres. In the summer of 1927 he accepted an invitation to lecture in Buenos Aires, and the Spanish government charged him with the mission to study potential Hispano-American collaboration in the field of technology and industry. He visited Argentina, Uruguay, Chile, and Bolivia. The contacts made during this visit enabled him to be invited to Argentina in 1936, thereby avoiding the turmoil of the Spanish Civil War. He worked at the University of La Plata and supervised a number of projects, including an airport for Buenos Aires. The stay in Latin America gave him the opportunity to become more familiar with US technology, mainly in the field of Aeronautics. Terradas played an important role in Spanish engineering in the first half of the XX century and most of his contributions were influenced by his European and American experience

FOREIGN ENGINEERS IN SPAIN AND IN THE OTTOMAN EMPIRE: A COMPARATIVE STUDY FROM A LONG-TERM PERSPECTIVE (18th TO EARLY 20th CENTURY)

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Hundreds of foreign engineers worked on Spanish and Ottoman territories during the 18th, 19th and the early 20th centuries. During this time, multilateral profitable relations were established: meanwhile foreign engineers obtained rentable, prestigious jobs they might have never achieved in their countries of origin and got access to a kind of expertise that distinguished them from their less mobile colleagues, different levels of administration, as well as private companies in the receptor countries benefited from the work and the expertise of these men. Local engineers, on the other hand, suffered from the competition of their foreign colleagues, having nevertheless the opportunity to learn from them and use the acquired knowledge for their promotion.

In our paper, we focus on comparing long-term trends in the activities of foreign engineers who worked on Spanish and Ottoman territory. We will pay special attention to the questions of scientific-technological interchange and to the dynamics related to the construction of modern state.

LA MISSION DES PONTS ET CHAUSSÉES EN GRÈCE (1882-1886) SOUS LE DOUBLE ASPECT D'UN CORPS NATIONAL D'INGÉNIEURS ET DES RAPPORTS ÉCONOMIQUES INTERNATIONAUX

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La mission du corps des Ponts et Chaussées en Grèce ne fut pas un cas d'exception en ce qui concerne la présence des ingénieurs français à l'étranger ; présence constatée non seulement dans les pays de la Méditerranée mais aussi en Autriche-Hongrie, en Russie, en Roumanie, au Luxembourg, en Suisse, en Belgique, aux Pays-Bas et en Amérique latine. D'ailleurs, il est reconnu que des ingénieurs français, dont plusieurs anciens élèves de l'Ecole des Ponts et Chaussées, première école d'ingénieurs au monde, ont largement contribué à la diffusion de la technologie française en Europe, surtout depuis l'époque napoléonienne.

Or, la présence dans les années 1880 de ce corps en Grèce n'était aucunement une nouveauté au sens de la diffusion de la technologie française. Le rôle initial de la mission se définissait pour être « la direction des travaux publics à exécuter dans le royaume de Grèce ». (lettre du Ministre des Travaux Publics, 24 octobre 1882, Archives du Ministère des Affaires Etrangères (dorénavant AMAE), 6/Affaires diverses politiques, V.135). Néanmoins son caractère tardif pourrait mettre en évidence quelques problèmes d'interprétation par rapport à l'évolution de l'influence de la science et de la technologie française dans le monde pendant le dernier quart du XIX siècle.

La question que nous posons en ce qui concerne la mission française en Grèce peut se formuler ainsi : comment un corps technique d'une constitution scientifique tellement « robuste » et d'une identité idéologique affleurant selon quelques chercheurs le post-moderne, désigné par le rang distingué qu'il occupe dans une société à la recherche du rôle structurant des sciences et des techniques, pourrait-il apporter son aide (parce que dans le cadre de la mission en Grèce c'est de cela qu'il s'agit, plutôt que de servir simplement de modèle) à un pays qui se trouve sans aucun doute à la périphérie des pays industrialisés ? Or, nous essayons de constater que le corps technique français par nature n'était pas en état d'offrir un secours positif à ce nouveau pays et en même temps de conditionner la demande de technologie comme elle se présentait dans l'état grec.

SOUS LE SIGNE DE L'ÉCOLE DES PONTS ET CHAUSSÉES : JOÃO EVANGELISTA DE ABREU ET LES CHEMINS DE FER PORTUGAIS

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L'enseignement des ingénieurs au Portugal est resté sous la direction de l'armée jusque le XX [e] siècle : les ingénieurs portugais étaient envisagés surtout comme des ingénieurs militaires qui pouvaient avoir une activité dans le cadre du génie civil pendant les périodes de paix.

Ce profil hybride de l'ingénieur était particulièrement désajusté au concept de progrès de la *Regeneração*(1850), fondé sur l'idée de développement industriel et technique. Dans ce cadre, où les travaux publics ont devenu particulièrement importants, les ingénieurs portugais ont cherché une formation plus spécialisée au-dehors des frontières du Portugal. L'École des Pontes et Chaussées, étant le paradigme du génie civil, attirait des ingénieurs de tout l'Europe : être un ingénieur de l'École était le synonyme d`être un expert .

Cette communication examine le parcours académique de João Evangelista de Abreu à l'École des Pontes et Chaussées, en cherchant des liens entre son expérience d'élève à Paris et son parcours professionnel au Portugal comme responsable de plusieurs lignes de chemins de fer.

A PLACE FOR FOREIGN SPECIALISTS: FRENCH AGRONOMISTS AND THE INSTITUTIONALIZATION OF AGRICULTURAL SCIENCES IN BRAZIL, 1870 – 1910.

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The scientific relationship between Brazil and France has already been written from different points of view. Until now no one has focused particularly on the agricultural sciences. In the traditional historiography agricultural sciences were usually seen as part of basic sciences or in a general engineering field. Recently I researched its institutionalization revealing its historical particularities and relations to both kinds of knowledge. This paper tends to show how French agronomists were called to attend a variety of missions which were related to different aims of the professionalization process. To comprehend this I describe the activities of a French agronomist León Quét who lived in Belo Horizonte, Minas Gerais state.

In the end of XIX century agricultural elites were discussing what kind of agricultural professionals the country would need. At the beginning of the XX century the discussion focused on what kind of regional professionals or even what kind of national profile would be desirable. On the same moment agricultural schools were proposed as the main institutional model to develop the agricultural sciences in Brazil, differing from other countries experiences and conflicting with other institutional models that were adopted by regional elites. In other words, it was led to the professionals and to the schools the problem of the Brazilian agriculture modernization.

What would be better? Graduated specialists on each branch of agriculture? Or professionals who would be able to apply all sciences and technologies in the field? Besides those main positions another kind of specialist was emerging and was motivated by the development of new scientific theories and technologies of the XX century. New instruments and procedures to observing, multiplying, reproducing and disinfecting all natural beings were reaccepted, adapted and developed in those agricultural schools. Hence specialization occurred not only for political and economical issues, but in the intention of creating the Brazilian agricultural science.

Despite the low salaries agricultural schools were a good choice for foreign young agronomists or researchers who wanted to investigate tropical agriculture or a particular culture, as coffee, sugarcane, horticulture, cattle culture, soil sciences, etc. They received and gave especial recognition to those scientific spaces. But they were frequently taken as an example of how expensive was to implement the modern agriculture, due to acquisition of books, instruments, more space for experimentations, plants, animals, museums and other costs.

In this context few of them stayed. That was the case of the French agronomist León Quét who lived in Belo Horizonte, Minas Gerais state, in 1897 and 1898. His passage through there only may be comprehended on a largest context of the French-Brazilian scientific relationship, comparing with other French agronomists in Brazil and inserted in the agricultural science institutionalization process. With this discussion I expect to contribute for the understanding of circulation of engineers abroad Europe and its relation to the development of Brazilian science.

GASPARD MONGE ET LES POLYTECHNICIENS À ROME

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Gaspard Monge, le fondateur de l'Ecole polytechnique, fut à Rome en tant que commissaire pour les sciences et les arts en 1796 et 1797. Il était chargé des l'envoie en France de cinq cent manuscrits de la Bibliothèque vaticane. Il se rattacha aux milieux savants de Rome. En 1798 Monge fut encore à Rome pour donner la Constitution à la République Romaine. Il fonda un Institut des sciences et des arts qui fut le modèle de l'Institut d'Egypte. Il projeta aussi à Rome une *Ecole Centrale Polytechnique*(entre parenthèse le nombre de chaires):

Sciences mathématiques (7): Arithmétique, Géométrie, Algèbre élémentaire, Synthèse, Analyse, Dynamique et hydrodynamique, Optique, Architecture hydraulique, Astronomie.

Sciences naturelles (6): Physique expérimentale, Chimie, Botanique, Minéralogie, Zoologie, Agriculture.

Belles Lettres (8). *Philosophie et droit* (9). *Médecine* (12).

Durée des cours: Belles Lettres, Philosophie et droit, Mathématiques: 4 ans; Médecine 5 ans ; Etudes d'ingénieur 3 ans ; Chirurgie, Pharmacie 2 ans.

Rome entra dans l'Empire Napoléonienne en 1809. Elle était destinée à devenir la deuxième ville de l'Empire (le fils de Napoléon fut désigné roi de Rome). Des savants administrateurs furent envoyés à Rome, tel que le préfet Tournon, le général Miollis, l'idéologue Degérando. Un plan moderne de la ville et du territoire fut dressé. Pour les grand travaux hydrauliques fut envoyé a Rome Gaspard Riche de Prony qui dressa en 1810-1811 un projet pour les Marais pontines devenu célèbre par ses écrits. Aussi Navier fut envoyé à Rome pour les ponts du Tibre et pour défendre la ville des eaux des fleuves.

Dans la conférence on examinera, sur la base aussi de nouveaux manuscrits inédits, les bienfaits de ces interventions des polytechniciens français à Rome. Après la restauration du domaine papale à Rome en 1814, le card. Ercole Consalvi, secrétaire d'état, pris soin de conserver la remise en ordre du territoire et des études pour les ingénieurs de la période française.

Références:

P. Alvazzi Del Frate, *Università napoleoniche negli Stati Romani*, Roma, Viella, 1985.

M. Crosland, *Science under Control: the French Academy of Sciences, 1795-1914*, Cambridge University Press, 1992.

S. Cardinali, L. Pepe, *Gaspard Monge. Dall'Italia (1796-1798)*, Palermo, Sellerio, 1993.

L. Pepe, *La formazione degli ingegneri a Roma dalla Scuola Politecnica Centrale alla Scuola degli Ingegneri Pontifici*, in *Amministrazione, formazione e professione: gli ingegneri in Italia tra Sette e Ottocento*, a cura di L. Blanco, Bologna, Il Mulino, 2000, pp. 301-319.

Camille de Tournon: Le préfet de la Rome Napoléonienne, 1809-1814, Roma, Palombi, 2001.

C. C. Gillispie, *Science and Polity in France: the Revolutionary and Napoleonic Years*, Princeton University Press, 2004.

L. Pepe, *Istituti Nazionali, Accademie e Società scientifiche nell'Europa di Napoleone*, Firenze, Olschki, 2005.

L. Pepe, *Gaspard Monge et le laboratoire institutionnel de la République Romaine: les écoles polytechniques,* in, *Gaspard Monge: un savant en son temps*, in *Bulletin de la société des amis de la Bibliothèque de l'Ecole polytechnique*, 41 (2007), pp. 144-157.

M. T. Borgato, L. Pepe, *Prony in Italia*, in *Bollettino di Storia delle Scienze Matematiche*, 27 (2007), pp. 77-108.

P. Del Negro, L. Pepe (éd.), *Le università napoleoniche. Uno spartiacque nella storia italiana ed europea dell'istruzione superiore*, Bologna, Clueb, 2008.

LES INGÈNIEURS ÉTRANGERS DANS L'INDUSTRIE DU GAZ ET DE L'ÉLETRICITÉ AU PORTUGAL, 1850-1920

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À partir de la deuxième moitie du XIXe siècle Portugal a connue un développement industriel favorisé par le nouveau régime politique (appelé "Régénération"), que soutenait l´importance des travaux publics, la modernisation de l'industrie et la création d'infrastructures urbaines pour le progrès du pays.

Cependant, tandis que le retard de la croissance économique et les difficultés financières du pays on imposé le recours aux financements étrangères, de même les insuffisances de l'enseignement technique ont entravé la création et la modernisation des industries et exigé qu'on recourrait à des ingénieurs étrangères, notamment pour la mise en place des réseaux de gaz et d'électricité et pour l'implantation de moteurs à gaz et à électricité aux usines. Les contrats d'achat des machines nécessaires à la production de gaz ou d'électricité impliquaient, fréquemment, l'aide de techniciens qui devaient superviser leur installation.

Les investissements étrangers ont poussé l'internationalisation des industries et, par le biais de leurs filiales ou de leurs capitaux, ces investisseurs ont stimulé la circulation des ingénieurs et des techniciens dans l'espace européen. Soit au service des industries, soit des écoles d'ingénieurs, ces hommes ont contribué à 1'uniformisation des connaissances et des procèdes technologiques.

En outre, en raison des intérêts de certaines compagnies électriques dans plusieurs pays européens, les ingénieurs ont été amenés à circuler dans les différents établissements exploités par ces entreprises ou par celles où avaient des intérêts financiers.

LES INGÉNIEURS DE LA RENAISSANCE AU SERVICE DU GRAND PRINCE DE MOSCOVIE, OU LES "HABITS" POUR UN ÉTAT UNIFIÉ (FIN XV^{e} - DÉBUT XVI^{e} SIÈCLES)

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Le premier contact marquant en matière de techniques, d'architecture et d'arts de l'ingénieur que la Russie ancienne établit avec l'Europe occidentale, eut lieu à la charnière des XVe et XVIe siècles, quand le grand prince de la Moscovie fit venir sur ses terres une poignée de spécialistes de l'Italie septentrionale. Malgré leur nombre limité (quelques dizaines) et la période relativement courte de leur présence collective sur le sol russe (70 ans), l'impact de ce groupe sur l'essor de la culture technique russe fut si considérable et le phénomène en soi si complexe que les historiens (de la Renaissance d'une part, de la Russie moscovite, de l'autre) n'ont pas de cesse de l'étudier sous toutes les coutures. Ayant entrepris, pour notre compte, de revisiter ce sujet du point de vue du transfert des connaissances ouest-européennes vers la Moscovie, nous nous sommes en même temps proposé de tester son caractère « unique » présumé et pour cela, l'aborder dans l'optique de comparaison avec d'autres pays européens durant la même période. Dans la présente communication, nous souhaitons offrir le premier bilan de cette recherche qui diverge sur certains points avec la vision établie. Nous y aborderons les questions suivantes :

- la composition nationale des experts qui ne se limitait guère aux seuls Italiens mais formait une entité à la fois polyethnique et multiconfessionnelle;
- le cadre chronologique des événements que flanquent deux dates certaines : 1469 – le début des pourparlers concernant le mariage d'Ivan III avec Zoé Paléologue, et 1539 – la fuite des terres moscovites du dernier architecte italien (Petrok le Petit);
- les domaines du transfert qui concernaient la quasi-totalité des activités humaines et les aléas de leur acculturation à la fois restreinte et sélective;
- l'intensité de l'intervention de ces experts qui ne fut pas la même du début à la fin de la période étudiée ; les raisons d'ordre politique, culturel et religieux qui ont provoqué son ralentissement progressif et son étranglement définitif seront questionnés.

En conclusion, nous tenterons d'expliquer ce clivage entre l'intensité, la courte durée et l'abandon final de cette politique de transfert massif des connaissances européennes vers la Russie moscovite qui ne sera reprise, et cette fois-ci avec succès, que deux siècles plus tard, lors de sa transformation en Empire russe suite aux initiatives modernisatrices de Pierre Ier.

GREAT HYDRAULIC WORKS OF FRENCH ENGINEERS DURING THE NAPOLEONIC PERIOD IN ITALY

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With the proclamation of the Italian Republic (1802), the successive transformation into the Kingdom of Italy (1805) and the annexation of the Veneto territories (1806), a large part of the Po Valley was joined into a single State and, for the first time, a series of plans were put forward for the area as a whole, with interventions such as the immission of the Reno into the Po River, the construction of a barrel under the Panaro River, and the reclamation of the Great Veronesi Valleys. Engineers and cartographers of Napoleon's retinue played an important role as they were entrusted above all with the general supervision of the projects and the carrying out of those projects which had strategic and military importance. Gaspar Riche de Prony, in particular, was sent to Italy three times over a period which lasted about two years: in 1805, on the occasion of Napoleon's coronation as King of Italy, to inspect the flow of the River Po and its tributaries; in 1807-8, after the Peace of Pressburg, to carry out works on the Lagoon and port of Venice; in 1810-11, after the annexation of Rome to the Empire in 1809, to supervise the reclamation of the Pontine Marshes. Prony was frequently assisted by both Italian engineers (Costanzo, Michelotti, Brunacci, and Fossombroni) and French engineers (Condère, Dausse, Bouessel, and Sganzin).[1] Two other French engineers of Bridges and Roads, Bruyère and Rolland, were engaged in Italy in the spring of 1805, for the reorganisation of the Adriatic ports. The most interesting part of the project involves the construction of a new port destined to be the terminus for the river trade to and from Lombardy. This was part of an even grander project to link the Adriatic and the Tyrrhenian Seas by means of a single system of navigable rivers and canals which terminated in the Gulf of Savona (*Canal d'Adriatique*).[2]

Interventions and administrative reforms of the Napoleonic period in Italy were inserted into a solid tradition of hydraulic studies, always one of the main fields of applied mathematics. Special Commissions carried forth their works in those years: the Milan Commission (1799-1802) for the organisational and administrative changes, the Modena Commission (1803-1806) for the Po Basin, the Padua Commission (1806-1807) for the Veneto territories and the Venice Lagoon. The collaboration between the French experts and the Italian hydraulic engineers was not without its conflicts as two different schools and traditions came up against each other: the Italian one with its practical and thorough knowledge of the territory, and the French one based on innovative mathematical theories. The French military objectives, moreover, did not always coincide with local interests. Different points of view, for example, emerged between Agostino Masetti and the generals of the French engineers corps Chasseloup-Laubat and Campredon, who constructed the dam equipped with a navigation lock which in Mantua separates the Lower Lake from the Mincio River. Prony gave a critical opinion against Brunacci's project, carried out in collaboration with Parea and Tadini: i.e. the building of a navigable canal between Milan and Pavia which was designed to complete the connection between the Po and the Milanese network of canals.[3]

1. M. Bradley, *A Career Biography of Gaspard Clair Francois Marie Riche De Prony***,** *Bridge-Builder Educator and Scientist***,** Lewiston, Mellen**,** 1998. M.T. Borgato., L. Pepe, 'Prony in Italia', *Bollettino di Storia delle Scienze Matematiche*, 27/1 (2007), 77-154.
2. M.T. Borgato, 'I porti dell'Adriatico all'inizio del Regno d'Italia: una relazione inedita di Rolland e Bruyère', *Rivista Italiana di Studi Napoleonici*, 34/1-2 (2001), 297-330. Id., 'Commissioni idrauliche e riassetto del territorio nell'Italia napoleonica', *Rivista Napoleonica RNR*, 7/8 (2003), 197-231.
3. M.T. Borgato, 'Agostino Masetti e i suoi progetti idraulici', in: *Contributi di scienziati mantovani allo sviluppo della matematica e della fisica*, Mantova, 2001, 29-44. A. Fiocca, 'L'ispettore generale Antonio Tadini tra idrodinamica e idraulica sperimentale', *Rivista Napoleonica RNR*, 7/8 (2003), 177-212.

OTAGES DE « L'INTÉRÊT DES ARTS ET DES FABRIQUES » : LES MÉCANICIENS ANGLAIS EN FRANCE AU DÉBUT DU XIX^{e} SIÈCLE

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Sous l'Empire, le gouvernement prescrit, dans le cadre du conflit franco-anglais, des représailles contre les Anglais résidant en France. Cependant, des instructions du ministre de l'Intérieur viennent corriger et aménager ces mesures pour ceux « que l'intérêt des arts et des fabriques pourrait permettre d'excepter des mesures de représailles que le gouvernement a ordonnées et de la surveillance rigoureuse qu'il commande d'exercer sur les étrangers de cette nation ».

Les tableaux que les préfets dressent des Anglais demeurant dans leur département, permettent de découvrir tout un monde d'employés, d'ouvriers et d'entrepreneurs originaires d'outre-Manche installés en France, parfois depuis de nombreuses années. Nombre d'entre eux, qui ne portent pas le titre d'ingénieurs, sont des mécaniciens, versés dans « la sciences des machines », particulièrement textiles.

Cette communication tentera de tracer une esquisse de cette communauté, de ses caractéristiques et de son apport à l'industrie française. Elle s'appuiera notamment sur les documents de recensement des Anglais en France (Arch. Nat., Paris, F/15/3496) et les archives du Bureau consultatif des arts et manufactures (Arch. nat., Paris, F/12).

Symposium S32
From Natural History to Biology, when Life Sciences were Looking for an Object

LA BIOLOGIE VÉGÉTALE DURANT LA DEUXIÈME MOITIÉ DU XIXe SIÈCLE : DE LA PRATIQUE AU LABORATOIRE ET RETOUR

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Durant la seconde partie du XIXe siècle, la biologie végétale, comme le montrent notamment les œuvres de Philippe Van Tieghem et Gaston Bonnier, se structure en tant que discipline. Cette évolution se caractérise par un processus de synthèse mobilisant, autour de ses objets d'études, les méthodes de la biologie descriptive aussi bien que celles de la physiologie.

A cette première originalité, quant à l'identité disciplinaire de la biologie végétale, s'ajoute le fait qu'un corpus de données empiriques provenant de diverses pratiques culturales s'adjoint aux travaux fondamentaux. Cette dimension supplémentaire, si elle est un apport de données concrètes, est aussi une source de problèmes biologiques nouveaux et l'étude simultanée des domaines pratiques et fondamentaux révèle des effets euristiques réciproques.

La présente communication se propose d'analyser la complexité de tels liens épistémologiques au travers des études sur les plantes ligneuses et sur l'arboriculture dans le cadre de la biologie végétale française de la fin du XIXe siècle.

QUELLE RÉVOLUTION PASTEURIENNE DANS LES SCIENCES DU VIVANT?

Gérard Jorland

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Qu'il y ait eu une révolution pasteurienne dans les sciences du vivant, personne n'en doute. Il n'est pourtant pas facile de la caractériser précisément. Serait-ce l'adjonction d'un nouveau règne dans la classification naturelle? L'émergence d'une nouvelle discipline? L'introduction d'une nouvelle thérapeutique? Je chercherai à montrer que la révolution pasteurienne consiste en une nouvelle définition du vivant: comme brisure de symétrie. Et qu'elle subsume toutes ses découvertes, de sa réfutation de l'hétérogénie à sa découverte des spores et jusqu'à la mise au point du virus atténué.

7. LA NAISSANCE DE LA ZOOLOGIE EN BELGIQUE : PIERRE-JOSEPH VAN BENEDEN THE BEGINNING OF ZOOLOGY IN BELGIUM : PIERRE-JOSEPH VAN BENEDEN

Marie Claire Van Dyck

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Des études de médecine avaient suscité chez Pierre-Joseph Van Beneden (1809-1894) une passion pour l'histoire naturelle qui l'amena à Paris afin de suivre, au Muséum, l'enseignement de E. Geoffroy Saint Hilaire. De retour en Belgique, il devint professeur de zoologie à l'université de Louvain où il mena une longue et remarquable carrière scientifique. Sa belle réputation de père de la zoologie dans son pays est due à la manière avec laquelle il élabora une méthodologie permettant l'observation, sur de longues périodes, d'animaux dans leur milieu de vie. Pour ce faire, il alla jusqu'à créer sur la côte belge, de ses propres fonds, le premier laboratoire de biologie marine au monde. Cette pratique dynamique de la zoologie lui fit mettre en évidence la complexité du cycle de vie de plusieurs groupes d'animaux marins passant par des plans d'organisation successifs. Elargissant ses techniques d'observation à des animaux non marins, il dévoila aussi la complexité du cycle de vie des plathelminthes parasitant d'autres hôtes à leurs différents stades de développement et démentit, du même coup, la génération spontanée chez les pluricellulaires.

L'analyse de son œuvre tente de mettre en évidence son questionnement particulier face aux animaux soumis à son observation qui l'a conduit à des conclusions parfois bien audacieuses.

LA RÉCEPTION DU TRANSFORMISME DANS LES MILIEUX CATHOLIQUES À LA FIN DU XIXè SIÈCLE

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Maurice d'Hulst (1841-1896), premier recteur de l'Institut catholique de Paris, a joué un rôle essentiel dans les rapports entre science et christianisme, dans le dernier quart du XIXème siècle. A cette période, surgissent de grandes difficultés dans le rapport entre foi et science, particulièrement en ce qui concerne le transformisme, opposé à une lecture fondamentaliste de la Bible. C'est dans ce contexte que Maurice d'Hulst décide de lancer son projet de réunir un congrès scientifique de catholiques. Les savants catholiques devront y aborder, entre autres, les problèmes du jour sur la création et l'évolution, au plan exégétique comme au plan des sciences biologiques et anthropologiques.

Sur la question de l'évolution, Maurice d'Hulst est un modéré : certes, l'évolution ne saurait être une génération spontanée infondée. Mais elle est objet de science. D'Hulst remet en question le fait d'admettre obligatoirement l'existence d'espèces fixes à partir de la lecture de la *Genèse* et donc, d'engager le plan théologique dans une théorie scientifique. Mais, comme beaucoup de ses contemporains, il n'admet pas le passage évolutif de l'animal à l'homme. De plus, D'Hulst fait appel à l'exemple de la génération spontanée qui cohabitait très bien avec la pensée de saint Augustin. Au moment où Maurice d'Hulst poursuivait et amplifiait l'initiative des congrès internationaux des catholiques, différents livres avaient été publiés pour tenter de concilier le transformisme avec la vision chrétienne de la création. Le Père Dalmace Leroy, dominicain, publia en ce sens en 1887, *L'évolution des espèces organiques* puis, une deuxième édition en 1891, *L'évolution restreinte aux espèces organiques*, et il suggérait l'abandon du sens matériel des premiers chapitres de la *Genèse* et la possibilité d'acculturer la théorie de l'évolution à la pensée chrétienne. L'ouvrage sera condamné et le Père Leroy devra se rétracter en 1895. D'autres points de vue comme ceux du père Monsabré, du marquis de Nadaillac ou de l'abbé Guillemet vont dans le même sens. On note surtout le livre du Père Zahm (1851-1921, professeur à l'Université Notre Dame, aux Etats-Unis), paru en 1895, *Evolution and Dogma*.

Après la rétractation du Père Leroy (1895), la mise à l'index du livre de Zahm et la mort de Maurice d'Hulst (1896), l'espace de liberté entr'ouvert en vue d'un dialogue entre l'Église et les sciences va se réduire et disparaître progressivement au début du XXè siècle, sous le pontificat de Pie X.

LA QUESTION DU VERDISSEMENT DES HUITRES : OBSERVATOIRE PRIVILÉGIÉ DE LA TRANSFORMATION DES SCIENCES DE LA VIE À LA FIN DU XIXème SIÈCLE ET AU DÉBUT DU XXème SIÈCLE

Briée M.-L. Céline

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Le phénomène du verdissement des huîtres, affinage généré dans les claires ostréicoles, est dû à l'absorption du pigment bleu d'une diatomée, *Navicula ostrearia*, au niveau des branchies des mollusques. Au carrefour de la botanique et de la zoologie, il relève à la fois de la physiologie, de la biologie cellulaire et de la biochimie. Avec l'étude de cette question, nous nous plaçons donc de manière privilégiée pour observer le développement de ces disciplines.

L'analyse portera sur la question du verdissement des huîtres de 1820, date de la première étude scientifique du sujet, aux années 1910, qui furent le théâtre d'une importante controverse opposant le zoologiste David Carazzi, en Italie, et le botaniste Camille Sauvageau, en France. En insistant particulièrement sur ce dernier épisode, nous nous interrogerons sur la manière dont ce type d'évènements peut nous éclairer sur la structuration de la biologie actuelle, divisée en disciplines cloisonnées, et, notamment, sur ce qui concerne la séparation de la biologie animale et végétale.

AUX ORIGINES D'UNE SCIENCE DU DÉVELOPPEMENT

Jean-Louis Fischer

Centre Alexandre Koyré (CNRS, EHESS, MNHN)

C'est au 19e siècle que se constitue une science du développement avec l'émergence du l'embryologie scientifique dans les années 1820 (Pander, von Baer), marquant la fin d'une embryologie speculative (E. Geoffroy Saint-Hilaire, ERA Serres), et la fin de la foetologie du 18e siècle. L'école de l'embryologie scientifique est d'abord et par nécessité descriptive, alors que l'embryologie spéculative va s'ouvrir à l'expérimentation dans le cadre de l'anatomie transcendante. L'embryologie descriptive et comparée et la pratique expérimentale vont se rencontrer dans la fin des années 1880 pour constituer l'embryologie causale ou expérimentale. Cette nouvelle embryologie initie une science du blastomère, traçant un lien entre embryologie et hérédité. Avant les années 1880 l'embryon avait été soumis à des pratiques expérimentales, dans le contexte d'une tératologie expérimentale (C. Dareste) dont la finalité était la maîtrise d'un transformisme expérimental. Au 19e siècle l'embryon devient modèle pour la compréhension du développement normal de la fécondation à l'éclosion ou la naissance ; modèle pour l'explication d'un développement anormal (H. Fol et S. Warynski) ; modèle d'une preuve de l'évolution des espèces et, dans sa phase d'œuf de 2, 4 … blastomères, modèle pour une néo-épigenèse ou une néo-préformation. Les modèles de l'embryologie du 19e siècle seront ceux qui au 20 e siècle, après l'évènement de la génétique (1906), vont se décliner en mutationnisme ; tératogenèse expérimentale, embryologie chimique, embryologie ùmoléculaire, génétique du développement.

Symposium S33
How Instruments Change Hands

‘DISTINGUISHED AND WELL-KNOWN TO PRINCES AND LORDS’: THE SELF-MARKETING OF EARLY-MODERN INSTRUMENT-MAKERS IN GERMANY

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‘Distinguished and well-known to princes and lords’: that is how the Augsburg clockmaker Georg Roll described himself in a 1586 manuscript accompanying one of his mechanical globes. This talk explores how such familiarity came about, looking at examples of the marketing and exchange of mathematical instruments in German courtly circles in the decades around 1600.

SYMBIOSIS AND STYLE: THE PRODUCTION, SALE AND PURCHASE OF INSTRUMENTS IN THE LUXURY MARKETS OF EARLY EIGHTEENTH CENTURY LONDON

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The flourishing trade in instruments in early eighteenth century London was tightly interwoven with a wide variety of other crafts and commercial ventures. Most trade members viewed their stock strictly as commodities, rather than thinking or acting as if their business made them participants in loftier intellectual and philosophical spheres. They produced and marketed instruments for all but the poorest of social and economic strata and for many interest groups and professions, from those in the wealthy and influential west end of town to those in the more impoverished and maritime oriented east. Some of the optical, mathematical and philosophical instruments of this period were indeed intended to meet the specialized needs of researchers and research institutions. However, the strength of the trade as a whole seems to have lain in its service of diverse professions and of the more affluent and fashionable, on a scale that was impressive before widespread mass production. Instruments complemented many other types of products, from the broadsheets and almanacs sold by members of the print trade to the canvas and rope offered by ship chandlers near the docks, not to mention the ‘toys’ and jewelry wielded by the stylish set. Previous research has only hinted at the resulting immersion of instrument makers and sellers in the labyrinthine social and commercial networks of the pre-industrial capital, and in diverse approaches to achieving financial success and stability.

The resulting interconnections and dynamics are especially apparent in the marketing and sale of instruments as luxuries and as fashionable accoutrements. This extended far beyond the production of individual prestige pieces for international royalty and nobility, which remain central to many modern collections. There was a widespread trade in smaller instruments that were often relatively common in technical design but were elegantly crafted from expensive materials including ivory, fine metals, and colorful leather and shagreen. The most popular of these included spectacles and pocket-sized telescopes, microscopes and sets of drawing instruments. In addition to their practical uses — and the use of microscopes in the more dilettante explorations of the natural world that were then so popular — such items emphasized their bearers’ wealth and sense of style. The ownership and public use of a case of gleaming drawing instruments could say almost as much about a man as did the way in which he took snuff. Many of these instruments have disappeared over the centuries, going the way of other old family belongings, or in some cases having been cannibalized or adapted for later use. However, their fine appearance and occasionally the renown of their owners have allowed a good number to survive to the present day. I will discuss this luxury element of the early eighteenth century trade with respect to the instrument trade as a whole, and as revealed in the unparalleled records left by the optical instrument maker and fashionable retailer, George Willdey.

COUNTERFEITS, COPYCATS, AND KNOCKOFFS IN THE BRANDING AND SELLING OF SCIENTIFIC INSTRUMENTS

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We live in a world of goods that do more than serve our functional needs. The material objects that we produce, exchange, use, and show off can be markers of social standing and social aspirations. They may be a bridge between who we are now and who we want to be.

This is evident today in the proliferation of counterfeits and knockoffs of designer-brand goods. Elite consumers want the best and the rare in order to stand out from the crowd. They will pay top dollar for this privilege, but the objects of desire must not be so exclusive as to be unrecognizable to others. They hope to be trendsetters. Mass consumers, on the other hand, are fashion followers who try to emulate their social superiors in taste and judgment. Like the elite, they view ownership of the goods as a mark of their sophistication, trendiness, or connoisseurship, but having less income, they must settle for cheap imitations of status-symbol brands. Two types of counterfeits circulate in this market—those intended to deceive the buyer and those that don't. Retailers of the former are looking for large profits from the gullible while the latter cater to savvy shoppers who want the "look" for less. But one thing is for sure: Objects would not be counterfeited or knocked off unless there was a great demand for them. By their very existence, the objects tell us what is hot and what is not.

There is evidence of the same market behavior in the world of scientific instruments. In the late 17th century, Michael Butterfield invented a cute pocket sundial with a bird gnomon, which became all the rage in Paris. John Dollond in London patented an achromatic lens in 1758, and his firm became synonymous with quality refracting telescopes. Not only did many instrument makers copy the style and design of Butterfield or Dollond instruments, but some also counterfeited them. In the late 19th century, Ernst Leitz, Spencer Lens Co., and Bausch & Lomb mass-produced microscopes that looked like those of their eminent rival, Carl Zeiss, and branded them with corporate logos that mimicked the Zeiss trademark. Likewise, Swiss watchmakers produced copycats of American watches, inscribing them with fake American business names.

These instances of counterfeit, knockoff, and look-alike scientific instruments shed light on the role of fashion in the design and sale of apparatus. They offer evidence of which instrument makers and models users thought were the best in their day.

SELLING SURVEYING INSTRUMENTS IN AMERICA BEFORE THE PRINTED TRADE CATALOG

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Before instrument-making became a specialized profession in North America, mathematical instruments were either imported from Europe or produced by a wide variety of local craftsmen serving mostly local markets. Many eighteenth-century colonial clockmakers, for example, also made surveyor's compasses and chains, but never in large quantities. Even the Rittenhouse brothers, David and Benjamin, whose surveying compasses could compete with the very best European models, produced relatively few instruments. As Deborah J. Warner has shown, it would not be until the 1830s that American makers began to specialize in surveying instruments and to produce them in large numbers. William J. Young, who opened his Philadelphia shop in that decade, was soon making more than 100 surveying compasses per year (probably more than the Rittenhouses produced in their lifetimes). Not coincidentally, Young was the first American maker to introduce a dividing engine into his production process.

This paper will explore the shift from non-specialized to specialized production of surveying instruments by examining the growth of markets for such products. The provenance of most extant instruments is usually unknown. Trade cards did not become widespread until the second half of the nineteenth century, and printed trade catalogues also did not start to appear until the 1840s. Hence, the best sources for tracing markets in the early period are the few surviving account books kept by individual craftsmen and their advertising in newspapers.

Over the past decade, nearly all of the early American newspapers have been digitally scanned. Full-text search engines now allow comprehensive searches of the advertising content of these newspapers. By analyzing the geographical spread of the ads in conjunction with the geographical locations of individual purchasers of surveying instruments as listed in account books, I hope to test some hypotheses about how mathematical instruments were sold, the geographical range of local markets, and the significance of newspaper advertising for both the pre-specialized and the specialized makers.

THE GENTLE ART OF PERSUASION: ADVERTISING INSTRUMENTS DURING BRITAIN'S INDUSTRIAL REVOLUTION

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During Britain's Industrial Revolution – usually taken to date between about 1760 and about 1830 – the advertising of scientific instruments increased with the volume and variety of new items being produced. Only one large London retailer appears to have survived for this entire period – the brothers William and Samuel Jones of Holborn. They had learned much from their forerunners in the trade, and alongside the expected trade catalogues, produced much more ephemeral material – leaflets, trade cards, even encyclopaedia articles. This paper will look at what instrument makers and retailers across England were producing by way of advertisement at this time of rapid and convulsive change and ask what it tells us about their marketing of new instruments.

SELLING BY THE BOOK: SCIENTIFIC TRADE LITERATURE

Liba Taub, Joshua Nall

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Recently, historians of science have been paying closer attention to material that has often been regarded as somewhat ephemeral, for example, newspapers, popular science magazines and scientific toys. Curators of scientific instruments have long recognised the value of scientific trade literature as an invaluable resource for identifying and dating objects in their collections, as well as providing information about the use and availability of instruments and other material.

Focusing on the extensive collection of trade literature held in the Whipple Museum of the History of Science, Cambridge, and building on the work of others, such as the *Handlist of Scientific Instrument-Makers' Trade Catalogues 1600–1914* produced by Anderson, Burnett and Gee in 1990, and previous work done by Kemal de Soysa on Victorian trade catalogues, we will consider the ways in which such literature can be useful for historians of science more generally. Concentrating on examples from our collection, we will discuss the marketing of scientific instruments, as well as the customers and consumers of scientific instruments, models and tools.

MATHEMATICAL INSTRUMENTS CHANGING HANDS AT WORLD'S FAIRS, 1851-1904

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From the 1851 Crystal Palace exhibition in London to the 1904 Louisiana Purchase Centennial Exposition in St. Louis, Missouri, world's fairs were places where mathematical instruments changed hands. This was an era of radical transformation in the design, manufacture and distribution of these devices. Mathematicians, inventors and entrepreneurs who exhibited sought both customers for their innovations and the recognition of international panels of judges. The instruments on display included early commercial adding and calculating machines, pioneering difference engines, newly designed slide rules, and sophisticated geometric models. Vendors also sold traditional drawing instruments like protractors and rules, often manufactured using new materials and production techniques that greatly reduced cost. These appealed to a broad range of potential customers, including schools. It also was an era when the mathematical community came to include a much larger portion of the world. Exhibits at fairs not contributed to the spread of ideas and products, and increasingly were used by governments to demonstrate national modernity and intellectual achievement. Surviving objects, printed documents, and archival materials amply demonstrate this improvement, diffusion and internationalization of the material culture of mathematics as it occurred through exhibition at the fairs.

THE ECONOMICS OF INSTRUMENTS: PRICES IN EUROPE BETWEEN 1800 AND1914

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Scientific instruments have been intensively studied in the last 25 years, but very little has been written concerning their role as market commodities. How did the prices of instruments varied during the 19th century? Why British, German and French instruments had sometime different prices? Which factors determined these fluctuations? Were the prices determinant for the choice of an instrument maker or supplier? Did economic crisis, inflation, wars influenced these prices?

By examining the prices of instruments it is possible to obtain a series of information concerning their trade and their diffusion. Today hundreds of trade catalogues are available on line, many collection inventories are published, and by analysing them it is possible to give some (at least partial) answers to the above mentioned question.

Symposium S34
Cold War Social Science: Transformations in Politics, Patronage, Disciplines, and Democratic Ideology

THE STRANGE CAREER OF NEO-EVOLUTIONIST ANTHROPOLOGY IN THE UNITED STATES

Howard Brick

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This paper describes a post-Boasian, neo-evolutionist strain in American anthropology during the mid-twentieth century—one that revived notions of sequential change in human societies while *also* posing as a countermovement to conventional "modernization theory."

Almost as soon as students of Franz Boas established themselves at the academic center of American anthropology, a challenge emerged to their brand of cultural pluralism—not from old-guard racialism but rather from newer claims to anatomize and explain *culture change over time*.

Three key figures got the ball rolling. University of Chicago's Robert Redfield, whose 1930 book *Tepoztlan, A Mexican Village*, sought to analyze life in that Morelos town poised between local tradition and modern city life; second, University of Michigan's Leslie A. White, ethnographer of the Western Pueblo, who made himself by the late 1930s the leading champion of 19th-century evolutionist Lewis Henry Morgan; and third, Julian Steward of Columbia University, who opposed White's "unilinear" evolutionary schemes but also criticized Boas's "descriptive, analytic, relativistic, and essentially aesthetic discipline." By the late 1940s, such figures as these, diverse among themselves, had moved vigorously to upgrade evolutionist perspectives in the human sciences. By the Darwin centenary in 1959, evolutionist revival appeared to be in full swing.

Very shortly, successors or students of Redfield, White, and Steward raised objections to U.S. Cold War practices in the third world and to conventional "modernization" narratives of third-world development. From around 1959 onward, figures such as Marshall Sahlins, Eric Wolf, Sidney Mintz, and Stanley Diamond charted new ways—deeply critical of Eurocentric modernity and empire—of imagining regional, transnational, and world relations of social development. They laid the bases for varied world-historical and world-systems approaches that flourished in the 1970s and 1980s, prefiguring the "global" scholarship of our own time.

THE CROSSROADS OF RACE AND GENDER: ASHLEY MONTAGU AND THE UNITY OF HUMAN NATURE, 1950-1975

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In the early 1970s, Ashley Montagu, anthropologist and public intellectual, spearheaded a coalition of like-minded scientists to oppose the increasingly popular argument that humans possessed an instinct for violence. This paper will examine how Montagu's stance on human instinct developed out of his work in the 1950s as a spokesman for racial equality (as author of the first UNESCO *Statement on Race*) as well as for women's inborn talents for mothering (in his influential *Natural Superiority of Women* and in his regular columns in *Ladies Home Journal*). I will argue that his work in these decades illuminates the process by which "human" nature became gendered during the Cold War. Scientists' production of consensus on human unity depended both on a repudiation of separate racial natures as well as on an equally clear reaffirmation of distinct male and female natures. Montagu may therefore have had more in common with his opponents in the debate on human aggression than he acknowledged and than has hitherto been recognized.

REVOLT AGAINST THE SYSTEM: RADICAL INDIVIDUALISM AND THE AMERICAN SOCIAL SCIENCES IN THE AGE OF THE COLD WAR 1945-2000

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The Cold War brought about a more conservative, patriotic, nationalistic, and conformist mentality in the American social sciences, especially before the mid-1960s. Thus those who planned and organized military and tactics, for example, prepared for global conflict against purported Communist aggression, whether either on the Eurasian continent, in Western Europe, or whether against "national wars of liberation" in which the Communist great powers were engaged with proxy local revolutionary forces. Such "realities" demanded complete loyalty and conformity, two important watchwords in civilian discourse, politics, and culture to the mid-1960s. The "decision sciences" [including game theory] yielded such nuclear strategies as MAD [mutual assured destruction]. Economists were split between market-oriented conservatives and Keynesian liberal interventionists. Yet all economists insisted that the state, either as the nation or as the government, or both, were central to American life and survival against worldwide Communism. Among sociologists, psychologists, and anthropologists there were attempts to create a theoretical structure for these just-unified social sciences in which the prediction and control of individual and group behavior was possible. Legal theorists justified "process law" which stressed the importance of process over substance (e.g., over civil liberties). City planners emphasized the growth of suburbs connected to central business districts by superhighways and elaborate networks of urban services and functions. The two ideological 'cements' that held these ideas together were collectivist in character—a belief in a unified capitalist nation and faith in the scientific community and the laws of nature and society.

Yet all of this became unraveled in time. In the 1950s radical individualism emerged in the social sciences with challenges, for example, to nativist racial typologies, to cognitive psychology, to new ideas of the diversity and complexity of individuals, with the revolt against traditional behaviorism, and with the attacks on conformist and unified social science, as in the attacks on Talcott Parsons' sociology. There was also a rapidly growing disenchantment with scientific positivism, especially after the publication of *The Structure of Scientific Revolutions* (1962) by T.S. Kuhn. Beyond the academy, with the growing rebellions for civil rights, for feminism, and against the Viet Nam War, there was a revolt against collectivist nationalism and collectivist scientific positivism, which eventually blossomed into such movements as critical race theory, critical legal theory, critical feminist theory, even queer theory, but also into a new individualistic social science in political science, economics, law, anthropology, city planning and many other fields of the social sciences.

COLD WAR MODERN? SHAPES OF KNOWLEDGE IN HARVARD'S DEPARTMENT OF SOCIAL RELATIONS

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The Cold War social sciences were defined not only by their characteristic objects and methods, but also by the *forms* in which knowledge of these new problem areas was expressed. It mattered how knowledge looked and felt: its tractability for technical exercises, its symbolic rigour and design. The reigning instrumentalist view of theories, echoed across the disciplines, encouraged just such an emphasis upon the shapes of knowledge. W. V. Quine, the leading Anglophone philosopher of the postwar era, was famous for his insistence that, given the empirical underdetermination of theories, the only criteria for choosing between rival "systems of the world" were those of elegance, clarity, ontological parsimony, and ease of use. This elevation of the aesthetic and ergonomic aspects of knowledge became visible in the new equations, models, figures, diagrams, and formats that increasingly characterized the published record of the American social sciences. The taste for short, highly mathematical papers in postwar economics is perhaps the most obvious example of this transformation.

In this paper I examine how concern for the shapes of knowledge played out in one of the more notable projects in the postwar behavioural sciences. Few communities of social scientists treated the art of epistemology more self-consciously than the founders of Harvard's Department of Social Relations (DSR). In their attempts to bring about theoretical integration in the social sciences, Talcott Parsons, Clyde Kluckhohn, Gordon Allport and Samuel Stouffer, along with occasional guests such as Edward Shils and E. C. Tolman, faced head on questions about the expression of knowledge of "social relations." I shall explore these varied efforts and offer some reflections on their ultimate failure. In historiographical terms, moreover, I seek to return to the issue of modernism in the human sciences, first raised by Dorothy Ross and others in the early 1990s. Given the DSR's sensitivity to matters of epistemological aesthetics and design, I ask, might we consider some of its published outputs instances of a certain sort of modernism—indeed, of a "Cold War modernism" in postwar American culture?

PRODUCING REASON

Dr. Hunter Heyck

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By the 1940s, many in the social sciences had become convinced that the ordinary human actor was (at best) imperfectly rational. Whether one was a Freudian or a Skinnerian psychologist, an opinion pollster or a market theorist, a culture-and-personality anthropologist or a functionalist sociologist, conscious rationality no longer could be assumed of one's subjects. (Even economists knew that *homo economicus* was not rational by any ultimate standard.) Yet world events clearly showed the dangers of unbridled unreason, and democratic ideals, which long had rested on faith in the mostly-rational citizen, were not to be given up lightly.

In the first two decades after WWII, a number of leading social scientists in America sought to find a way to deal with this dilemma, hoping to provide a safe grounding for both their science and their society. One solution was to shift the focus of analysis, and the test of rationality, from the decision-maker to the decision. Decisions could be rational even if decision-makers were not. The key, in this view, was to develop systems that would mass-produce uniform, predictable, rational choices just as modern factories mass-produced uniform, predictable, rationalized material products out of dissimilar and unpredictable raw materials and laborers.

The irony of this story is that by shifting one's focus from the decider to the decision, one vested power in the system that produced the choice rather than in the individual doing the choosing. Hence, while many of the proponents of such decision systems genuinely believed that they were helping to shore up democracy, by the 1970s, many people began to feel trapped and voiceless within such systems and to resent the "rationality" such systems produced. This paper will explore three important attempts to develop production systems for rational choices, looking at work in organization theory, operations research, and game theory in the 1950s and 60s.

THE BIRTH OF A MOVEMENT: JOY PAUL GUILFORD AND CREATIVITY RESEARCH IN AMERICAN PSYCHOLOGY, 1950-70.

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"The neglect of this subject by psychologists is appalling." So said psychologist Joy Paul Guilford during his 1950 Presidential address to the American Psychological Association. The subject in question was *creativity*, and Guilford's protest was so effective that in 1975 a leading psychologist could say that it represented a "paradigmic shift" to rival Binet's development of the IQ test. Guilford's contribution to that research is well documented by psychologists, both for its intrinsic merit and its historical significance. But these internal accounts do not show the extent to which Guilford's work was part of a *movement*: a unified and self-conscious effort among psychologists to study creativity and to use the results to help solve social problems. In fact, creativity research at this time was prolific, self-aware, had a strong institutional background, had close links with the world outside academia, and drew together a diverse range of approaches to the study of creativity. To show this I draw on articles and books by Guilford and other psychologists from the time, published proceedings from conferences on creativity, and (for the popular side of the movement) *Applied Imagination,* a widely read book written by the entrepreneur Alex Fackney Osborn. As for Guilford himself, the significance of his 1950 address has been exaggerated in internal accounts of the movement. The address was decisive for creativity research, but for the existence of that research rather than its methodology. This can be seen by contrasting the work of Guilford with that of other major psychologists of the era, such as Frank Barron.

INTERNATIONAL INFLUENCES AND INTERPRETATIONS OF FUTURES STUDIES

Tolon, Kaya

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This essay investigates to what extent the futures studies movement of the 1960s and 1970s was a global phenomenon. Futurists were a diverse group that spanned across a multitude of disciplines and industries. Although hard to classify, they captured the attention of business managers, military officers, and academics alike. In the words of one futurist, they shared – more than ever – the belief "that decisions made now need to be guided by a broad and penetrating understanding of future options."

The futures studies movement of the 1960s was an international endeavor, but to what extent? How widespread were their signature forecasting tools like the Delphi method, cross-impact analysis, or scenarios? Were there any futurists in the Soviet Union? The first of three types of sources I analyze in response to these and other questions consists of various futures studies journals. In my overview of these serials, I review their content, editorial boards and contributors, as well as readership to see their global distributions. Second, I examine whether this movement penetrated – or originated within – international academic institutions. Finally, I investigate the international extent of this movement in the sciences, popular culture and especially political and ideological discussions.

Although the roots of futurists traces back to the early Cold War pressures and the patronage of the U.S. Air force, the content of futures studies changed dramatically. The beginning of détente coincided with the outlook of many futurists that were increasingly preoccupied with peace studies, and social and humanitarian crises rather than military ones. Nevertheless, the gloomy scenarios in which the two superpowers exchanged nuclear attacks demarcated the global political paradigm. The duration, prevalence, social impact, and nature of this movement is complex, but in short my hypothesis is that futures studies was a global movement that transcended the dichromatic political divisions of the Cold War context.

GEMEINSCHAFT AFTER ALL: THE FRONTSTAGE AND BACKSTAGE OF SMALL GROUP RESEARCH IN EARLY COLD WAR SOCIAL SCIENCE

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This paper, on the history of small group research in post-World War II American social science, explores the contrast between the *public* framing of small group research in published scholarship and public intellectual debate, with the *unpublished* government- and foundation-funded use of this research. It is my thesis that postwar small group research was deployed as reassuring evidence for the endurance of fellow feeling, custom, and other *Gemeinschaft* elements in the context of Cold War liberalism—as a key argument in the choose-the-West public intellectual defense of American pluralism. In its public face, small group research was, moreover, presented in historical terms, as a "rediscovery" of a native American sociological tradition that had correctly recognized the persistence of a rich associational life in modern society. Over the course of the 1950s, many of the same social scientists were using small group insights in an altogether different way: in the ongoing effort, that is, to design effective propaganda for the emerging national security state, in studies that, from the mid-1950s on, were normally unpublished and often classified. The study locates these contrasting faces of small group research in the remarkable (and understudied) community of elite post-war social scientists who coalesced around the "behavioral sciences" label.

SOMEWHAT KNOWN BUT NOT KNOWN WELL: SOCIOLOGIST HARRY ALPERT'S TRAVELS IN AMERICAN SOCIAL SCIENCE

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From 1953, when he was hired by the U.S. National Science Foundation, until 1958, when he left the agency, sociologist Harry Alpert was the key figure in establishing the agency's basic policy framework for funding research and fellowships in the social sciences. Historical scholarship has emphasized that Alpert constructed a viable policy framework for supporting the social sciences under difficult circumstances. Due to the controversial position of the social sciences in the agency's legislative origins as well as to ideological, political, and institutional pressures during the 1950s, Alpert promoted a cautious policy framework that placed the social sciences within a unified scientific enterprise and identified them as junior partners to the more established natural sciences.

In the following decades, NSF became one of the most significant sources of funding for academic social science in the United States (and it remains so to the present day). In 1978, twenty years after Alpert left NSF and one year after Alpert's death, social scientists Richard Hill and Walter Martin observed that "to a significant degree, NSF support for the social sciences rests upon the philosophy and policies established by Harry Alpert." While historical accounts have confirmed the accuracy of Hill's and Martin's observation, this literature tells us little about Alpert's own views about the social sciences and does not ask if his views may be relevant to understanding the character of his policy work at NSF.

This paper has four parts. The first concerns Alpert's studies of Durkheim. Historian of sociology Jennifer Platt has noted the importance of Alpert's effort to refute the view that Durkheim believed in the independent reality of society as something that is "set above and apart from individuals." In this sense of the term, Durkheim was not a "social realist." However, historians have said little about Alpert's analysis of Durkheim's life and work relevant to central questions about the social sciences that Alpert's generation was struggling with. The second section considers Alpert's experiences with and concerns about government social science programs during and after WWII. Though Alpert had extensive experience with government agencies and wrote frequently about the rocky history of government social science programs, this part of Alpert's career has received scant attention. The third section examines Alpert's policy work at the National Science Foundation, where we will see that at NSF Alpert found himself dealing with old problems in a new context. In the fourth section I propose that Alpert's success in crafting a viable policy framework for NSF's support of the social sciences came at a price. In some important respects, Alpert's own views about the social sciences were at odds with his policy work and major trends in the social sciences that NSF's policies were associated with. By examining how Alpert addressed these issues during his travels in American social science, we will begin to know Alpert better. This analysis, in turn, illuminates important developments and tensions within the U.S. social science enterprise during the middle decades of the twentieth century.

AMERICAN FOUNDATIONS AND SOCIO-ECONOMIC RESEARCH IN ITALY: A LONG-TERM ANALYSIS

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In the last months in Italy there was an intense debate about the financial restriction on research and more in general about the status of scientific research in Italy. Focusing on the social and economic sciences the declared crisis is not a product of the present but has deep roots in the past and particularly in the 1960's. the paper will analyse the role of the American Foundations (Rockefeller and Ford) and their grant-making policies as well as the behavior of Italian academic and institutional actors within and outside the University system, including the public agencies and the political leaders, the recurrent misunderstanding between the American and the Italian partners and the reason why the expectation of role related to the creation of Italian Foundations committed to empower research policies found obstacle in the configuration of Italian society and limited the opportunity to generate an "epistemic community": The paper will present a series of case studies and will discuss the reasons why there was a relevant failure in the introduction of the Doctoral program. As a matter of fact Doctoral programs were introduced in Italy on ly in the Mid-Eighties- A comparison with France will illustrate the similarities but also the deep differenc of impact af American Foundations policies in Europe.

"COLD WAR EMOTIONS: MOTHER LOVE AND HUMAN NATURE IN POST-WAR AMERICA."

Marga Vicedo

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Following WWII, there was an explosion of research on human emotions and its biological underpinnings, instincts. Through scholarly and popular writings, psychoanalysts, ethologists, and psychologists studying child development succeeded in bringing instincts back into scientific and social debates. In my paper I will explore their influential work on emotions and instincts within the social and cultural context of the Cold War by focusing on scientific views about mother love.

I first argue that the main factor leading to explore the impact of mother love on an individual's psyche was the rising concern about emotions after WWII. In search of an explanation for human destructiveness, the scientific and popular imaginations turned to the non-rational causes of human behavior, the emotions. Assuring a peaceful world order required controlling human emotions, and to do this one first needed to understand them. In seeking out the source of an individual's emotional nature, scientists soon found the mother. The reasoning went like this: personality is a direct result of the individual's emotions; emotions are created in childhood; and children are raised by their mothers. The mother thus became the foundation of a healthy personality. Second, analyzing how scientific experts and other commentators understood that good mothers turned into bad mothers by loving their children too much or too little, I show that the concern about the mother-child relation epitomized widespread postwar anxieties about the formation of a stable self and emotionally mature individual amidst the disintegrating forces of the modern world. Unless properly held in check, these authors noted, the forces of modern society could destroy humanity. In this view, the civilizing, modernizing, artificial forces of the mechanical world were destroying the natural needs of men, women, and children. In this context, reasserting the power of mother love was a way of reasserting the human over the machine, the natural over the artificial traps of modern civilization. Third, I claim that the emphasis on mother love, the most natural of emotions, brought the notion of instinct, which had almost disappeared from explanations of human behavior before the war, back into the scientific and popular realm.

The return of the maternal instinct in science and popular culture heralded a larger concern about the disintegration of human nature in an increasing mechanized and artificial world. Scientific expertise was required to harness the maternal instinct, which had been derailed by the dislocation of gender roles and, like other forces of nature, threatened to destroy humanity with its explosive power. The appeal to science to harness the power of the maternal instinct, I conclude, is an example of the postwar attempt to combine a respect for the powerful forces of the natural world while using science to channel them within socially desirable boundaries.

MAINTAINING HUMANS

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The Cold War was about distrust. It was, in the first instance, about the distrust of people and political actors: the distrust of humans. But it was also shaped by the distrust of material and machines: the distrust of technology. This paper explores how these two spheres of distrust - the human and the technological - were intertwined in the cold-war human sciences' concern over electronics maintenance.

Concerns over the reliability of electronics figured centrally in the strategic and cultural aims of the Cold War. Those concerns transformed technicians into the subjects of psychological investigations and human factors engineering, disciplines that moved technicians' work away from the black arts of repair towards the clean algorithms and rational processes that could be carried out and taught by machines. Within cold-war engineering, broadly understood, making electronics trustworthy meant engineering people as well as devices. In exploring those connections between the human and the machinic around the subject of maintenance, this paper contributes to a broader understanding of the Cold War itself, where crucial struggles were fought out at the level of politics and popular culture, but also at the level of technologies and the social forms that surrounded them.

THE MOST ADVANCED OF ALL SOCIAL SCIENCES?: LINGUISTICS IN COLD WAR AMERICA

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This paper explores the relationship between linguistics, mathematics, and machine translation at the MIT Research Laboratory of Electronics during the early Cold War (1950-1960). Many commentators on American linguistics describe Noam Chomsky's syntactic work as a response to machine translation efforts of the early 1950s. However, Chomsky broke with MIT's machine translation group soon after his arrival in Cambridge in 1955, and consistently described computer applications of linguistics as "pointless as well as probably quite hopeless".

I argue that the misconception in the literature arises from a conflation of machine translation and mathematics at the RLE, or, more specifically, a misunderstanding of the centrality of adequacy conditions to Chomsky's conception of linguistics. Chomsky's conditions of adequacy — generative capacity, universality, simplicity, and the ability to account for constructional homonymity — are independent from any computer applications. As such, applicability to machine translation has, for Chomsky, no bearing on theoretical validity, and cannot be used to evaluate or compare syntactic models. Importantly, rival syntactic theories chose to include computerizability as a condition of adequacy, leading to a discipline-defining debate about the proper role and status of linguistic phenomena. In summary, Chomsky's mathematical work needs to be understood as a two-track program with specific implications for the introduction of adequacy conditions and grammar-model choice in linguistics.

Symposium S35
History of Numerical Tables - The Second Meeting on History of Exact Sciences along the Silk Road

FROM SQUARE TABLES TO CALCULATION OF SURFACES IN MESOPOTAMIA

Christine PROUST

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In this paper, I will analyse links between some numeric tables and field texts. I will rely on two groups of documents. The first group include presargonic (mid third millennium B. C.) tables of surfaces and some field texts dating from the same period. In contrast to these archaic texts, I will present the Old-Babylonian (beginning of second millennium B. C.) coherent metrological system attested in school tablets and the relationship between this system and calculation of surfaces. My aim is to draw up a link between the surface problem (transformation of unidimentional magnitudes into bidimentional ones) and the apparition of place value notation in Mesopotamia.

FRACTIONAL TABLES AND WATER CLOCKS IN EGYPT

Micah Ross

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The best known and most far-reaching Egyptian contribution to astronomy division of the day and night into twenty-four hours is. Somewhat less known but more remarkable given the latitude of Egypt is the fact that the difference between the seasonal hours and the equinoctial hours was also an Egyptian observation. The Egyptian approximation of the seasonal hours is documented by two sources document: fractional tables and water-clocks.

These two sources have often been perceived as being in opposition. Several divergent methods of approximation are preserved in the fractional tables. Neither were all water clocks constructed by the same principals. In fact, in some cases, water clocks may be used to explain the meaning of the fractional tables. A coordination of elements from these two sources establishes several correspondences and eliminates several disparities.

Similar fractional tables of seasonal hours exist in cuneiform sources. A variety of proposals once related these fractional tables to the construction of Babylonian water clocks but the recent discovery of more explicit texts has established the fractional tables as shadow lengths. Even though shadow lengths cannot explain all the fractional tables in Egypt, this approach to understanding fractional tables in an Egyptian context demands consideration.

Because the use of water clocks in Egypt was described in (fantastical) detail by Macrobius, his account also merits re-examination. The historical context for his account is demonstrably wrong, but several errors in his description betray a confused, second-hand account of probable Egyptian practices.

FROM LISTS TO A TABLE TO MANAGE GRAINS: THE EVIDENCE FROM THE OLDEST EXTANT CHINESE MATHEMATICAL BOOKS

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CNRS, France & Yamaguchi University, Japan

The oldest extant Chinese texts devoted to mathematics contain a passage related to equivalences between grains, a product, the management of which was an essential task for the imperial bureaucracy. In the *Book on mathematical procedures* (*Suanshushu*), a manuscript excavated from a tomb sealed *ca* 186 B.C.E. and being so far the earliest known mathematical text from China, the equivalence between various kinds of grain is provided in the form of several sentences. Each of them states a sequence of equivalent amounts of given types of grain, expressed with respect to measure units of weight and capacity (bamboo slips 88—90, Peng Hao, 2001: 80). The editor Peng Hao showed that the format and the content of this passage were essentially identical to what can be found in the "Regulations for granaries *canglü*," a text copied during the Qin dynasty (221 B.C.E.—206 B.C.E.) and discovered among Qin legal documents at Shuihudi. By contrast, in *The Nine chapters on mathematical procedures*, a writing probably completed in the 1st century C.E., the corresponding passage takes the form of a table with a homogeneous pattern, in which all grains are gathered and associated with an abstract figure. There is no known legal document from the Han dynasty that can be compared to this passage from *The Nine Chapters*.

The main question that the talk will address is: how can we account for the difference between the two texts shaped to handle equivalences between grains? To deal with the issue, the authors will discuss the systems of measure units underlying the two passages and cast light on the nature of the data recorded in them. Moreover, they will show that the values used in both texts constitute different types of quantities, which they will relate to the distinct mathematical contexts evidenced by the two books, within which the passages were inserted. Lastly, they will suggest hypotheses linking the differences between the two passages and the differences between the practices of managing grains at the two distinct time periods. In particular, they will address the issue of the difference between the shape of the texts: sequences versus a table.

PENG Hao, 2001. *Zhangjiashan hanjian «Suanshushu» zhushi* (*Commentary on the* Book of mathematical procedures*, a writing on bamboo slips dating from the Han and discovered at Zhangjiashan)*, Beijing: Science Press (Kexue chubanshe), 2001.

The research presented in this communication could be completed during two months that the authors spent at the Max Planck Institute for the History of Science, Berlin, in the summer 2007.

THE FUNCTION OF NUMERICAL TABLES IN THE DEDUCTIVE STRUCTURE OF PTOLEMY'S *ALMAGEST*

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The *Almagest* has a fairly concise deductive structure and Ptolemy uses tables in a number of interesting ways to advance the mathematical argument of the text. In the course of the argument, Ptolemy uses tables both the facilitate calculations that could be made using straightforward arithmetic or the underlying geometry, or to make possible calculations that cannot generally be solved using Greek geometry. Tables, however, also function as objects of knowledge. Tables, like theorems or problems, are presented both as the results of mathematical research and as important tools used in developing new knowledge. In this talk, I will look at a number of examples of Ptolemy's tables performing this dual function.

THE NUMERICAL MODEL OF CHINESE PLANETARY THEORY

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Astronomical table as tool played an important role in Chinese mathematical astronomy. Quite different from the geometrical system in Western tradition, the planetary theory appeared in old China took the numerical model which was always constructed with several difference tables. The function and precision of these tables will be discussed in this talk.

THE PRECISION OF THE PLANETARY CALCULATION IN THE SONG DYNASTY

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Planetary theory is one important part of traditional Chinese mathematical astronomy. Ancient Chinese calendar-makers usually regarded the precision of planetary calculation as one standard for verifying whether one calendar was excellent or not.

According to Chapter of Calendar in the Histories of Song, the maximum error of planetary calculation that calendar-makers of the Northern Song dynasty permitted was only two degree, and in the Southern Song dynasty, the maximum error of planetary calculation that calendar-makers permitted was only one degree.

By analyzing the precision of planetary calculation of *Jiyuan Li*, one calendar compiled in the Northern dynasty, we point out that the computational error of the Jupiter and Saturn in *Jiyuan Li* could meet the requirement of precession that the calendar-makers of Northern Song dynasty expected, but the computational error of Mars, Mercury and Venus couldn't.

MERCURE ET LE SECOND ÉQUATOIRE DE JEAN DE LIGNIÈRES

Matthieu Husson

EPHE, France

Our aim in this presentation is to analyse and compare the second equatory of John of Ligneris and the *Tabule magne* of the same author. Both were produced in Paris during the early fourteenth century. Both are means to compute the equation of a planet in the ptolemaic model.

We will first confirm, using an *ad hoc* adaptation of Beno Van Dalen parameter evaluation methods, that this set of table is build on Alphonsine parameters. We will, on this basis, study the error pattern of the *Tabule magne*. Two possible families of models will be examined: the geometrical models, and the tabular models with the standard Ptolemy interpolation for the equation of planets. This study will show that the error pattern of the *Tabule magne* is very specific: all the planets except Mercure appear to be closer to the geometrical model. Mercure is closer to the tabular model. A study of the equatory will demonstrate that the geometrical instrument present exactly the same error pattern. This fact may allows us to wonder if the table were computed with the use of the equatory.

COMMENTS ON THE NUMERICAL TABLES AND ALGORITHMS IN FIBONACCI'S LIBER ABACI

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Fibonacci's *Liber Abaci*(1202) is one of the most important books on mathematics of Middle Ages. Its effect was enormous in dissemination the Hindu number system and the methods of algebra throughout Europe. The Hindu numerals with the place system are used both to make the calculation and to write down the result. So these calculating procedures and the results formed a plenty of numerical tables in *Liber Abaci*.

By presenting a classification of different numerical tables in *Liber Abaci*, this paper will demonstrate how those numerical tables were used for calculation. Some famous algorithms such as gelosia method, galley division, Egypt unit fraction, the systematic proportion based diagram method, and the method of false position are additional to those numerical tables. Just these numerical tables and algorithms provided a useful calculating methods for the *Maestri d'abbaco*.

It is well known that the gelosia method has its roots in Hindu, unit fraction in Egypt, algebra in Arab, this paper will also point that in *Liber Abaci* there are some problems and algorithms which are similar to those in ancient China.

CARDANO'S RULE OF PROPORTIONAL POSITION IN *ARTIS MAGNAE*

ZHAO Jiwei

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Cardano's *Artis Magnae* in 1545 is a milestone in the development of algebra. It is credited especially for the first publication of the solutions of cubic and quartic equations. Many books on the general history of mathematics tend to explain Cardano and Ferrari's method of solving quartic equation by means of 5-term equations. However, from the rules in chapter 7, 26, 34 and 39 of this book, it seems that Cardano and Ferrari have not got the general method for the 5-term quartic equations.

In chapter 33 of *Artis Magnae*, Cardano intends to find two numbers such that the sum or difference of them is given, and the sum of the squares of certain parts of the two numbers added to its square root is also given. Cardano discovers the rule of proportional position by which he could solve the problem through the equation

$$px^2 + q + \sqrt{px^2 + q} = n \quad .$$

Thus, by the traditional method, i.e., letting the root alone on one side of the equation and square both sides, it will lead to a solvable bi-quadratic equation.

The rule of proportional position is explained by 7 numerical examples. Cardano gives the procedure of the calculation on the two proportions of the two numbers. However, he does not explain why he needs to discover a new rule, nor does he explain why it should be operated in such way. This paper is to respond to these questions. The purpose of this rule is to avoid 5-term quartic equation. For if by simple position, the above problems will lead to equations of the form

$$ay^2 \pm by + c + \sqrt{ay^2 \pm by + c} = n \quad .$$

If solving it by traditional method, it will lead to a 5-term quartic equation which is unsolvable to Cardano. By this rule, Cardano could transform $ay^2 \pm by + c$ into $px^2 + q$. As for the procedure of the calculations, Cardano calculate by unknowns to find the results firstly, and then he transforms the result into procedure of calculation on the related proportions. Cardano's reasoning is complemented.

EARLIEST FACTOR TABLES

Maarten Bullynck

Belgium

The earliest factor tables were produced as an aid for solving classic Greek number problems,viz. perfect and amicable numbers. Frans van Schooten's table (1657) in the *Exercitationes Mathematicae* was, however, embedded in the more ambitious project of divulging and promoting the Cartesian method in mathematics. As a reaction to van Schooten's table, John Pell organized the calculation of the first extensive factor table, upto 102,000 in 1668. For Pell, the factor table had not only mathematical interest, but was to be a specimen of a more general tool, viz. a table of simple ideas could be combined to form truths. Both the cultural and mathematical contexts in which these two early factor tables were produced will be discussed, and the fabrication and usage of this tabular tool in mathematical problems will be illustrated by examples.

UNE ÉTUDE EMPIRIQUE DE GEORG CANTOR

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University of Paris 5

L'intervention de Georg Cantor au congrès de Caen (1894) de l'*Association française pour l'avancement des sciences* est constituée d'un tableau de vérification empirique de la conjecture de Goldbach. Cette conjecture de théorie des nombres prévoit que tout nombre pair est la somme de deux nombres premiers. Elle n'a reçu de nos jours encore aucune démonstration.

Cantor en vérifie la validité jusqu'au nombre 1000 en donnant toutes les décompositions des nombres pairs, compris entre 2 et 1000, en somme de deux nombres premiers. Il établit ainsi, dans les limites fixées, la table de la fonction empirique qui associe à un nombre pair le nombre de ses décompositions de Goldbach.

Mais l'examen de sa correspondance avec les mathématiciens Charles Hermite ou Felix Klein révèle une tout autre ambition. Cantor est à la recherche de lois vérifiées par la fonction précédente et fait à ce propos des conjectures audacieuses dont nous apprécions la valeur à la lumière de recherches récentes.

EULER-OTTO'S BALLISTIC TABLES

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In 1753, Euler gives a new method of numerical integration for the differential equation of the motion of a projectile in a resistant middle, and provides the computation scheme of a set of numerical tables for the use of artillery. These tables, calculated and published in 1842 by captain Otto, of the Prussian army, will then remain in use until the late 19th century.

We shall analyze Euler-Otto's tables and we shall compare them with the other projects of calculation of ballistic tables conceived during the period 1750-1850 by Graevenitz, Lambert, Borda, Bezout, Legendre, Obenheim, Poncelet, and Didion. It will allow us to draw up a state of numerical and graphical methods of computation used in this time, and to study the circulation of knowledge which could exist in Europe between mathematicians and artillerymen.

INSTRUMENTS *VERSUS* TABLES DANS LE CALCUL DES DÉBLAIS ET REMBLAIS DANS LA FRANCE DES ANNÉES 1830-1860

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Les années 1830-1860 constituent une période faste pour les travaux publics en France et accueillent la réalisation de multiples projets en matière de routes et de canaux et, à partir de 1842, de chemins de fer. Ces projets demandent de nombreux calculs fastidieux des surfaces de déblais et de remblais sur les profils en travers de ces différentes voies de communication. Les ingénieurs du corps des Ponts et chaussées, soumis à la pression d'un volume de travail accru, essaient alors différents procédés de calcul plus ou moins expéditifs. Plusieurs tables numériques donnant directement les surfaces en fonction d'un certain nombre de caractéristiques de la route et de son environnement, telles que la largeur de la chaussée ou l'inclinaison du terrain naturel, sont alors fabriquées. Pendant la même période, des ingénieurs du corps inventent aussi plusieurs instruments à calculer rapidement toutes sortes de surfaces sur un plan. Notre communication propose une vue panoramique sur cette production protéiforme selon une perspective qui envisage les tables et les instruments comme des « objets » qui sont produits selon un « processus de fabrication », mis sur « marché » et « consommés » (utilisés) par les praticiens. Nous allons ainsi étudier à la fois le « produit » (les caractéristiques de l'objet, les logiques qui ont présidé à leur élaboration…), les caractéristiques du processus de fabrication (les auteurs des tables et des instruments, qu'il soient concepteurs ou exécutants, l'organisation du travail, les divers « moyens » de production employés pour la fabrication de ces objets…), les modalités de diffusion et les pratiques d'usage des tables et des instruments relatifs au calcul des déblais et des remblais, enfin.

MATHEMATICS, ANALYSIS AND MECANISATION IN GREAT-BRITAIN (1834-1934)

Durand-Richard Marie-José

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When Charles Babbage conceived his « difference engine » and his « analytical engine » in 1834, his main goal was to mechanise **the** algebraic analysis, by transfering to the machine the organisational principles of the division of labor. So the machine could produce directly some numerical tables, essentially for astronomy and navigation. From the second part of the 19th century, the methods induced by the mechanisation of analysis were essentially different. The harmonic analyser (1876) of Lord Kelvin, as well as the differential analyser (1931) of Vannevar Bush, as soon realized by Douglas R. Hartree in Manchester and Cambridge, applied the reading, analysis and drawing of continous curves. Nevertheless, these machines were largely involved in the making out for firing tables during the World War II. My talk will precise what kinds of differential equations were so resoved, and how analogous and numerical methods interact during this period.

THE RELATIONSHIP BETWEEN NUMERICAL AND GRAPHICAL METHODS IN THE FIRST HALF OF THE 20th CENTURY

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Numerical and graphical methods became a focal point of applied mathematics in the first half of the 20th century not only at universities but also in industry.

An international figure was Carl Runge (1856-1927) who introduced these methods not only at German and American universities but also in German industry. There are new findings that his eldest daughter Iris Runge (1888-1966) became one of his most important followers and that a book written by the British automobile factory owner and aircraft researcher F. W. Lanchester (1868-1946), which was translated into German by Carl Runge, his wife, and Iris, promoted the enthusiasm for using and developing graphical methods.

From 1923 to 1945, Iris Runge worked as a (single) mathematical consultant to engineers in German communication industry, using a wide range of mathematics. I would like to show the relationship between numerical methods (equations and tables) and graphical representations in this context.

THE DESIGN OF NUMERICAL TABLES FOR STATISTICAL QUALITY CONTROL IN INDUSTRY (1920-1950)

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Statistical methods for the control of quality of manufactured products are used in industry when the characteristics of the products are sensitive to random variations in the production processes. Methods currently in use in many industries under various appellations (e.g. “six sigma” in electronics industry) have been devised since the years 1920s, nearly at the same period but independently, in industrialized western countries (USA, Germany, France, UK).

From the beginning, such methods required the treatment of large volumes of numerical data running through various operations : data collection, presentation, computation of statistical summaries, hypothesis testing and conclusions (ASTM, 1933). Graphical representations have been used extensively (histograms, distribution charts, control charts...) as well as lists or tabular representations of data. Both kinds of representation, graphical and numerical, complement each other in a dialectical process attempting to better catch the properties of series of numerical data.

The methods under scrutiny are most generally intended to be put to use by industrial workers not trained in higher mathematics or statistics, such as shopfloor technicians, quality inspectors, or even machine workers. Control chart methods, for exemple, rely on a very intuitive graphical display (Shewhart, 1931), allowing ordinary workers to perform a periodic sampling of the production and draw correct conclusions. On the other side, acceptance sampling methods rely on sets of numerical tables where the numbers are digitally expressed (Dodge & Romig, 1944).

After presenting the different genres of numerical tables implied in statistical quality control, I’ll concentrate on numerical tables for acceptance sampling. Successive publications of these tables will be compared in relation with the historical context (first publication in 1928, the same as a standard published in 1944, and a different form designed for the war industries). I hypothesize that the tables are designed to become cognitive instruments fitted to specific working situations, and I try to show how such orientations shape and modulate the scientific structure at the foundation of the tables.

ASTM, 1933. American Society for Testing Materials. Manual on Presentation of Data. Published by American Society for Testing Materials

Dodge H.F. & Romig, H.G, 1944. Sampling Inspection Tables - Single and Double Sampling. New York: Wiley

Shewhart, W.A., 1931. Economic Control of Quality of Manufactured Products. New York : McGraw-Hill

``WHY MIGHT A MATHEMATICIAN WANT TO ADD PULSE CIRCUITRY TO PENCIL AND PAPER?'' MATHEMATICAL TABLES IN THE ERA OF DIGITAL COMPUTING.

Liesbeth De Mol

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In his paper *Computer technology applied to the theory of numbers* dated 1969, the number theorist Derrick Henry Lehmer provided his answer to the question ``Why might a number theorist want to add pulse circuitry to pencil and paper?'' by summing up several different usages of the computer in number theory in order of increasing machine involvement. This list of number-theoretical computer usages ranges from computing sequences of numbers to find counter-examples to conjectures to real computer-assisted proofs. Included in this list is the actual construction and inspection of mathematical tables, while the several other usages often make implicit use of tables in some way or the other. Although almost each of these usages were, theoretically, not beyond human reach before the rise of the computer (including the inspection and construction of mathematical tables) the gain in speed and memory as well as the possibility of automation have nonetheless made available a new “universe of discourse” – to put it in Lehmer’s words – that was not accessible before. Mathematical tables play a fundamental role here, since most of the applications involve *automated* (explicit or implicit) construction and/or inspection of tables. The aim of this talk is to come to a better understanding of the methods of construction and use of mathematical tables since the rise of the digital, electronic general-purpose computer in order to trace the impact they have (had) on mathematics. The starting point will be Lehmer’s ideas on mathematical tables in relation to computing machines. He not only made extensive use of computing machines for doing mathematics, often involving the construction and inspection of tables, but was also, on several occasions, quite explicit about how the computer might change mathematics. On the basis of our analysis of Lehmer’s work and ideas on the topic, we will consider several examples of the use of mathematical tables throughout the history of digital computing up to now, evaluating them in the light of Lehmer’s ideas on using pulse circuitry in number theory, and, more generally, mathematics.

Symposium S36
Introduction of Modern Mathematics in Iberoamerica

THE TRANSLATION OF KURT GRELLING'S *THEORY OF SETS* INTO SPANISH

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In the early 1940s three related events marked the process of professionalization of modern mathematics in Mexico: the establishment of the Mathematics Department within the Faculty of Sciences, the foundation of the Institute of Mathematics and the appearance of the Mexican Mathematical Society. At the beginning, the student population was not very significant, in terms ofquantity and most of the textbooks used were kept in their original languages, mainly English and French.

But almost as soon as this decade started, a German textbook on set theory was translated into Spanish. In a previous talk, I have discussed why the translator selected this text. Now, I'll analyzed the translator's academic background.

THE INTRODUCTION OF SET THEORY IN COLOMBIA

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In Colombia, in the 1940 decade, we find evidence of two clear attempts to formally introduce set theory in the teaching of mathematics. One of them is the book *Introducción a la teoría de conjuntos* (*Introduction to set theory*) (1944), a compilation of lectures given in 1942 by FRANCISCO VERA, the well known Spanish mathematician and historian of sciences and Republican exile. The other one are two outstanding expository papers by WALDEMAR BELLON, a German mathematician who arrived to Colombia fleeing from the Nazi regimen in 1938; these papers were published in the journal Revista de la Universidad Nacional de Colombia (Revista trimestral de cultura moderna). One of the purposes of this presentation is to review these works taking into account the Colombian political and sociological situation at that time. Also, we will examine the steps taken in order to introduce set theory in higher education for the first time in the Universidad Nacional de Colombia undergraduate mathematics program created in 1951. Finally, we will present the reforms, starting in 1960, in primary and secondary education levels, containing rudiments of set theory.

LOGIC AND SET THEORY IN PRIMARY AND SECONDARY EDUCATION IN SPAIN

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The world wave of mathematics reform of the sixties and seventies also reached the isolated Spain under Franco, then committed to a technocratic process of modernizing the economy. Thus, in 1961, just two years after the famous Royaumont Seminar (1959), the Ministry of Education promoted a meeting of Professors of Mathematics in Secondary Education in which the Professor of Projective Geometry of the Central University of Madrid, Pedro Abellanas, explained the need for a comprehensive reform of the mathematics curriculum of secondary education. Modern algebra, set theory and to a lesser extent, mathematical logic started an entry in non-university education that would lead them to primary school with the Education Act 1970.

HILBERT'S "GRUNDLAGEN DER GEOMETRIE" TRANSLATED INTO SPANISH: A CASE OF A FAMOUS MATHEMATICAL TEXT AND ITS CONTEXTS

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Around 1940 a translation to Spanish of Book I of Euclid's *Elements* was published at the Universidad Nacional Autonoma de Mexico. This was intended as a first step towards what should be a definitive, full translation of this work into Spanish. The entire project, however did not materialize. Nevertheless, the published translation of Book I is accompanied by a translation of David Hilbert's *Grundlagen der Geometrie*, by David Gracia Bacca. In this talk I will explain some of the background and context to Garcia Bacca's translation, as well as to other translations of Hilbert's epoch-making book.

MISCHA COTLAR'S FIRST STUDIES ON MEASURE AND INTEGRATION THEORY (1939-1944)

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In 1940 a series of publications began to appear in the Institute of Mathematics in the city of Rosario, under the direction of the eminent Italian mathematician Beppo Levi, who was to play a critical role in the development of mathematical studies in Argentina. Levi had just taken up office as director of the institute in the National University of Litoral. One of the primary contributors to the new magazine was Mischa Cotlar, a mathematician of Russian origin, who had lived in Uruguay since his childhood, mainly self-taught. Cotlar submitted a paper on non-measurable sets and a generalization of the Lebesgue integral. Cotlar's ideas strongly attracted the attention of Levi, who realized that this was an important work and that its author possessed the creative qualities of someone destined to be an eminent mathematician.

In fact, although Cotlar would only obtain his doctorate much later on (at the University of Chicago, in 1953) by the time this publication was written he was thoroughly acquainted with the state of the art of research in Measure Theory and Integration (Lebesgue, Fréchet, de la Vallée Poussin, Banach, Kuratowski, Saks, Sierpinski, among others). His particular field of interest was the problem of determining the conditions of the measure of a set from which it is possible to generalize the Lebesgue integral of an abstract space.

The epistolary exchanges that took place between Levi and Cotlar focused specifically on the most appropriate way to provide a formal presentation of the results of Cotlar in this matter: definition of the pseudo-measure of a set, generalization of the Lebesgue integral for non-measurable functions and demonstration of the main theorems of the classical theory. An important issue throughout his results is Cotlar´s employment additive functions of abstract sets that Fréchet introduced in 1915 and in 1922 in his theory of the integration of generalized functions. Taking into account this fact and the consideration of other works of the same period, it will be shown that Cotlar was one of the first mathematicians to choose the topology of abstract spaces as the privileged scenario for his investigations.

In this communication we study the evolution of Cotlar's ideas, from his first contributions at the end of the 30s in what he called "theory of anágenos", right up to the mid 40s. The correspondence Levi and Cotlar exchanged during the publication of the article in the magazine directed by Levi is also studied with special care.

THE IMPACT OF ANTONIO MONTEIRO ON THE ESTABLISHMENT OF ALGEBRAIC LOGIC IN LATIN AMERICA

Eduardo Ortiz

SUR UNE CONTRIBUTION DE PI CALLEJA AU PROBLÈME D'INDUCTION ET RÉCURSIVITÉ DANS LES AXIOMES DE PEANO POUR LES NOMBRES NATURELS

Luis Carlos Arboleda

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Un des livres les plus influents dans la diffusion de l'approche formaliste des systèmes numériques dans l'enseignement, a été "Grundlagen der Analysis" d'Edmund Landau. Initialement publié en 1930 et traduit comme "Foundations of Analysis" à Chelsea en 1951, "Grundlagen" systématise les notes des cours de Landau à Göttingen depuis 1909. Dans la préface adressée aux enseignants de l'ouvrage, Landau se réfère au docteur Grandjot, son assistant à Göttingen, qui a corrigé le manuscrit du livre en cherchant en particulier de présenter de la manière la plus rigoureuse et complète les Axiomes de Dedekind-Peano pour les naturels.

Karl Grandjot est plus connu dans l'Amérique Latine comme l'un des pionniers de l'introduction de l'enseignement moderne des mathématiques au Chili (1929-1967). L' "objection de Grandjot", à laquelle concerne la préface de "Grundlagen", est liée à la confusion répandue depuis lors dans plusieurs textes, que la "Définition par récursivité" (de la somme et le produit de naturels) est permise par la possibilité de la "preuve par induction". Landau pense avoir répondu à l'objection sans introduire axiomes supplémentaires à ceux de Peano, en utilisant une procédure suggéré par le mathématicien hongrois L. Kalmár.

En 1949, le mathématicien catalan Pedro Pi Calleja réalise une étude détaillée de la question visant à justifier la position de Grandjot. Le travail a été publié en "Mathematicae Notae", la revue dirigée par Beppo Levi à Rosario (Argentine), et les comptes rendus de Church et Curry montrent qu'il a eu une certaine notoriété internationale. Sur la base du formalisme logique des "Grundlagen der Mathematik" de Hilbert et Bernays et en interaction étroite avec Levi, Pi Calleja montre l'ampleur réelle de la "objection de Grandjot", en ce qui concerne la nécessité de préciser le statut logique des "Définitions récursives" d'addition et de multiplication fondées sur les axiomes de Peano, et de répondre à l'exigence de nouveaux postulats formulés dans une logique plus forte que la logique de prédicats de premier ordre.

Dans la présente communication on essaie de situer l'importance du travail de Pi Calleja par rapport à l'État d'art de la question d'Induction et Récursivité avant les années 1950, et dans le cadre des efforts déployés par Levi et ses collaborateurs, pour étayer l'enseignement du calcul dans nos pays sur l'étude rigoureuse de l'axiomatique des systèmes numériques.

A BRASILIAN GENEALOGY OF THE MATHEMATICS FROM LUIGI FANTAPPIÈ

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This work is a inicial contribution for the construction of a brasilian Mathematic genealogy. It begins with the study of the arrival of the first *Foreign Mission* in Brazil for the equipment of the *Faculdade de Filosofia, Ciências e Letras – FFCL* from *Universidade de São Paulo – USP*.

What is done in this study is to observe Fantappiè's academical activities in *São Paulo* from 1934 until 1939 and, then, research and present the mathematic affiliation that he left in Brazil, focusing the mathematicians that worked in the *Universidade de São Paulo*.

The first people classified in this genealogy, from Fantappiè, were chosen first of all because of their participation in the *Seminário de Matemática e Física da USP* in the year of 1935, that was published in the first and unique number of the *Revista de Matemática Pura e Aplicada da Universidade de São Paulo* in 1936, and second because they became mathematicians.

Besides this, the central idea of this work is to classify this affiliation according to the areas of Mathematics research and try to observe the influence of cultural capital in the professional choice of each Mathematician listed in this genealogy.

THE BIRTH OF THE RESEARCH IN MATHEMATICS INSIDE THE STATE OF SÃO PAULO - BRAZIL

Sergio Nobre

UNESP - Brazil

In this lecture we will talk about the creation of centers of mathematicians' formation and of research in mathematics inside the state of São Paulo, especially in the Faculty of Philosophy, Sciences and Letters of Rio Claro's city and in the School of Engineering of São Carlos city (belonging to the University of São Paulo). Both these institutions were founded in the fifties of the 20th century, decade when, it can be said, it began the process of professionalization of the scientific research in mathematics inside the state of São Paulo. Personalities like the Italian mathematicians, Achile Bassi, Jaurès P. Cecconi and Ubaldo Richard, that had the responsibility of creating the Department of Mathematics of the School of Engineering of São Carlos, and especially Nelson Onuchic and Mário Tourasse Teixeira, founders of the Department of Mathematics of Faculty of Philosophy of Rio Claro will be evidenced in this talk. Nelson Onuchic worked in Rio Claro until the year of 1966, when he moved to São Carlos, beginning his work in the School of Engineering, where it stayed. Mário Tourasse Teixeira was in Rio Claro until the death in 1993. Both had many students that followed them in their academic activities. Prof. Onuchic dedicated their mathematical researches in the area of the Differential Equations and Prof. Mário Tourasse in the area of the Foundations of the Mathematics. It will be done a short report about these two mathematicians and of some of their students.

INTUITION, FORMALISM AND PURITY IN BRAZILIAN MATHEMATICS

Rogério Monteiro de Siqueira

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In 1957, a small report, almost a resume of ideas, entitled "A Natureza dos Juízos Matemáticos" caused some disagreements between two important figures of Brazilian mathematic community. The report presented by Newton Carneiro Affonso da Costa at the section for logic and philosophy of science of a congress of philosophy was sent by a college to Omar Catuda. In spite of this friendly gesture, Catunda explicitly disagreed from Costa's ideas in a posterior letter. The main reason for the controversy was the distinction between intuitive and symbolic mathematics which Costa had sustained in the report, whereas Catunda had advocated the construction of mathematical concepts could not be separated from practical and real examples.

Intuitionism, formalism and logicism are old personages of the history and philosophy of mathematics very explored in the modernist movement. They can be observed, for example, in early communities like the German mathematical community, where Felix Klein, David Hilbert and Hermann Weil had acted. In the same way, Catunda and Costa revive in Brazil a very common motif for divergences. However, in the Brazilian fresh community of mathematics, established at thirties decade, such modernist face will gain other colors, depending on the disciplinary origins of the scientific actors and the available space within this new community.

The symbolic view of Costa, for example, can be identified in many episodes as a searching for an independency of his objects and themes of research. At the fifties decade, his discourse is proclaimed in an interesting way: It is an amalgam of his interest in philosophy and mathematics that found a "secure" place in congresses and journals of philosophy. By the other side, in spite of a mathematician with deep interest in structures, like sets, groups and rings, behind the mathematical ideas, Catunda was very concerned about teaching of mathematics, as many other professors at university in this period. At the following decade, Catunda participated in a very influential group responsible for the modern experience in the Brazilian secondary school. In his pedagogic view, there is not space for pure or symbolic ideas without the use of intuition and practical examples.

Therefore, in the genesis of modern mathematics in Brazil, also in the debate performed by Costa and Catunda, emerge three phenomenons: the reception of international early divergences, the beginning of the professionalism in mathematics and philosophy in Brazil, and the establishment of new Brazilian experts in the scientific community. The aim of this work is to analyse the confluence of these three phenomenons with the rising of modern mathematics in Brazil.

ON THE DEVELOPMENT OF PARACONSISTENT LOGIC AND THE BRAZILIAN SCHOOL OF LOGIC

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A theory is *inconsistent* if there is a formula of its language such that the formula and its negation are both theorems of the theory; otherwise, the theory is *consistent.* A theory is *trivial* if all formulas of its language are theorems. *Paraconsistent logics* are the logics of inconsistent but non-trivial theories. A deductive *theory* is *paraconsistent* if its underlying logic is paraconsistent. In paraconsistent theories the Aristotelian principle of (non-)contradiction is not valid in general.

The first logician to construct a formal system of paraconsistent logic, restricted to the propositional level, was Stanislaw Jaskowski in 1948. In 1958, the Brazilian Newton C.A. da Costa, independently of Jaskowski, began the general study of contradictory systems.

From 1963, da Costa has developed several systems and theories related to paraconsistency, apparently becoming the first logician to develop strong paraconsistent logical systems which could be useful for mathematics, as well as for empirical and human sciences. Da Costa and collaborators, from Brazil and several other countries, have introduced and studied many paraconsistent logics and set theories, appropriate semantics and algebras associated to the systems, decidability procedures, paraconsistent model theories, a paraconsistent differential calculus; and have studied applications to the foundational analysis of physical theories and to partial truth. Nowadays, 'paraconsistency' has become a field of knowledge and there have been applications of paraconsistent logic not only to the foundations of science and its philosophical analysis, but even to informatics and technology.

In this talk we shall present a general survey on the development of paraconsistent logic and da Costa's work, emphasizing the role played by the Brazilian School of Logic.

Da Costa, N.C.A., Krause, D., Bueno, O. Paraconsistent logics and paraconsistency. In: Dale Jacquete (Ed.), *Handbook of the Philosophy of Science. Philosophy of Logic*. Elsevier: 2007, pp. 791-911.

D'Ottaviano, I.M.L. On the development of paraconsistent logic and da Costa's work. *The Journal of Non-Classical Logic* 7 (1/2), 1990, pp. 9-72.

SOME HISTORICAL CONSIDERATIONS ON THE PARACONSISTENT LOGIC IN BRAZIL

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In Brazil the paraconsistent logic approach had its beginning in the works carried out by Professor Newton da Costa in the fifties in the twentieth century. His thesis was published in 1963 and was entitled "Inconsistent Formal Systems". In 1974 he published an abstract from his thesis in the Notre Dame Journal of Formal Logic entitled "On the Theory Of Inconsistent Formal Systems". This abstract is considered the starting point for researches in paraconsistent logic in Brazil. Besides being one of the first researchers to develop works in paraconsistent logic at an international level, Professor Newton da Costa and his students have studied several applications of paraconsistent logic into philosophy problems, computing, artificial intelligence and medicine fields. We want to present an overview on the historical development of this line of research in Brazil.

Symposium S37
Science, Politics, and Development in the 20th Century

UNESCO IN THE 50s : FROM THE PERIPHERY PRINCIPLE TO TECHNICAL ASSISTANCE

Patrick PETITJEAN

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Joseph Needham and Julian Huxley participated to the social relations of science movements in the 30s and the 40s, from which they drew their ideas when establishing the post-war UNESCO: science for peace, freedom and social welfare.

With the science department, they tried to implement a new form of international scientific cooperation, which they called the "periphery principle". UNESCO was to turn towards the countries which need the more a scientific development. Their agenda met much opposition, from the main powers within UNESCO as well from their fellow-scientists of the First World.

The international political context changed with the Cold War. Needham and Huxley left UNESCO in 1948. When inaugurating his new presidency in January 1949, Truman proposed to develop a "technical assistance" through the international agencies, a new form of using science for an economical development following the lines of the US model: A depoliticized science, instrumental for economical aims, forgetting its power for liberation. But actually, politics were still underlying: it was the "free world" against the "communist world".

Needham's and Huxley's idealistic conceptions of science were not contradictory with the standard views of their fellow-scientists. Even the periphery principle was not exempt from Eurocentric features. Their ideas proved to be a very poor defence against the dominance of the technical assistance scheme in the 50s.

INTERNATIONAL SCIENTIFIC ACTIVITY IN AN AUTARCHIC AND ISOLATED REGIME: THE ORIGINS AND CONSTITUTION OF PARTICLE PHYSICS IN SPAIN.

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Experimental Particle and Nuclear Physics was created in Spain thanks to Joaquín Catalá de Alemany, who started research in this discipline at the University of Valencia in 1950. Catalá obtained a one-year grant from the CSIC (Spain Research Council) to go to the University of Bristol in August 1949. He joined Cecile Powell's group which was working with photographic emulsions. Powell won the Nobel prize in Physics in 1950 for his development of photographic technique. The physics of photographic emulsions were well adapted to the depressed situation in Spain, an authoritarian regime following the Civil War, isolated and with an autarchic economy until half 50's. It was impossible for Spanish physicists in this situation to build or to buy accelerators or expensive electronic apparatus but they could analyze emulsions.

This paper gives new information about the origins and constitution of the group that fostered a tradition that continues today in IFIC (Instituto de Fisica Corpuscular). We will describe how, using these techniques and mainly microscopes, Catalá created a group and a new way of understanding research in a singular context as a Faculty without Physics degree; tried institutionalization of their activities since their origins; started new research lines and developed new techniques; established links with international laboratories and obtained national and international recognition. However not all were success in this difficult context. They couldn't do research into cosmic radiation, a field where a lot of new particles were discovered at that time, although as we will explain they attempted to do.

THE TECHNICAL AND SCIENTIFIC ACTIVITIES OF THE OFFICE OF INTER AMERICAN AFFAIRS (1940-1946)

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The Office of Inter-American Affairs was set up in 1940, under the leadership of Nelson A. Rockefeller reporting directly to the President of the United States. Its aim was to promote and coordinate actions of propaganda, technical and scientific assistance as well as cultural exchange between the US and Latin America and the Caribbean. It was established in order to prevent the potential influence of the Axis countries in the hemisphere. Based on a study of primary sources, in this paper I discuss some of the most representative technical and scientific programs developed by the Office. Although technical and scientific relations between North and South America go back to the 19th Century, those projects can be seen as isolated initiatives. I argue that the Office was the first explicit attempt to exert a cultural and tecnoscientific hegemony in the region by the US. In this sense it was a crucial step towards the “Americanization” of Latin American science and technology in the second half of the 20thC, catalyzed by the Cold War, and embodied in the famous “Point IV” of the Truman Doctrine. This paper is part of a larger research on the tecnoscientific relations between the US and Latin America in the 20th C, carried out by an international research group based in Mexico and Colombia.

THE EXACT SCIENCES AND POLITICS IN ARGENTINA, BRAZIL, PORTUGAL AND SPAIN IN THE IMMEDIATE POST-WAR YEARS: COMMON FEATURES AND DIFFERENCES

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During the war years Spain, Portugal, Brazil and Argentina were forced to adopt a policy of import substitution, which gradually helped them in the development of some areas of industry. In these years the perception of science and modern technology by the political elites of these countries experimented considerable changes. After the end of that war, when competition started to be felt again, new efforts were made by these goverments to keep industry alive. However, their undemoctratic character had put them at odds with wide sectors of the local inteligenzia and, in particular, with scientists. In this communication some differences and similarities in the relationship between the state and science in Spain, Portugal, Brazil and Argentina are considered; discussion is centered on the case of the exact sciences.

SCIENTIFIC DEVELOPMENT UNDER MILITARY DICTATORSHIPS: THE CASE OF BRAZILIAN PHYSICISTS (1964-1985)

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Brazilian science underwent dramatic institutional changes in the late 1960s and the early 1970s, a period at the apex of the cycle of military dictatorships which characterized South America during Cold War times. The authoritarian regime did not take exception to scientists. All critics of the regime were politically persecuted. Theoretical physicists such as J. Leite Lopes, M. Schönberg, and J. Tiomno were among them and were obliged to retire in 1969 when the government denied basic civil and political rights to Brazilian people. Indeed, as a consequence of the political arbitrariness of the times even people who were not politically active were persecuted. At the same time, science was supported like never before in Brazil. An institutional setting for graduate studies was created; the universities were restructured; new institutions were created; and governmental funding for research grew exponentially. For Brazilian physics such changes come at the same time as the diversification of research themes with solid state physics taking the main share, while high energy research - the previous main field of Brazilian physics – taking a lesser share. At the same time, a few leading physicists who had been working abroad, such as S. P. S. Porto, R. C. C. Leite, F. S. Barros, and H. M. Nussenzveig, returned to Brazil believing in the new environment created for scientific research.

The available literature has understudied or widely underestimated such changes. However, a contemporary observer would notice traces of these changes in current Brazilian science. An intellectual obstacle for studying such processes is the still widespread assumption that development in science is only possible under democratic regimes. However, such an assumption has been challenged in recent studies on the practice of science in places such as the former Soviet Union and the Franco's dictatorship in Spain. Our conjecture is that in order to better understand these changes in Brazil one needs to give up such an assumption and take into account the convergence of different factors related both to government policies and behavior of scientists and their agendas. Through the whole 20th century the Brazilian military were committed to the goals of modernization and development of the country, and after World War II the development of science became part of these goals. After 1964, following the military takeover, these goals were not abandoned and the high rates of economic growth – the Brazilian miracle – allowed the governments to pursue them. However, now the economic development's goals were flavored with the anticommunist and authoritarian mentality typical of Cold War times in Latin America. In the Brazilian case, such a mentality also had strong roots in a country whose history had been tainted by a colonial heritage and slavery which outlasted independence by more than sixty years. On the other hand, and this is the main aim of such research, Brazilian scientists, physicists in our case study, exploited this historical conjuncture to push ahead their agenda for the reinforcement of scientific activities. In hindsight their behavior may be described as marked in a certain extent by ambiguities. Historical sources from oral histories and archival documents suggest resistance to the military dictatorship – mainly through scientific societies, such as the Brazialian Physical Society [SBF] and the Brazilian Association for the Advancement of Science [SBPC] and covert individual action – as well as accommodation to the policies of the times. This meant that the main decisions on science and technology policies were taken not only by bureaucrats but also by scientific leaders, which may explain much of the success story experienced by Brazilian physics at the time. In our talk we will present some cases of Brazilian physicists who reveal both resistance and accommodation. [This research is sponsored by the CNPq].

A NEW LOOK AT AN OLD DEVIL: A DEMOCRATIC COMPUTER MARKET RESERVE DURING AN AUTHORITARIAN DICTATORSHIP

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Supplying the computer market with technically obsolete and high priced products plus the American pressure against it does not provide a satisfactory explanation for the fact that the market reserve practiced in Brazil from the 1970s to 1990 ended as an experience that even today is more intensely rejected than simply taken as an economic failure.

This account offers a new explanation that brings forward three specific socio-technical (simultaneously social, political, economic and technical) developments that came along the computer market reserve period in Brazil. The proposed new explanation runs against previous economic and sociological accounts that unproblematically consider a continuously unified computer market period during those two decades and bind the roots of the computer market reserve in Brazil to the authoritarian character of the military regime. The situation requires more complex historical accounts. As the result of combination and imbrication of three specific socio-technical – the special character of the community of Brazilian computer professionals, the intervention of the political police of the military dictatorship, and the appearance of the microcomputer –, the present account divides the period into two different phases. In contrast to previous analysis, the two phases are considered as quite different stages for industrial and scientific-technological policy making. Surprisingly, the first phase shows a strong relation, so far barely present in the historiography, between liberal democratic practices and the possibility of successful industrial and educational policies that simultaneously seek economic and techno-scientific development.

KEY-WORDS: computers, industrial policy, technological development, democracy, authoritarianism, community

SCIENTIFIC POLICIES IN PORTUGAL DURING THE DICTATORIAL REGIME AND THE PHYSICS AND GENETICS COMMUNITIES (1929-1954)

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In this talk we analyze how the scientific agenda of the Portuguese dictatorial regime influenced the emergence and development of both the physics community and the genetics community. Considering the relationship between science and politics as a dynamic one, we discuss both the extent to which physics and genetics served as a resource for the political regime and how scientific contents and practices were accommodated to the political context in which they were situated.

The dictatorial regime, installed in 1926 and known after 1933 as "Estado Novo" (New State), created different types of institutions for the support of science. Some defined state scientific policies and implemented a grant award system, starting with the Junta de Educação Nacional (Association for National Education) created in 1929 and modelled after its Spanish counterpart. Aurélio Quintanilha, a leader of the genetics community located at the University of Coimbra and Manuel Valadares, a leader of the community of experimental physicists of the University of Lisbon, were in good terms with their directors and were able to secure support for their respective groups from this institution. Other types of institutions housed groups of scientists pushing forward a definite scientific project. They included the Estação Agronómica (Agronomical Experimental Station) created in 1936, the first state institution where research on genetics was applied to agriculture, and the Junta de Energia Nuclear (Association for Nuclear Energy) created in 1954, the first successful institutional embodiment of a project for applied physics. Sousa Câmara, an agricultural engineer deeply committed to the regime but critical of many of its actions, is the connecting link between the genetics and the physics communities.

Disagreements with the political regime were behind the dismissal from the university system of Quintanilha, in 1935, and Valadares, in 1947. In Coimbra, José Serra, Quintanilha's disciple, shaped a new agenda for anthropology and phenogenetics which could be easily appropriated by the political regime, while later on he initiated research on animal breeding responding to the interest of the political regime. In Lisbon, the Spanish ultra-conservative Julio Palacios was called for to head the Laboratory of Physics which Valadares had turned into the most productive university center for physics. In what concerns physics, the regime pushed forward a new agenda after the end of WWII which materialized in the creation of the Association for Nuclear Energy.

SHAPING SCIENTIFIC COMMUNITIES IN FRANCOIST SPAIN, 1939-1967

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This paper analyzes the role played by the Consejo Superior de Investigaciones Científicas (Higher Council for Scientific Research, known by the acronym CSIC) in setting up Spanish scientific communities in the specific political context of Francisco Franco's dictatorship (1939-1975). My paper will discuss first the origins of the CSIC out of the tensions between political factions within the Francoist regime to show that the institution finally emerging from then was meant to be the political arm of the regime in higher education and research. Then the paper discusses the institutional mechanisms that made possible for the CSIC to build up a credible facade of scientific and scholarly respectability while turning most scholars and scientists into allies or at least passive supporters of the regime. In particular, it will discuss why and in which ways the CSIC —which embraced a rhetoric of opennes and international cooperation— was responsible for the backwardness and relative "scientific isolation" of the country.

LES AGRONOMES SYLVICULTEURS ET LES POLITIQUES FORESTIÈRES DES ANNÉES 1930-1960 AU BRÉSIL

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Le texte examine le processus de conformation de la nation brésilienne entre 1930 et 1964 en ce qui concerne l´influence des scientifiques sur la spécialisation et institutionnalisation de secteurs d'administration de l´État, ainsi que sur l' élaboration de politiques publiques. Afin d'analyser ce processus, une etude de cas est utilisée: la construction de la notion de forêt , ainsi que le processus de territorialisation des reserves forestières. On souligne que tout au long de la première moitié du siècle XX, le bois – mais également le caoutchouc et le maté – était le produit forestier central de l´économie brésilienne. En consequence l´exploitation et la construction des forêts fûrent l'objet de d' intenses débats entre, d'un côté les défenseurs des forêts homogènes visant la seule exploitation, d'autre les partisans de la conservation du patrimoine forestier brésilien. L'analyse est entamé à partir des trajectoires, actions et ouvres d' agronomes-sylviculteurs, tels que Paulo Ferreira de Souza e Horácio Mattos et le directeur du service de forêts et président du Conseil de Fiscalisation des Expeditions Artistiques et Scientifiques (dans lês années 30) Vasconcelos Sobrinho. Cette étude montre, à partir d'um cas spécifique, les circonstances et limites de partitipation des intellectuels dans la vie publique.

HISTORICAL NOTES ON THE GEOPHYSICS IN BRAZIL – PETROBRÁS AND THE NATIONAL DEVELOPMENT

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The progress of the geophysics in Brazil was implemented thanks to the job of new scientific and technological resources, introduced through graduate courses, as well as for the arising of the Brazilian Company of Petroleum (Petrobrás). With the discovery of the first wells of oil in Lobato (Bahia, Brazil), in 1939, and the support of the government of President Getulio Vargas, the mentioned company was developed and today it is the greater of country and one of the great ones in the world. In the present time, with the discovery of other deposits of oil, including those situated ones in deep regions, in the Basin of Santos (São Paulo, Brazil), below of a wide saline layer, are waited beyond a great scientific and technological development, that Brazil whether becomes one of the main worldwide producers of oil.

The modern teaching of the geophysics, in the country, was initiated in the Federal University of Bahia (UFBA), from an accord between the Institute of Mathematics and Physics and the cited Petrobrás, in 1965. Other accords firmed with the Institute of Geology (UFBA) and other agencies of incitement to the research in sciences and technology in Brazil (CNPQ, CAPES) and from abroad (UNESCO, World Bank) had made with that researchers of other countries came to the UFBA and developed a precursory work, in Brazil, of formation of researchers in distinct areas of the geophysics. The nuclear geophysics and the applied and theoretical geophysics are examples.

With the use of different nuclear and electromagnetic techniques applied to the geophysical problems, many graduates whether had spread for other regions of Brazil for instance the states of Pará, Rio de Janeiro, São Paulo and in Brasília, and have formed new groups in geophysics. The presence of these professionals and the determination of Petrobrás in using new knowledge of geophysics have been factors of great success. On the other hand it is important to emphasize that the research in geophysics, since the beginning have interested the scientific community, in sight of the mineral wealth of Brazil, its rich environment and the great potential in their application of the distinct geophysical techniques.

The search of the knowledge of several aspects involving the different environments (marine, terrestrial and aerial), for example, the atmospheric pollution, the evolution of the organic matter in distinct types of soils, the mineral exploration, the geochronology of marine sediments and many other topics, have generated knowledge and wealth.

The authors thank to professor O. Freire Jr., by the fruitful discussions.

THE MATHEMATICIAN NORBERTO CUESTA DUTARI RECOVERED FROM OBLIVION

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This contribution describes the life and work of the Spanish mathematician Norberto Cuesta Dutari (1907-1989), whose academic career run in parallel to the Franco regime. His activities as a mathematician, historian, and compromised person are considered, in close relationship with the social and political environment in Spain during the Franco years (1939-1977).

N. Cuesta and his signature

The importance of Cuesta's contribution is highlighted by the fact that he always worked on his own, in the isolation of the provincian University of Salamanca. In order to end with this isolation he had a key role in establishing a study track in Mathematics at Salamanca in the early seventies, when the Franco regime was coming to an end. He had been a sharp criticist of the regime, even opposing to the honorary degree the University awarded the dictator Franco in 1954.

Professor Cuesta was a remarkable example of a "scientific outlier". He wrote in 1942 –and on his own- his thesis "*Teoría Decimal de los Tipos de Orden*" (A decimal theory of Order Types), where he anticipated many results rediscovered later on by other mathematicians, in particular the surreal number system described by J. H. Conway and D. Knuth in the seventies.

As a mathematician, Cuesta became well known as the first one to write a book devoted to order properties, his still often cited "*Matemática del Orden*" (Ordered Sets) from 1959. He authored over thirty papers on this topic between 1943 and 1958, and then switched to Metamathematics, foundational questions, and History, with more than twenty papers and many congress presentations. He always published in Spanish, a handicap for the dissemination of his work.

Cuesta also made substantial contributions to the History of Mathematics from a critical viewpoint. His studies on the Invention of Infinitesimal Analysis and on rigour in the work of Euler on series can be found in his monumental treatise on Mathematical Analysis "*La Sinfonía del Infinito*" (A Symphony of the Infinite) of 1981, a mathematical testament where his deep conceptions of Mathematics and Philosophy of Science are expounded.

A complete list of his more than ninety papers in journals and plenary addresses, and five books contributions to Mathematics and its (Social) History has been compiled for this presentation.

THE REBIRTH OF A «*SCIENTIFIC MOVEMENT*» AND THE FOUNDATION OF THE NATIONAL BOARD OF EDUCATION IN THE FIRST PERIOD OF PORTUGUESE DICTATORSHIP

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In previous studies, history of science has paid attention to the organization, management and promotion of scientific activity at different countries in the first half of twentieth century. Institutions created to this purpose had been studied, as instance those in Spain, Canada, USA or England. A major concern is the analysis of scientific relations amongst countries specially the scientists' movements through world institutions, improving their knowledge, communicating their expertise or establishing research cooperation. In Portugal all this movement of scientists was initially supported by a new institution ["Junta de Educação Nacional" (JEN)], the National Board of Education. The role of JEN during the inter-wars period is the subject of our presentation.

The advent of Republic in Portugal (October 1910) brought important reforms in higher education. However, during the next two decades, political difficulties prevented the creation of a national institution able to promote and fund the organization of scientific research. Only in 1929, with the military dictatorship of 28 May, the Minister of Education approved the Decree creating the «Junta de Educação Nacional» (JEN). The government assigned to the JEN the indispensable financial resources but, so far it was noticed, they didn't had any plans to innovate national education and they supported important funding restrictions in this area. JEN main actions were directed to improve scientific research institutions, to manage a grants service for national and foreign apprenticeships and to promote specific research, based on the experience of ex-grant holders. Starting in 1928-29 JEN gave some funding to institutions already engaged in scientific research.

Studying JEN documents we can get a picture of the research institutions supported, how and where the money was applied and the results obtained. A statistical analysis of grants data highlights the foreign places selected to apprenticeships and enables to identify the selecting patterns related to specific disciplines. Moreover, it provides us an account along the time that should be studied considering its historical context. An analysis of legislation, annual accounts and regular meeting proceedings will elucidate us about JEN trends for grants attribution and laboratories financing. It is possible to have a large characterization JEN general politics towards the implementation of national research laboratories. JEN activity suffered important contradictions under the «New State» general policy. Although JEN implemented measures were below expectations, the knowledge of its activity outcomes allows us to recognize this institution as an important fact to consider the so called «rebirth of a scientific movement» in Portugal.

In this presentation we intend to summarize on JEN's activities in modernizing Portuguese science and also the purpose to redefine the scope of the theme «fascism and science» during the inter wars period, having a new contributions to a Portuguese comparative study in European context of history of science.

SCIENCE AND SOCIAL INEQUALITY: CASTE AND GENDER IN MODERN PHYSICS IN INDIA

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Far too often postcolonial histories, especially of modern science, use colonialism and nationalism as the only salient analytical categories, imposing overly simple binary oppositions, and erasing from colonizer and colonized alike their internally differentiated power structures. In the case of India, for instance, caste, gender and class find little expression in histories of science as these are subsumed under the generic bifurcation of the Indian society into western educated elite and the subaltern. There are few, if any, scholarly works on the impact of social inequality on science in India. The need for more inclusive histories of modern physics, "histories from below" if you will, is therefore urgent for a more accurate understanding of science. I will draw upon micro-histories of modern physics in India to argue for an analytical framework that recognizes the complexity, differentiation, and stratification in scientific relations as well as acknowledges the possibility of scientific truth.

PERSONAL MOTIVATION IN THE CREATION OF THE FIRST PROFESSION AND RESEARCH INSTITUTIONS OF PHYSICS IN MEXICO

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In this work four examples appear that were very important for the beginning and development of the physics in Mexico, and all of them were motivated and promoted by personal interests: The creation of the first studies in Physics in the thirties, the inauguration of the first National School of Physics and Mathematics (1936), the foundation of the first Institute of Physics (1938), and the operation of the greatest experimental nuclear physics laboratory (1952) in this country in the first half of XX century. In this lecture I'll took about personal interests of the Mexican engineers and scientists who promoted these projects, which did not respond, initially, to the national scientific or education policy.

THE POLITICAL ENGAGEMENT OF A SCIENTIFIC INSTITUTION: THE MUSEU NACIONAL OF RIO DE JANEIRO IN THE BEGINNING OF THE 20th CENTURY

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The scientific knowledge concerning natural resources, developed during the 19th century, became an industrial and agricultural input in the beginning of the 20th century. The practice of natural sciences in naturalistic voyages promoted by scientific societies, botanical gardens and, especially, by natural sciences museums was further fostered by virtue of sponsorships from firms in accordance with scientific institutions. In Brazil, the government created a system of concession of land to incentivize firms to install themselves in regions until then economically unexplored such as, e.g., the Amazon. Institutions like the Kew Garden of England worked in connection with industries aiming to stimulate the introduction in their markets of tropical goods, such as different varieties of coffee, new textile fibers, and especially rubber latex.

The policy of the major and oldest institution of natural sciences in Brazil, namely, the Museu Nacional of Rio de Janeiro, was in stark contrast with this scientific trend of imperialist expansion. The scientific practice of the Museu Nacional was part of an overall government strategy to explore the vast Brazilian territory. Given the 19th Century standards, this meant restricting attention to the collectionism, classification and exhibition of the objects of nature. Sciences and politics were in the same path. In the 20th Century, the Brazilian government submitted natural sciences to its political plans of communication and settlement, and the expeditions to the interior were chiefly of political nature. Scientific activities were only secondary and that was the spirit permeating the practice at the Museu Nacional. The tradition of the 19th century to focus on new natural resources and on the distinct ethnicities of Brazil persisted at the Museu Nacional, so that the main advances were in the fields of anthropology and ethnology. International relations with similar scientific institutions were made by exchange of natural products and publications. Its participation in the growing movement of industrialization of Brazil was only through the analysis of products that had privileges of production.

In the beginning of the 20th Century, the Museu Nacional broke the nexus between natural sciences and economic production, which formed one of the basis of imperialism. The political engagement of the Museu Nacional was esentially restricted to the Brazilian sphere and hence played a secondary role in the international movement of natural sciences. In line with the industrialization process, led mainly by the pharmaceutical and food-processing industries, the Museu Nacional continued to research about new botanical, zoological and mineral products. In the 50s, while the government envisaged economic development, the Museu Nacional changed course by conducting research in ecology, rather than following the tenets of political engagement. The latter was outdated at Museu Nacional, whose political engagement became inversely proportional to the scientific engagement in state-of-the-art research'.

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MARX'S APPEAL TO DUTCH SCIENTISTS

Leo Molenaar

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In the period after 1945 Dutch science was revolutionized *twice* by internal *movements* that disputed the social function of science. After the World War II research workers wanted to prevent the products of science from being further misused in the future by the politicians in power: the *Verbond van Wetenschappelijke Onderzoekers* (*VWO*, Association of Scientific Research Workers) was born. Twenty-five years later, in 1969, the *Bond voor Wetenschappelijke Arbeiders* (*BWA*, Union of Scientific Laborers) was founded with the goal to promote the ideal of an 'oppositional practice' in the member's daily work. They also advocated that results of science should benefit the common people. Both initiatives were the new generation's expression of the dissatisfaction with the existing power structures in science, and in both cases Marxist opinions played a significant role[1].

After the First World War groups of scientists had already given form to their 'social responsibility'. A forceful, international impulse had been given by the British *Association of Scientific Workers* (ASW), both by their collective publication *The Frustration of Science* (1935) and by *The social function of science* (1939), by their Marxist spokesman John Desmond Bernal. In 1946 the *ASW*, which at this time acted as a partner in the then Labour government of Great Britain, called upon scientists worldwide to erect sister organizations. This helped lead to the foundation of the *Verbond* in the Netherlands. I would like to begin with the clarification of the expression 'Marx's appeal to scientists' in this context.

1. Leo Molenaar: *We can't leave it to the politicians any longer; The history of the Association of Scientific Workers 1946-1980*, Den Haag 1994. The information in the speech comes mainly from this source.

VYGOTSKY, BLONSKY AND MARXIST PSYCHOLOGY IN SOVIET RUSSIA

Alexander Dmitriev

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This conribution will be devoted to implement of Marxism in the behaviorial sciences during the first decade of Soviet history. Alexey Leontjev, Lev Vygotsky's follower, remembered in his late writings that he and his associates in 1920's estimated Marxism not on level with another schools (Behaviorism, Associanism, Psychoanalysis etc.) in psychology but as à special prospective and prominent *stage* in the whole development of the discipline from the time of Aristotle. No doubt this Leontyev's retrospective comment is partially nostalgic idealisation but also it marks real pluralism and even competition between *different* Marxist approaches in early Soviet psychology, beyond the stricted frames of any doctrine. The dominant mainstream in Soviet psychology occured only after Stalins death, mostly completed by same Leontyev and Sergey Rubinstein as well as their pupils (both schools rested upon the manuscripts of early Marx, discovered in 1930's). The development in USSR also was complicated after the decree of VKP(b) Central Committee "On Pedolodical Perversions in Narkompros Systems" (1936) that banned all after-revolutionary experiments. This document stricted the dissemination of legacy of Lev Vygotsky (1896—1934) at decades and caused the disfavour of Pavel Blonsky (1884—1941).

I suggest to pay most attention on the Blonsky's and Vygotsky's works from 1920's and their common intellectual and ideological background. Both of them were marginalized in late Russian imperial academic system and shared semi-oppositional experience: Vygotsky was anchored in Jewish cultural life; Blonsky was even arrested for his leftist activity during Revolution 1905—1907. Vygotsky was interested in Spinoza and Russian Modernism; Blonsky studied critically and in great detail the history of idealist philosophy; he published in 1910's special works about George Berkeley, Eduard von Gartmann and Plotinus. During the First World War Blonsky and Vygotsky were both engaged in Shanyavsky People University in Moscow as alternative to state and elitist institutions. That time Blonsky concerned himself on pedagogical issues, he also supported Bolsheviks in 1917 and then worked at high position in Narkopros as adherent of Nadezhda Krupskaya.

Essential principles of well-knowing *cultural-historical psychology* was implied in “The Historical Meaning of the Crisis in Psychology” (1926—1927), unpublished doctoral thesis by Vygotsky. In this work he treated Marxist psychology as some intermediate space between materialist philosophy and specific concepts about mind, emotions etc.; there he also refered to notion of *scientific* psychology by Blonsky. Previously Blonsky was more radical in building of Marxist psychology within process of total and vigorous reconstruction of humanities (“Reform of Learning”, 1919). He insisted on *complex* analysis of all aspect of social activites by psychology – and not only the cognition and perception (“Outlines of Scientific Psychology”, 1921). These innovations would be compared with similar research programm of some branch of early Frankfurt School (especially Karl Asugust Wittfogel as autor of “Die Wissenschaft der bürgerlichen Gesellschaf”, 1922) because of common technical-indusrial bias and attention on the practical goal of education. In the early 1930’s both theorists seems to traded the places: Vygotsky created a broad research programm and personal school (Luria, Teplov and others), while Blonsky attended on more special questions (studies about the memory of about children sexuality – as alternative to psychoanalysis etc.).

SOVIET MARXISM AND SCIENTISM

Alexei Kojevnikov

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Many novel practices and prevailing attitudes towards science that developed within the Soviet Marxist tradition typically claimed to have been derived out of Marxist theory. Yet often they could go well beyond established doctrines, blaze exploratory paths, and occasionally receive *post hoc* ideological rationalizations.

1. Scientism. Soviet-style communism placed a much higher value and expectations upon science than did other political movements and regimes of the twentieth century. This extraordinary cult of science requires explanation: it reflected, besides other influences, the cultural values of the Russian intelligentsia and lessons derived from Russia’s experience in World War I.

2. Experts in Political Roles. Scientists and engineers, rather than, say, lawyers or businessmen occupied positions of political power alongside professional politicians. Their presence was particularly visible during the 1920s, when most such ‘bourgeois experts’ were not even communist sympathizers, yet served in responsible posts in the Soviet government. Together with the Bolsheviks, they invented the new Soviet state.

3. Science and Practice. Insisting that all scientific knowledge is related to social and practical goals, Soviet Marxism explicitly rejected the prevailing ideology of separation between pure and applied research. Some authors advanced the idea of social construction of knowledge, combining it with, rather than opposing it to, scientific realism. Soviet understandings of science spread westwards after the 1931 London Congress of the History of Science, but their strongest impact on changes in science policies came in the wake of the 1957 Sputnik shock.

4. Research as Profession. By privileging research over teaching, the Soviets effectively instituted scientific research as a separate occupation in its own right. Special research institutes gave employment to the new mass profession of scientists/research engineers and influenced institutional reforms of research infrastructure internationally, from CNRS in France to NASA in the USA, and Academies of Science in China and Eastern Europe.

5. Affirmative Action. The view of science as a mass, rather than elite, occupation implied a radical broadening of research demographics. ‘Bringing science to the masses’ involved dedicated popularization efforts and a system of special measures (currently known as affirmative action) designed to ease recruitment, training, and promotion from previously discriminated against and underrepresented groups: workers and peasants, women, racial and ethnic minorities.

6. Bourgeois and Marxist Science. In comparison with the 19^{th} century classics, Soviet Marxists recognized that not only philosophical, social and legal doctrines, but also ‘positive’ sciences are susceptible to ideology. This view led them to an early rejection of eugenics as ‘bourgeois’ and ‘racist’ in 1931, as well as to a temporary ban on genetics in 1948. They were reluctant to write assertively of specifically ‘Marxist’ or ‘proletarian’ science, but the invention of some basic concepts of contemporary quantum physics – ‘quasiparticles’ or ‘collective excitations’ – strongly relied on socialist understandings of collectivism and freedom.

RE-EXAMINATION OF THE DISPUTES OVER THE INTERPRETATION OF PHYSICAL THEORIES IN PRE-WAR SOVIET RUSSIA: FROM THE PHILOSOPHICAL VIEWPOINT

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Philosophical disputes over the natural sciences in the USSR proceeded, needless to say, along ideological line. In this talk, I will examine how the internal structure of philosophical contents affected disputes over classical/modern physical theories in the pre-War period.

As is well known, recent historical studies of Soviet sciences have thrown light on various aspects of the disputes that occurred in many academic fields. One of the most interesting results of these studies is clarification on the social origins of political battles. For example, it is now clear that various groups of natural scientists -not only "-pseudo-" scientists but leading scientists as well- fought for political legitimacy or social benefits in ordinary life in the USSR.

However, social factors are not the only ones to an occurrence or the way the disputes proceeded. Internal analysis of philosophical aspects is also required to grasp the process as a whole. From this perspective, we can't reduce the disputes over physical theories merely to dirty political struggles reflected by ideological suppression. By re-examining the confrontations between leading physicists and old-school scientists or communist philosophers in the 1930s, I hope to reveal the internal origins of the tendency towards serious dissent from the orthodox descriptions of the concepts of classical/modern physics. Many of these epistemological/ontological arguments in the pre-War period USSR imply worthy perspectives, in spite of the use of vulgar ideological rhetoric.

The talk may refer to topics, such as objections to the Copenhagen interpretation of quantum mechanics; the realistic worldview as opposed to the positivistic or formalistic tendency in Western countries; objection to the idea of 'thermo dynamical death' and expansion of the universe; attention to the metaphysical meaning of the law of conservation of energy and claim for the infiniteness and multi-classified structure of nature.

Many of these topics were also discussed among Marxists of other countries, but in the USSR, institutional supports and a wider expanse to various persons made the disputes quite numerous and deep.

FOUNDATIONS OF QUANTUM THEORY AND MARXISM: ROSENFELD VERSUS BOHM

Anja Skaar Jacobsen

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When the young American physicist David Bohm proposed a new interpretation of quantum mechanics in 1952, introducing so-called "hidden variables" in the theory, Léon Rosenfeld, who had developed into the most ardent exponent of Niels Bohr's quantum epistemology, became Bohm's most vitriolic criticiser. The following dispute between the two physicists also bore on their different Marxist positions. Bohm and Rosenfeld met on a few occasions where they discussed the foundations of quantum mechanics, for example at the symposium "Observation and Interpretation" in London 1957. However, their confrontations also took place in correspondence and book reviews, etc. During the 1960s Bohm's views on quantum physics changed slightly and the relationship between the two physicists became much friendlier and respectful. On the basis of correspondence as well as printed sources I will compare their different views on the foundations of quantum theory as well as their different Marxist positions, and probe the larger social and political contexts in which their dispute evolved. The talk will be based on a joint work in progress with Christian Forstner and Olival Freire Jr.

LE LYSSENKISME ET LA CONCEPTUALISATION DE LA SCIENCE PROLÉTARIENNE EN FRANCE

Deniz Uztopal

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En février 1949, c'est-à-dire 6 mois après le fameux Congrès où Lyssenko institutionnalisa sa théorie, un membre du Bureau Politique du Parti Communiste Français et responsable de la section des Intellectuels, Laurent Casanova conceptualisa en France la thèse de la science prolétarienne. En effet, le parti avait décidé de réunir 503 intellectuels à la salle Wagram, à Paris, pour critiquer les positions d'atermoiements qui dominaient jusqu'à là parmi les intellectuels communistes à l'égard des thèses de Lyssenko. Pour défendre ce dernier, Laurent Casanova avait affirmé l'existence d'une science prolétarienne. Depuis, les historiens et les scientifiques ont qualifié le lyssenkisme comme l'exemple par excellence de la science prolétarienne.

Or une analyse des textes et des discours, non seulement de Lyssenko, mais aussi de Staline et de Jdanov, nous permet de préciser que ces derniers n'ont jamais qualifié leur conception de science de « science prolétarienne ». Bien au contraire, les interventions de Staline sur la linguistique, publiées pour la première fois en français en août 1950, accule Laurent Casanova à faire une « autocritique » timide en novembre 1951 et à demander aux communistes français de ne plus utiliser ce concept. Autrement dit le concept de la science prolétarienne est désormais condamné alors que le lyssenkisme est toujours à son apogée en tant qu'une interprétation soviétique de la biologie.

En effet, désormais l'enjeu n'est pas de défendre la science prolétarienne, mais bien au contraire de la condamner. A partir de « l'autocritique » de Casanova, les idéologues communistes français tentent de trouver des soubassements idéologiques aux condamnations au concept de la science prolétarienne. Dans un premier temps, des intellectuels (Cogniot, Vassails etc…) s'appuient sur les œuvres de Staline pour condamner les erreurs idéologiques commises en théorisant le concept de la science prolétarienne. Or, le XXe Congrès du PCUS en février 1956 vient sanctionner un infléchissement idéologique entamé à partir des années 1954 – 1955. En effet, après la condamnation de Staline par Khrouchtchev, la condamnation idéologique de la science prolétarienne change de nature. Désormais, on ne s'appui plus sur les œuvres de Staline pour la condamner, mais on l'utiliser pour condamner le stalinisme. A ce titre le discours de Roger Garaudy au XIVe Congrès du PCF est signifiant. Celui-ci, devenu le philosophe officiel du Parti, et auteur de deux thèses de doctorat en philosophie utilise son notoriété pour décrire les origines de la science prolétarienne dans la conception du stalinisme. Désormais, les condamnations idéologiques du stalinisme de la science prolétarienne sont obnubilées, et la nouvelle politique du Parti, c'est d'attribuer la responsabilité de la conceptualisation de la science prolétarienne à Staline.

THE IMPACT OF THE SOVIET GENETICS CONTROVERSY ON JAPAN FROM THE LATE 1930S TO THE EARLY 1950s

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The domination by the Soviet plant physiologist, T.D. Lysenko, over Soviet genetics in August 1948 stimulated the interest of western intellectuals, and following this event, the Soviet genetics controversy, now well-known as the Lysenko controversy, arose in almost all the Western countries. However, in Japan, this controversy underwent a peculiar development and was extraordinarily agitated.

Japanese intellectuals began receiving information about Soviet genetics from the mid-1930s onwards. A certain part of reliable information also came from the Manchurian region that was under the rule of Japan before World War II. However, in the second half of the 1940s, the availability of information was weakened due to Japan's defeat in World War II. In 1946, two basic books on Lysenko's theory—*the New Genetics in the Soviet Union* by Hudson & Richens and *Heredity and its Variability* by Lysenko—were published in the West, and as a result, there was a serious delay in the acceptance of these books in Japan. Hence, Japanese biologists were unable to obtain detailed information on Lysenko's theory before August 1948.

Two main individuals strove to compensate for the delay in the acceptance of information on Soviet genetics in the Japanese academic circle. The first was Ryuichi Yasugi, who was a historian of Darwinism but not a trained geneticist. He managed to obtain very few sections of Lysenko's journal, *Iarovizatsiia,* and tried to translate Lysenko's theory from Russian into Japanese. The second was Hitoshi Kihara, who was a distinguished geneticist and a specialist in wheat genetics. He attended the 8th International Congress of Genetics in Stockholm in July 1948, and during this trip, he collected a considerable amount of western literature on genetics including the two abovementioned books that were published in 1946. As a result of both men's efforts, Japanese intellectuals were gradually able to examine Lysenko's theory in detail by the early 1950s. However, soon the leading Western biologists began to politically and ideologically criticize Soviet genetics, and their opinions affected the controversy in Japan to a certain degree, making it difficult to maintain purely scientific discussions. The Japanese intellectuals were soon involved in the political and ideological conflict between both the pros and cons of Lysenko's theory.

In the early 1950s, the controversy in Japan displayed a peculiar aspect. Farmers, not having been directly involved in the debate in academic circles, began practicing Lysenko's theory by themselves with a genuine desire to increase their crop yield. Further, the tide of the Lysenko controversy reached various social groups in Japan, and the heated controversy in Japan continued till the end of the 1950s, while that in the West had almost disappeared by the early 1950s. Both intellectuals and farmers displayed diverse approaches toward Lysenko's theory, unlike the controversy in America, where the almost singular hostility toward Marxist ideas including Lysenko's theory as a kind of a Marxist science appeared in connection with the policy toward the Cold War.

MARXISM AS A USEFUL TOOL: JAPANESE PARTICLE PHYSICISTS

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Makoto Kobayashi and Toshihide Maskawa received the Nobel Prize 2008 in physics with another Japanese-American physicist Yoichiro Nanbu. In 1973 Kobayashi and Maskawa predicted the existence of at least three generations of quarks which is now accepted as the basic framework of the standard model of elementary particles. It is well known that they were influenced by the thought of Shoichi Sakata (1919-1970) of Nagoya University. Their mentor Sakata was known as a leader of the post-WWII democratization of Japanese academic community and an advocator of Marxism, especially its methodology in physics. He developed his own Marxist methodology with his Marxist colleague physicist Mitsuo Taketani. For them Marxism offered not only progressive perspectives for Japanese postwar democratization but also a useful methodological tool for research in physics.

In his student days Sakata read Frederick Engels' *Dialectik der Natur* and Lenin's *Materialism and Empirico-Criticism*. This reading made him feel "a strong stimulus … to accomplish a practical application in my real research of natural dialectic as the methodology of contemporary science." Sakata developed his own view of nature called the "stratum view of nature" that claimed that nature consisted of an infinite number of strata, each of which was governed by a peculiar law of motion.

In 1956 Sakata proposed a composite model of hadrons that postulated three baryons - p, n, and - were more fundamental than other hadrons. He successfully interpreted the new quantum number *strangeness* in terms of the number of -particles. Sakata believed that the mysterious "logic of form" (*strangeness*) could be transformed to a clear "logic of matter" (the number of -particles). This "logic of matter" strategy became one of characteristics of the Sakata School from which the Nagoya Model, the New Nagoya Model, and the Quartet Model appeared. The Kobayashi-Maskawa Model in 1973 developed from this "logic of matter" strategy.

However, as Maskawa argued in 1981, due to its distrust of quantum theory, the Sakata School ignored the development of the Weinberg-Salam theory: The Sakata School had strongly hoped for another revolution after quantum mechanics. This expectation prevented them from exhaustively utilizing existing quantum field theories. The Marxist tradition of the Sakata School was useful and successful in fostering a peculiar research strategy but blinded them to other approaches.

REJECTION AND ACCEPTANCE OF PLATE TECTONICS: STALINISM AND THE JAPANESE GEOLOGICAL COMMUNITY

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In North America and Europe, most geophysicists and geologists accepted plate tectonics by the early 1970s. It became a dominant paradigm in earth sciences. By contrast, not until the middle of the 1980s was plate tectonics generally accepted in the Japanese geological community. One reason for this delay of the acceptance was because of the great influence of Stalinist thought which was popular among social movements for democracy in postwar Japan.

In 1947, about one hundred young geologists founded an association named “Chidanken” (Association for Geological Collaboration) in order to democratize the Japanese geological community and to collaborate in their research. “Chidanken” organized election campaigns for councilors of the Geological Society of Japan (GSJ). During the 1950s “Chidanken” succeeded in obtaining a majority in the executive committee of the GSJ and had a great influence on the distribution of research funding, selections of various awards, editorial articles of journals and so on. In 1974, the membership of “Chidanken” became three thousand as many as that of the GSJ itself.

“Chidanken” also generated a new research tradition that could be named “historicism.” It was founded on an idea of Syoji Ijiri, who had served as the director of the science-technology bureau of the Japanese Communist Party. He derived the idea from Stalin’s “On Dialectical Materialism and Historical Materialism,” a section of *A Short Course on the History of the Soviet Communist Party of the Soviet Union (Bolsheviki)* published in 1938. Ijiri claimed that geology was a historical science to discover laws of the evolution of the earth. This historicism developed a theory of geosynclinal mountain building that claimed geosynclines possessed mountain-building forces within them. This idea was influenced by so-called “dialectical materialism.” Based on this theory, “Chidanken” published *The Geologic Development of the Japanese Islands* in 1965, to which about one hundred researchers contributed. This theory gradually grew into a kind of paradigm.

When plate tectonics was introduced into Japan at the end of the 1960s, the adherents of the historical research tradition rejected it, because it was built on “actualism” rather than “historicism”. Moreover, the geosynclinal mountain building theory conflicted with plate tectonics which accounted for mountain building as a consequence of plate motions. Many members of “Chidanken” criticized plate tectonics as a mechanical theory, because plate tectonics denied a core theory of *The Geologic Development of the Japanese Islands*. By the middle of the 1980s, it was gradually recognized that most of Japanese Islands was formed by accretionary prisms that originated in plate subductions. Then most Japanese geologists accepted plate tectonics.

MARXIST PHILOSOPHY AND NATURAL SCIENCE IN THE LAST DAYS OF THE USSR

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How did philosophical concerns play out in Soviet science after the death of Stalin and especially in the Brezhnev era and beyond? What motivated specialists in terms of questions of epistemology and research? Considering the case of a few leading physicists, in this brief talk I shall discuss how questions of epistemology lost interest for scientists, while those of the politics of funding, establishment of research priorities and personnel policy gained increasing importance.

Symposium S39
Early Modern Conversations between Science and the World's Religions

THE HERESY PROSECUTION OF RENAISSANCE SCHOLARS DOMENICO SCANDELLA, GIORDANO BRUNO, AND GALILEO GALILEI

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A popular misconception about the medieval and Renaissance heresy prosecutions collectively referred to as the Inquisition is that they represent a unified movement of the Catholic Church to repress individual thought and the scientific pursuit of truth. However, an exploration of the patterns of obedience and resistance to Church authority in three relatively well-known trial histories – those of Galileo Galilei, Giordano Bruno, and Domenico Scandella – reveals a different picture. While Bruno historian Edward Gosselin has explored the connections between Galileo's and Bruno's trials, scholars have not considered the stories of these three heretics together. Their cases examined as parts of a larger story confirm that the Holy Office was not an all-powerful institution, uniformly intent on repressing scientific progress and intellectual innovation. One significant form of variation in the course and outcome of a trial was in the defendant's opportunities for resistance, subtle or overt, to the authority of the Church. Moreover, we see that opportunities for such resistance were often rooted, not in a defendant's contesting the intellectual validity of his heresies, but in availing himself of the social networks he had previously cultivated.

OSWALD CROLL'S *DE SIGNATURIS INTERNIS RERUM*: A THEORY OF PHARMACOGNOSY AT THE CROSSROADS OF TRADITION AND MODERNITY

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Oswald Croll (c1560-1609), a German phycisian and alchemist, published *De signaturis internis rerum* (*Treatise of Signatures*) in 1609, and appended it to a much longer opus called *Basilica Chymica* (*Royal Chemistry*). While the latter lists recipes for an impressive number of chemical remedies, and played a prominent role in the diffusion of iatrochemistry, the former focuses on botany and the doctrine of signatures, which states that the medicinal properties of plants are revealed by tell-tale signs of similarity to the affected organ, or the symptoms of the ailments.

Beside relating intriguing naturalistic anecdotes and exhorting fellow physicians to learn to read signatures, Croll makes a case for both an esoterical theory of pharmacognosy and a direct experimentation by the physicians, as opposed to the book learning, drawing heavily on the authority of Paracelsus.

During the seventeeth century, both texts have been actively reprinted and translated into a variety of languages, often with questionable accuracy. Later, the *Basilica Chymica* was outmoded by the development of modern chemistry, while the alchemist manifesto developed in the preface of the *Treatise* ensured its ongoing vogue in occultist circles, the botanic handbook aspect of the work all but forgotten.

A new edition of this book is currently being put together, including the first modern translation of the text (in French, by Sandra Mouton) and its first scientific commentary that will try to elucidate the more obscure parts, determine the botanical species listed, and exhibit the interest and place of the work in the development of early modern medicinal botany.

THE ATMOSPHERE AS PHYSICAL MIRROR OF THE SOCIETY – THE CASE OF JEAN ANDRÉ DELUC (1727-1817)

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In a unique way, the Calvinist citizen of Geneva, Jean André Deluc combined in his life and work a career as merchant and political activist, with empirical research, instrument making and a firm belief in the Bible. This mix made him eligible to the position of reader to the English queen Charlotte of Mecklemburg-Strelitz, who was a bluestocking with sincere interest in philosophy, physics, botany and geology. Under her patronage, Deluc moved into the center of a Calvinist European network of natural philosophers and literati, who were deeply committed to the ideal of tolerance between the Christian denominations, and eager to fight the non-believers' intolerance towards revealed religion. Deluc aimed especially at restoring the contested revelation, weakened by historical research and since the mid 18^{th} century also by physical theories. Deluc's contribution to the common cause was not only to develop a catastrophic theory of past geological catastrophes that shaped the surface of the Earth during a great flood, but to further advance instrument making in barometry, hygrometry and electricity. His standardization of the barometer and his formula for the measurements of heights with the barometer was praised by his contemporaries as the best contribution to physics since the days of Newton, an assessment which shows that faith and scientific research could well support each other, but could also rival and be hostile to the Enlightenment and its historical and physical research as well as to its radical political implications. This will be exemplified by Deluc's political use of his scientific instruments, experiments and concepts in his battle against "Neologians" in German Protestant Theology as well as in French Chemistry after the outbreak of the American and French Revolutions. In both fields, theology and chemistry, Deluc's battle over the right scientific interpretation of the history Earth and the components of water and air, gives us an example of how the Earth and the atmosphere became united as the physical mirror of a revolutionary European society, where the attitude towards the Christian foundations of knowledge and society could hardly be neutral.

LAPLACE'S PRIVATE RELIGIOUS DISCOMFORT

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Laplace had a well-earned reputation as an unbeliever, expressed in his famous retort to Bonaparte that he had no need of the hypothesis of God to fathom the system of the world. Underneath this brash expression of self-confidence, there remained doubts about its general validity that gnawed at him until his death. Having dismissed traditional arguments for the existence of God, he struggled with the issue of free will in a universe of fixed laws. Instead of focusing on theological arguments which he knew full well, Laplace expected that scientific research would uncover by what mechanism the human mind could operate upon the material world.

THE SCIENTIFIC REVOLUTION AND THE TWO FACES OF AUGUSTINIANISM

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Recent work in the history of science has revealed the importance of 'Augustinian' themes within early modern natural philosophy. On the one hand, the view that human cognitive and perceptual faculties had been greatly weakened by the Fall was commonly used in the late seventeenth century to justify the use of new sorts of scientific instrument. On the other hand, the relative insignificance of (scientific) *scientia* compared to (Scriptural) *sapientia* was a key element in the 'Galileo affair' of the 1610s, and was also prominent in a range of attacks on the hubris of the new philosophy in the following century. In this paper I suggest that understanding how knowledge was 'instrumentalised', that is, turned into a tool to achieve a range of future benefits, was arguably the central achievement of the Scientific Revolution. More traditional Christian views to the effect that *scientia* could become a source of idolatry became irrelevant in the new culture, in which curiosity and the pursuit of knowledge for its own sake became impressive sources of virtue. The process by which scientific knowledge became instrumentalised, and formally detached from moral and religious knowledge, has been largely ignored in the historical literature, an effect of the success of the alliance between natural scientific knowledge and technical skill. I look at the ways in which both natural philosophers and clerics used Augustianian positions to debate the case of the separation between Scripture and scientific knowledge between 1600 and 1740.

THE SCIENTIFIC REVOLUTION AND THE EASTERN ORTHODOX CHURCH

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The 17th century is a period of scientific revival for the Greek speaking communities of the Ottoman Empire and the Venetian possessions. At the beginning of the century, leading Orthodox scholars, as the Patriarch of Constantinople Cyrill Lukaris and the director of school of the Patriarchate Theophilos Corydaleus establish a new curriculum putting forward science in a humanistic spirit. Their aim is to reaffirm the bounds between Orthodoxy and Ancient Greece, following the teaching of the scholars of the first and second Byzantine humanisms as for ex. Psellos or Vlemmydes. The result was the renewed teaching of Aristotle and Ancient Greek mathematical sciences.

At the end of the same century, other leading Orthodox scholars as the Patriarch of Jerusalem Chrysanthos Notaras, having been in contact with "new science" (as they called the new European scientific ideas), introduced this knowledge into the orthodox world. These scholars avoided supporting openly the ideas of this new science in the cases it came into conflict with the established knowledge. As a consequence, the curriculum in the orthodox schools remained Aristotelian until the middle of the 18th century.

New science was introduced in the Orthodox schools following the reforms of the university of Padua, where most of Greek orthodox followed university studies. At the middle of the 18th century, Orthodox officials as Eugenios Boulgaris or Nicephorus Theotokis introduced new physics and mathematics in these schools.

Strong reactions to this new curriculum are not detected until the French revolution, which provoked to the conservative Orthodox circles a general fear against everything new. This reaction had two faces, one putting forward the heritage of Ancient Greece as the main intellectual value for Orthodox Greeks and another who denied scientific knowledge as a whole.

The paper will present and discuss the conflicts arisen in the Eastern Orthodox Church by the spread of the new science. Three trends can be discerned among the Orthodox clergymen. These are represented by the followers of the Orthodox humanism who supported Ancient Greek science revival, the followers of the Enlightenment who supported new science as means of a revival of the Orthodox communities and the followers of the Hesychast movement who did not considered scientific knowledge as important at all.

Symposium S40
Visual Representations in Science and Pseudo-Science in Pre-Modern and Non-Western Cultures

"MAPS OF CHINESE EMPIRE IN EAST ASIAN CARTOGRAPHIC TRADITIONS: AN ATTEMPT AT A TYPOLOGY"

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The earliest surviving maps of the Chinese Empire date from the Song dynasty (960 – 1279). The maps are either engraved on stone stele or block-printed. The so-called references to such maps in ancient texts cannot be regarded as absolute proof of their existence, due to the ambiguity of the character *tu* 圖that, apart from "map", stands for a wide range of "graphic representations"– schemes, drawings, pictures, tables, spatial textual layouts, etc., and, therefore, do not allow one to determine what specific type of "graphic representation" is designated. Even if the Song maps rely on a continuous cartographic tradition, their "serial" production facilitated by block-printing still demonstrates a special interest in the imperial mapping under the Song dynasty, or, in other words, in representing the "civilised world" (Chinese Empire) as the focus of the inhabited world. Many of such maps refer to the *Yu gong* 禹貢 ("Yu's [System] of Tribute", ca. 5th-3rd centuries BC), the most authoritative terrestrial description in ancient China. However, at a closer examination, few of the maps formally referred to the *Yu gong* are absolutely faithful to its topographical description, most of them incorporate topographical data from a broad range other texts, in some cases, even from those whose information contradicts the *Yu gong* topography (e.g. the *Shan hai jing,*山海經 "Itineraries of Mountains and Seas*",* compiled about the 1st c. BC). For instance, the Yellow River source, located at Jishi 積石 Mountain, according to the *Yu gong*, and at the mythical Kunlun 崑崙 (昆侖) Mountain, according to the *Shan hai jing* and many other ancient Chinese texts, but the majority of the so-called *Yu gong* maps show Kunlun as the Yellow River source. A completely new "true" location of the Yellow River source in Chinese cartography, this time not related to the ancient written tradition, appears with the diffusion of new topographical knowledge by Mongols who ruled China under the name of Yuan dynasty (1271-1368). Beginning from this period of time, the mainstream location of the Yellow River source in Chinese maps is the Lake *Xingxiuhai* 星宿海, the "Sea or Lake of the 'Star' Lodge" most likely named after one of the 28 lunar lodges called the 'Star' (the central lodge of the southern heavenly sector). The *Yu gong* maps are still occasionally produced and reproduced, but lose their status of the Maps of the Empire, becoming more of a historical cartography.

I shall discuss further diffusion of maps of the Chinese Empire in East Asian cartographies. The location of the Yellow River source provides here an excellent test landmark in affiliating these maps with pre-Yuan or after-Yuan cartography.

THE REPRESENTATION OF JAPANESE ISLANDS ON EUROPEAN MAPS

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Interest in the early European cartography of Japan dates from the beginning of the twentieth century. As knowledge about maps and mapmakers representing Japan increased in the West, the researchers classified maps according to the most influential cartographers. Western specialists in the history of cartography paid much less attention to the configuration of Japanese islands than to their location.

On the European globes and maps of 15^{th} century Japan appears to be one big island. On Paolo Toscanelli's map (1474) and on Martin Behaim globe (1492), Japan is located some 25° off the coast of China on the tropic of Cancer where Marco Polo had put it.

One can see Japanese islands as a chain of small dots on the anonymous map of 1545-1548?, as well as on the maps of Diogo Homem (1558) and Girolama Ruscelli (1561). Soon after that, on the maps of Munster (1575), Daniel Cellarius (1578), Joan Martinenes en Messina (1583), Cornelis de Judaeis (1589), Antonio de Herrera (1601) Japanese archipelago appeared as one big island and a chain of small dots. These maps looked like the result of a synthesis of maps of the two aforementioned types.

Graphically somewhat strange, but close to the actual shape of the three main islands (Honshu, Kyushu, and Shikoku) looked the representation on the maps of Domingos Teizeira (1573) and Antonio Millo (1582).

The closest to the actual shape of Japan was the map made by the Portuguese cartographer Ignacio Moreira (1538/39-?), who accompanied the Jesuit Embassy to Japan in 1590-1592. According to the extant documents, when designing his map he used the first-hand information obtained during his own travel and the information provided by "skilled Japanese", and especially the data of the so-called Gyogi-type maps.

The preliminary results of the classification of the European maps representing Japan according to the shape and configuration of the Japanese islands can provide important data for reconstruction of the spatial ideas of European cartographers of 15^{th}-17^{th} centuries and of the influence of the spatial ideas of East Asian geographical traditions (in particular, Chinese, Korean, and Japanese ones) on their work.

MAP BEHIND THE MASK OF A TALISMAN: THE TAOIST DIAGRAM OF THE "TRUE FORM OF THE EASTERN SACRED MOUNTAIN TAI"

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The mysterious talismans in the Taoist Canon, Diagrams of the True Form of the Five Sacred Mountains (*wu yue zhen xing tu*), in fact conceal a unique achievement of the Taoist cartography. In the Diagram of the True Form of the Eastern Sacred Mountains (Mount Tai, *Tai shan*), the positions of the ranges, peaks, valleys, caves, routes, rivers and water sources are marked with cartographic symbols and annotations. All those approximate the geographic reality, providing a fairly accurate topographic map of Mount Tai, with features roughly representing contour. In terms of map-making, it is an extension of ancient cartography showing pronounced influences from the traditions of the Han, Wei and Jin dynasties to the Tang. As an alternative cartographic school with particular characteristic features that existed in that period, it has great significance for the history of map-making and historical geography.

For the present investigation, the author applied modern geographic software system and developed a new method of interpretation of the diagrams. The proposed methodology based on the comparison of the Taoist talisman with the contour map of the Mount Tai resulted in a new interpretation of the Diagrams.

DIAGRAM AND ALGEBRAIC EQUATIONS IN CHINESE MATHEMATICS OF THE 13TH CENTURY: THE EXAMPLE OF THE *YIGU YANDUAN* BY LI YE.

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In the history of Chinese mathematics, the 13th century is usually considered as a period of significant developments in mathematics. Among the famous mathematicians of this epoch, there is Li Ye (李冶1192-1279), the author of *Ceyuan haijing* (测圆海镜, Reflections of Measurement of Circle on the Sea, 1248) and of *Yigu yanduan* (益古演段, Development of Pieces of Area for the (Collection) Augmenting the Ancient (Knowledge), 1259). The central topic of the *Yigu yanduan* is the construction and formulation of quadratic equations derived from problems on squares, rectangles, circles and trapeziums. The peculiarity in this text is that it introduces and differentiates two distinct methods for setting up quadratic equations. The first method, which is algebraic, is named *tian yuan,* 天元 (celestial unknown), and the second, which is geometrical, is named *tiao duan* 条段 (section of pieces of area). Among the 64 problems of the texts, 61 are presented with two diagrams.

In his preface, Li Ye claims that he found his inspiration in a previous text named the *Yiguji.* He states that he added diagrams and changed the text to make it clearer. But actually, there is no trace of the *Yiguji* and the first edition of *Yigu Yanduan* of 1259 is lost; only two later editions of the *Yigu Yanduan* are available. The older one is the critical edition in the imperial Encyclopedia, *Siku quanshu*, (四库全書) published in 1789, containing some commentaries by its editor. The other one is a commented edition by Li Rui who publishes the text in the *Zhibuzu zhai congshu (*知不足齋叢書) in 1798. There is a gap of more than five centuries between the writing of the *Yigu yanduan* and its commented editions.

I intend to do some research on the diagrams of this text, however, before raising any questions, one must first consider the relibility of evidence of the diagrams, and this talk will be on the publication of these diagrams. To do so, we have the following evidence provided by these two editions of Li Ye's diagrams.

The few notes added by the editor of the *Siku quanshu* comment on how to interpret mathematical expressions. Later, the editorial notes added by Li Rui in 1797 as criticize of the edition in the *Siku quanshu* emphasize the modifications that were added to the diagrams and to the writing of polynomial expressions. Consequently, the comparison between the editions of the text in the *Siku quanshu* and in the *Zhibuzu zhai congshu* provides some relevant clues on how the polynomial expressions and diagrams were represented before the 18th century's editions and describe the material that the editor had under the eyes. The purpose of this study is then twofold: to determine how the two editors dealt with diagrams and mathematical expressions and to investigate how far we can restor the features concerning diagrams and mathematical expressions that were used as the basis for the publication.

A SURVEY OF GEOMETRICAL FIGURES IN KOREAN MATHEMATICAL TEXTS IN 17th TO 19th CENTURIES

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The author discusses different features of the geometrical figures found in more than ten Korean mathematical texts written in 17th to 19th centuries, or the latter half of the Chosŏn dynasty (1392 - 1910). These texts include the *Kusurak* 九數略 (late 17th century), the *Kuiljip* 九一集 (ca. 1714), the *Chusŏ kwangyŏn* 籌書管見 (1718), the *Sanhak ibmun* 算學入門 (1770s), the *Sanhak punwŏn* 算學本源 (1770s), the *Sŏgye swaerok* 書計瑣錄 (1786), the *Sansul kwangyŏn* 算術管見 (1855), the *Ch'ŭkryang tohae* 測量圖解 (1858), the *Yu ssi kugo sulyo tohae* 劉氏勾股述要圖解 (1860s), the *Kujang sulhae* 九章術解 (1864), the *Sanhak chŏngŭi* 算學正義 (1867), and the *Sanhak sŭbyu* 算學拾遺 (1869).

According to the contents and figures of the texts, they can be roughly separated into two groups: those written in the 17th and the 18th centuries, and those written in the 19th century. Although the Chinese translation of the first six volumes of Euclid's *Elements* (*Jihe yuanben* 幾何原本, 1607) had been transmitted to Korea shortly after its publication in Beijing, it seems that not all Korean mathematicians chose to follow this Western text in classifying mathematical topics or constructing geometrical figures. In fact, many of the figures show some processes of transformation, which is the main function of figures in traditional Chinese mathematical texts. One of the important methods for proving area formulae in ancient China, using the concept of transformation, is "mending the void with the excess" 以盈補虛, and this requires the readers to perceive the "void" before transforming the figures. The author will give examples from the Korean texts that the "void" is actually marked in black for readers to see. The author will also compare figures in *Jihe yuanben* and those in the Korean texts.

The texts written in the 19th century are much more influenced by Western mathematics, mainly through the Chinese text *Shuli jingyun* 數理精蘊 (Collected Basic Principles of Mathematics, 1723). The figures in those 19th-century texts put more emphasis on the geometrical objects themselves instead of transformation.

The difference in the features of the geometrical figures provides an example showing the change of intellectual paradigm in the late 18th century from ancient Chinese canons to Western learning, which is described in the literature.

ASTRONOMY AND ASTRAL DIVINATION IN EARLY MEDIEVAL JAPAN

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From the time of mid Heian 平安 Period (794-1184) through Kamakura 鎌倉 Period (1185-1333) of Japan, the official custodians of calendar-making and astrology in the Onmyōryō 陰陽寮 (Yin-yang Bureau) were members of the Kamo Family 賀茂家, descendants of Kamo no Yasunori 賀茂保憲(917-977), and the Abe Family 安倍家, descendants of Abe no Seimei 安倍晴明(921-1005). These two families held hereditary positions within the bureau for centuries. They conducted astronomical and meteorological observations and provided services for the imperial court and members of nobility such as star-worship, performance of various forms of divination based on the calendar and prognosticative astrology, the determination of auspicious dates, fortune telling, making offerings, visiting shrines and performing rites of purification. This paper will examine the following issues: the organization and structure of Yin-yang Bureau; Kamo and Abe families and their competitive engagement in astronomical and astrological activities during early medieval Japan; astral divination and its connection with Buddhist and Daoist astrology; astronomical and astrological literatures (for instances, sacred mandalas and celestial maps) and their iconographical significances.

MAPPING THE BODY IN EARLY MEDIEVAL DAOISM: VISUALIZATION OF DEITIES IN THE LAOZI ZHONGJING.

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If one were to summarize the Daoist view of the human body in one word, it would be "microcosm." Both the body and the universe contain flows of qi and accommodate diverse pantheons of deities. For one's well-being, one has to rely on the inner deities and needs to manage the inner flows of qi. This is done by the means of meditation and visualization.

Laozi zhongjing 老子中經 – "The Central Scripture of Laozi" is perhaps one of the earliest transmitted manuals of Daoist cosmology. It is an anonymous text written on behalf of Laozi, dated to approximately 3rd century CE; it provides detailed descriptions of the inner deities, who should be visualized in order to achieve longevity and, eventually, immortality. In fact, each section in the text carries the title *Shenxian* 神仙, Divine Immortal: "The First Divine Immortal," "The Second Divine Immortal," etc. In the fifty-fifth chapter, the text refers to itself as *Shenxian xuantu ri yuli wushiwu zhang* 神仙玄圖日玉曆五十五章 or "Mysterious Pictures of Divine Immortals Solar Jade Calendar in Fifty-five Chapters." This is an indication that initially the text might have contained illustrations. Thus, the chapters' names can be interpreted as "The First Divine Immortal's Picture," "The Second Divine Immortal's Picture" and so on.

This paper will compare *Laozi Zhongjing*'s textual descriptions of visualizations with the extant pictures preserved in the *Daozang* 道臧 – Daoist Canon, in particular to those which accompany texts of the *Shangqing* 上清 – "Supreme Clarity" School, which eventually incorporated the Central Scripture of Laozi into its textual body. I will attempt to establish whether any of the pictures is an exact counterpart of the textual descriptions provided in the *Laozi Zhongjing*; then, I will investigate the partial correspondences. Moreover, I will look at the textual descriptions of the inner deities contained in the other texts of the *Shangqing* school, tracing similarities with those of the Central Scripture. Finally, I will inquire into the general role of a picture as an illustration, i.e. as a visual aid on one hand, and as a visual revelation succeeded by its written account on the other.

THE TALISMANIC TABLEAUX OF THE MASTERS OF PSALMODIA: BETWEEN WRITING AND IMAGE IN CHINA

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My aim is to examine "visual representations" from Southwest China: talismans made up of images and shamanistic writings, whose links and efficacy will be discussed – I will focus particularly on the iconic origin of the writing as well as on images as generative figures.

The tableaux, which have prophylactic powers, are executed by shamans called *bimo(s)*, word which means literally "Masters of psalmodia (chants)". Indeed, during rituals, those specialists chant psalms by reading their manuscripts written in a specific writing. Secret, exclusively ritual and different from the Chinese one, this writing is the privilege of the shamans to whom it is strongly connected: the body of the *bimo(s)* and the graphic signs are associated. Indeed, the words "characters", "blood" and "breath" are phonetically and graphically the same (they are all named *se*). Body and writing are consequently "consubstantial". After having presented the shamanistic writing of the Masters of Psalmodia, I will describe a tableau in particular and analyze his support as well as the inscriptions we can observe, directly connected to the body of the shaman.

Divided in two parts from top to bottom, the tableau represents on one part the spirits of the shaman who draws them. Each figure – having a human body – has its name written beside and it is accompanied with a partner which is not drawn. The power of the twelve spirits drawn and of the other twelve spirits who stay next without being represented, is activated by the shaman who asks them to have a look at the people they have to protect. And they literally "have a look": they see and observe what happens inside the house in which they are placed.

The other part of the tableau is only constituted of images (designs): buffalos, dog, pig, house, tree, cart, etc., in one word, it represents the environment of the shaman and of the family who has asked for this prophylactic and exorcist ritual.

What this particular piece of writing and images mixed all together tells us about visual representations? The talismanic tableau is a visual representation of the world of the spirits (the half of them remaining unrepresented whereas it does "exit", connected to the tableau) as well as of the world of the human. At the same time, this representation has an efficacy by having a view on our world. It is not just a visual representation but also an incarnation of our own visibility.

TALISMANS AND DIAGRAMS IN THE MANUSCRIPTS OF THE MINORITY NATIONALITIES OF NORTHERN VIETNAM

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Until recently, works on the history of science in Vietnam largely neglected topics related to the traditional science understood in a broader sense, that is, including such disciplines as astrology, divination, "magical medicine", geomancy 風水, etc., often referred to as "pseudo-sciences". The latter disciplines, however, are of a considerable interest for the studies on the history of science and on the history of interaction between science and religion. The first results of my work on the history of traditional science in Vietnam supported by two grants of the National Science Council (Taiwan) in 2006 and 2007-2010 revealed the existence of a vast literature related to these disciplines: I identified approximately 370 treatises devoted to traditional medicine and over 80 treatises on geomancy. Moreover, I was able to locate more than 150 manuscripts devoted to astrology, divination, and other "pseudo-sciences" collected in the areas populated by minorities nationalities, in particular, the *Dao* (Chinese Yao 傜) and *Tay* (Chinese Tai 傣) still using classical Chinese for (re)production of the religious and (pseudo-)scientific texts.

In my paper I will briefly present the collected manuscripts and focus on the diagrams and the so-called "talismans" they contain. I will propose a preliminary classification of the diagrams and talismans based on the presumed provenance of the manuscripts, types of the texts, and represented objects. It was discovered in 1930s by R.F. Fortune that Yao's religion is one of the forms of Daoism 道教, and M. Strickmann suggested that it resembles the Song dynasty Daoism, even though some doubts were later expressed by B. ter Haar. To test this hypothesis, in the second part of my paper I will compare the identified diagrams and talismans with their counterparts found in the collection of the Chinese Daoist text *Dao zang* 道藏 published in 1445.

An anthropomorphic medical talisman, supposedly of Dao (Yao) origin (collection of A.Volkov).

Symposium S41
Ideas and Instruments in the Iberian World in Early Modern Times (15th to 17th Cent.)

PORTUGUESE COSMOGRAPHY IN SIXTEENTH-CENTURY FLORENCE. PORTUGUESE MAPS IN THE GRAND-DUCAL COLLECTIONS: THEIR USE, INFLUENCE AND LEGACY

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Old views on Portuguese and Italian scientific ties in early modernity could be summarized by the motto "Italy gave and Portugal received". Recent research has been producing a more balanced and truthful view of Portuguese-Italian interactions, highlighting two main cultural processes: the separateness and incorporation of the Portuguese in Italy, and Italians in Portugal; and the acquisition, appropriation and imitation of each other's cultures and scientific knowledge.

The scientific and political impact of Portuguese Expansion as well as cosmographic knowledge related to Portuguese navigations were among the principal interests that were debated and exchanged between the two areas, despite official policies of secrecy. Two major trends can be recognized. During the course of the 15th century, both Florentine and Venetian cosmographic studies were commissioned (through the trading companies operating between Italy and Portugal) by the Portuguese Court, as well as by high ranking men of the Church. From the beginnings of the 16th century, the reverse takes place: it is now the Italian courts who attempt to acquire, often resorting to espionage, the *padrão real*, or new synthetic world maps drawn up by the cosmographers and pilots of Portuguese ships at the time. These documents were a synthetic account of their sea voyages, beyond the existing boundaries of the known, and inhabited world of the period and were also accompanied by written accounts.

Among Portuguese cosmographies that circulated in Italy, two noteworthy, but today little known examples, are the outstanding nautical planispheres respectively drawn up by Portuguese cosmographers Lopo Homen in 1554 and Bartolomeu Velho in 1561. Both the maps belonged to the Grand Duke of Tuscany, Cosimo I (1519-1574) and are nowadays kept at the Museum for the History of Science in Florence.

Cosimo I - he himself the author of cosmographic studies - since 1563 asked the monk cosmographer and mathematician Egnazio Danti (1536-1586) to produce geographic maps of all territories then known to be displayed in a Map Room specifically built for this purpose by G.. Vasari in the Palazzo Vecchio in Florence.

Starting with an analyses of both Homem's and Velho's maps, this paper focuses on the way Portuguese 16th-century cosmography circulated in Italy and, in particular, was used by, and influenced Danti's depictions of the New Worlds and of Asia in Cosimo I's Map Room, as well as other coeval Italian maps and cosmographies. In addition, it will also analyze their successive use in the "Stanza delle matematiche", a room built by Cosimo I's son, Grand Duke Ferdinando I, in the Uffizi Palace at the end of the 16th century, to exhibit mathematical instruments and «books and geographical maps and plans» (several of which are today housed in the Museum of the History of Science and in the Biblioteca Nazioale Centrale in Florence).

THE MAGNETIC VARIATION AND THE VARIATION COMPASS IN PORTUGUESE NAVIGATION TECHNIQUES, XV TO XVIII CENTURIES.

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During the early explorations of the Pacific and Indian Oceans, direction by night was mainly obtained from the bearings of stars near the horizon, when they were slowly rising or setting. By day, the bearing of the sun, and/or the direction of the wind, direction of bird's flight, etc., were the main references for course.

Although the magnetic needle was already known in the area since very early, its application for navigation was not practically needed and it is known that its use very limited.

In fact, the navigation on the Western Pacific and North Indian Ocean was mainly between the tropics, and navigators soon recognized that the stars on the celestial sphere, on those low latitudes, made circles, during its regular movement, that were almost perpendicular to the horizon, having an almost constant bearing during rising or setting.

Besides that, the variation of bearing during rising or setting resulting from the variation in latitude was, again on those low latitudes, also very small.

So, instead of the magnetic needle, the stellar compass was adopted by almost all the navigators in the area. And the need for adapting the magnetic needle to navigation was postponed.

On the other end, on another area of intensive maritime traffic but of higher latitudes, where the heavenly bodies were not suitable for direction, the Mediterranean Sea, the magnetic needle was adopted, and finally adapted for convenient use aboard ships, being transformed on the magnetic compass that survived almost with same form till today.

But on the Mediterranean, the navigators needed only to use the compass as it was, following the directions given by it and introducing these directions first on the written instructions and after on the ancestors of the modern charts. In reality, being probably already known that the compass needle did not pointed to the north pole, the courses followed and inscribed on the charts were all magnetic. In fact, for practical reasons and on a restricted area of very low difference of latitude, errors on future courses were very small.

But during the 15th century, the European navigators began to explore the high seas of the Atlantic, and along time, it was recognized that it was necessary to correct the courses for variation, which began to be calculated aboard the ships and in land.

On consequence of this, many procedures for finding variation and many instruments were proposed, being the objective of my paper to make an overview of these techniques and instruments proposed by Portuguese sailors or teachers of navigation during the period of the XV to the XVIII centuries.

MATHEMATICAL DIAGRAMS AND OTHER THEORETICAL "INSTRUMENTS" IN XVIth CENTURY NAUTICAL SCIENCE

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Navigation has always been intimately dependent on instruments. Many developments in fifteenth and sixteenth century nautical practice were associated to profound improvements in the making and the use of instruments. These were not simply improvements in quality and accuracy but were sometimes changes in the very nature of the instruments used. In fact, the very notion of "instrument" was considerably enlarged during that period to include a number of idealized or theoretical "instruments", or diagrammatic procedures, that allowed men with low levels of scientific training to use efficiently advanced scientific notions and techniques. By inspecting some of these sixteenth century theoretical "instruments" used in nautical activities (graphics, mathematical diagrams, paper instruments, etc) I will show how the concept of instrument, in a generalized sense, played a central role in the development of navigation.

MATHEMATICS AND COSMOGRAPHY IN SIXTEENTH CENTURY (SECOND HALF) SPAIN: INSTRUMENTS, IDEAS AND PRACTICES

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The term cosmography was applied in sixteenth century to a number o works and activities of different character and scope. The cosmographical activity in Sixteenth Century Spain was to a large measure connected with the effort of the explorations, and with the control and rule of the lands conquered and had characteristics of a state monopoly. But there was another cosmographical activity carried out in the universities and elsewhere too, developed by different types of scholars worthy of being studied, in itself and by the relations and influences, in both directions, with the activity linked to navigation and exploration. Sometimes a distinction has been done between the activities like the geography, the cartography and the art of navigation, mainly descriptives, practical and applied and the astronomy and the cosmology with theorical objectives for the most part. This distinction can have analytical utility. But we would like emphasize the interactions between the two kinds of activities. Frequently, were practiced by the same persons, as is the case of Pedro Nunes in Portugal or Jerónimo Muñoz and Andres García de Cépedes in Spain In Pedro Nunes's case, the critics toward the limited value of his mathematical considerations loss validity in the context of the circulation of knowledge and interactions between areas of inquiry and practices. The astronomy practitioners affirmed the legitimacy and effectiveness of the astronomy to discuss questions of cosmology. And in activities like the cartography and art of navigations the demands of precision were rising. The aim of this work is to study the circulation and interactions between the different areas, activities and knowledge with particular focus in the function of instruments in it.

"COSMOGRAPHY AND ASTROLOGY IN MANILA: TRACING AN INTELLECTUAL NETWORK IN THE IBERIAN COLONIAL WORLD".

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This paper will deal with two different fields of knowledge that where closely related during the early-modern period: astrology and cosmography. By studying some inquisitorial cases against certain cosmographers in the Philipines, who were accused of practicing judicial astrology, it will aim at reconstructing an intellectual network of scholars sharing a common background, and pursuing common interests. While doing so, this paper will underline the importance of the transmission and circulation of knowledge between the Spanish kingdom and the New World, as well as within the colonies themselves.

CLAVIUS, COIGNET, GALILEO, GUNTER: THE EUROPEAN DISCUSSION ABOUT THE SECTOR IN LISBON

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Instrument-texts of the 17th century sometimes echo a vivid discussion about authorship of the sector, and by taking sides, they enhance the celebrity or infamy of scientific actors of the immediate past. While meant to impress the contemporary reader, they precondition the historian's work, too: special care is required not to take them at face value, as this would lead to a biased history. This paper looks into an episode of this European discussion reflected by texts written in Lisbon.

The different forms of the instrument called "sector", "compasso" or "pantometra" etc. embody basic concepts of the theory of proportions and the typical calculation methods of early modern mathematics. The proposals for the use and some polemic about the invention of the sector are well known by Ignace Stafford, a Jesuit of English birth, but brought up in Valladolid. When he is dispatched to Lisbon by his superiors in 1625, he brings with him a vast knowledge about English instruments, some of them including logarithmic and nautical scales introduced by Gunter a little earlier in the century. Stafford and John Rishton, a successor of his as a teacher of mathematics at the Jesuit college in the 1650s, both write and read about the sector during their sojourn in Lisbon. While the contributions to the development of the sector by Clavius, Coignet, Galileo, and Gunter provide the background for their presentations, what exactly is these Jesuit mathematicians' idea of the instrument? How have they learned about it? Why do they deem it important? How do they approach its description? What is known about the impact of their teaching?

Through such questions, this inquiry addresses the more general problem of how instrument-texts nurture legends and the creation of champions in a narrative of science history in the early modern period. A close reading of unpublished manuscripts by Stafford and Rishton, some of which may have served as preparation for private or public lectures, yields insight into the criteria of choice and the methods of conveying not only knowledge about and through an instrument but also a certain vision of its history.

INSTRUMENTS FOR LEARNING. THE PRACTICE OF ASTROLOGY AND ASTROLOGICAL DISCS

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Astrological discs, usually paper instruments containing astrological information, as well as astrolabes for astrological use, were not uncommon during the early modern period. This paper describes one of them (included in a manuscript kept at the Dibner Library of the Smithsonian Institution in Washington D.C.) comparing it to other discs previously studied by historians of science, particularly with the known article by Steven Vanden Broecke on the Mercator disc. The objective is not only to place the discs in their astrological contexts, but also to discuss the objectives of the instrument makers. Many of these astrological discs where not astronomical instruments, i. e., they would not be of help in calculating the positions of the planets or other astronomical data on the stars. They only contain astrological information. Thus, they should have been made for learning astrology, or to help in its practice.

INSTRUMENTS EMPLOYED BY MASTER ESQUIVEL TO CREATE THE MAP OF SPAIN (c. 1555)

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Pedro de Esquivel worked around 1555 in the preparation of the cartography of Spain, using methods and topographic instruments adapted specifically to this task. He measured numerous geographical coordinates using common instrumentation for astronomy or cosmography applications, and constructed a particular goniometer (divided in four quadrants) that he used to measure the horizontal angles. He started from the theoretical explanations of Apiano's *Cosmography*, modifying the structure of the limb and the measurement procedure in order to make it applicable to such a map whit the characteristics and extension of the Iberian Peninsula. The map remained unfinished, but the field notes of the surveys have been preserved (popularly known as '*the papers of Stockholm'*), and they permit to know the characteristics of the instruments, the precision of the measurements and the use of compass, in order to keep a fixed reference in every survey station.

Mathematical instruments have been described in different texts from the Renaissance, but in this case we know about their application, because he performed thousands of angular measurements following a particular procedure. While the map was left out, the same cannot be said of these utensils, since they were used fifty years later by Juan Bautista Labaña for the *Description of the Aragon Kingdom*. The references of the Chronicler Ambrosio de Morales indicate that these instruments were made of wood and so large that it was necessary a mule to carry them, but due to their *perfection* and *fineness* they were very *singular* and *strange*.

The use of mathematical instruments and topographic methods gave a new dimension to the maps, which became precise documents made from direct observations on the ground. The Spanish cartography in the 16th century clearly expresses this evolution in two of its most significant maps. The Atlas of El Escorial, a manuscript made around 1540 by Alonso de Santa Cruz, represents the traditional cartographic conception, and, on the other hand, the Master Esquivel's map of Spain (c. 1555) introduces specific instruments to perform thousands of angular observations, leading a great step towards the precision cartography.

***Key words**: Pedro de Esquivel, mathematical instruments, precision cartography, 16th century, map of Spain, Atlas of El Escorial, Papers of Stockholm.*

MATHEMATICAL INSTRUMENTS IN THE SPANISH ARTILLERY TREATISES. 1530-1700

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Between the years of 1536, as Diego de Salazar's *Tratado de Re Military* appeared, and 1699, in which Fernández de Medrano's *El perfecto artificial y bombardero y artillero* came to life, around 15 Spanish treatises about artillery were published. Geometry went gradually penetrating them under the influence of the progresses of the new Ballistic science, notably developed by mathematicians and exposed in works not expecifically addressed to artillerymen. Depending on the authors of the artillery treatises being practicing artillerymen or mathematicians away from de military campaigns, the incorporation of the Ballistics was featured by different elements. Among the former, the theoretical hypothesis were contrasted with the practical artillery, and the geometrical methods were only accepted if the use therof improved the practical results. In the works written by mathematicians there were seldom references to the specific problems raised by the shooting in campaign, such as the influence of air, the heeting of the parts or the need to increase the fire frequency.

In spite of the reluctance of the artillerymen to the incorporation of Geometry and Ballistics, these gained increasingly presence in the military treatises, which obviously resulted in a greater reference to geometrical instruments therein. Thus, from hardly a compass to measure the caliber of cannon balls in the works that appeared in the early stage of the subject period, to the nearly 20 instruments deemed necessary for the artilleryman since the second decade of the 17th century, with special relevance given to set square, level, quadrant, geometric square and several types of compasses and rulers.

In those treatises was explained the way to build and calibrate the said instruments, as well as the different uses and applications thereof. There was also importance given to the geometrical postulates and properties justifying the operations for the artillerymen to make with the instruments, and attention was paid to the detriment that the lack of practice in the handling of each one of them would bring about for the shooting in campaing.

"NEW WORLDS AND OLD LANGUAGES: THE PROBLEM OF THE TRANSMISSION OF KNOWLEDGE IN UTOPIAN LITERATURE"

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Neither the Ancients nor the medieval philosophers were unaware of the problem of the plurality of languages, represented symbolically by the Biblical Tower of Babel. The sixteenth century, nevertheless, had to face the problem from perspectives that went beyond the traditional philosophical debate. The discovery of new territories, new languages, new natural beings without known denomination, as well as the proliferation of names for apparently the same thing, created a great problem of scientific communication precisely when this began to erect like one of the essential values of the investigation of nature. The question about how to know nature became inseparable from the question about the best instrument to transmit natural knowledge. I propose here a review about how the utopian literature of sixteenth and seventeenth centuries echoed this problem about scientific communication, as well as some of the proposals coming from the own scientific practices.

JOSE ZARAGOZÀ AND THE SCIENTIFIC RENEWAL IN 17th CENTURY SPAIN: IDEAS, INSTRUMENTS, AND PRACTICES

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Jose Zaragozà (1627-1679) was one of the most important figures of the Spanish Scientific Renewal in 17th century second half. He joined the Jesuit order in 1651, and lived in Valencia (Spain) between 1660 and 1670, studying and teaching mathematics and astronomy. His work in Valencia was decisive in turning this city into one of the most flourishing centres of the Spanish Scientific Renewal. Towards the end of 1670 he was offered the Professorial Chair of Mathematics at the "Reales Estudios" of the Imperial College of Madrid, where he also held the posts of royal cosmographer and maths teacher of the Spanish king Carlos II.

Zaragozà published several works on mathematics. He was the first in Spain to publish a logarithm table and its use in trigonometry. He was also the first to introduce Viète's method for finding rational positive solutions of low degree polynomials. He contributed to studying and discussing the possibility of solving the classical problems of squaring the circle, doubling the cube, and trisecting angles by compass and straightedge. He contributed to the revival of classical Greek geometry, providing a complete resolution of a very difficult plane locus of Apollonius. In order to solve this locus, he introduced the Centrum Minimum, which is the basic point in his central work *Geometria Magna in Minimis*, where he develops his idea of a barycentric method in order to calculate geometrical ratios. Following this method he proved the theorem nowadays attributed to Ceva before Ceva himself.

Zaragozà was also an excellent observer in astronomy. Among his many observations, those of comets in 1664 and 1667 stand out. He wrote several works on astronomy and compiled astronomical tables. Zaragozà designed his own instruments to make astronomical observations. In his last work, *Fábrica y uso de varios instrumentos matemáticos*, he explains the use of a series of instruments – built by him himself – for geometric, topographical, and astronomical purposes, and considers musical instruments as well.

This paper gives a brief account of the role that ideas and instruments played in the scientific work of Zaragozà.

Symposium S42
The Emergence of the Periodical Form (17th-18th Centuries) as an Instrument of Scientific Change

ADVANCING THE BACONIAN SCIENCE? 'QUERIES FOR NATURAL HISTORY' IN THE EARLY PHILOSOPHICAL TRANSACTIONS AND THE CORRESPONDENCE OF HENRY OLDENBURG

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It was almost immediately after its institutional establishment in 1660 that the Royal Society set up an ambitious program of devising the so-called 'queries of natural history', a sort of questionnaires on various topics – countries (e.g., Brazil, Japan, Turkey, etc.), locations (e.g., mines), or phenomena (e.g., cold) – which were meant to advance their knowledge of nature in ways recommended by Francis Bacon. The queries were distributed by letter but also by printing them in the *Philosophical Transactions*, where they looked an entirely *sui generis* form in contrast with the usual articles, book reviews, and advertisements. The aim of this paper is to analyze the questionnaires in order to see how they were composed and distributed by the Society's Fellows, and used by people away from London. An attempt will be made to evaluate the impact they had on the Society's communications in general and in the journal in particular.

NOUVELLES STRATÉGIES DE COMMUNICATION SCIENTIFIQUE DANS L'ITALIE MODERNE. LES PUBLICATIONS DE A. VALLISNERI DANS LA REVUE SAVANTE « LA GALLERIA DI MINERVA » (1696-1717)

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Dans la République des Lettres cosmopolite, dans laquelle la communication se faisait essentiellement au moyen des correspondances savantes que les érudits de l'époque entretenaient quotidiennement, la diffusion de la littérature périodique s'imposa. Il s'agissait de journaux et de revues qui, dans ces années du « pré-illuminisme » européen, firent connaître et diffusèrent l'effervescence de ce nouveau savoir au sein du réseau culturel international.

« La Galleria di Minerva » - revue publiée à Venise par Girolamo Albrizzi qui était membre de l'Académie du même nom, inaugura en Italie la saison du journalisme érudit. Ses sept volumes divisés en fascicules mensuels recueillirent, entre 1696 et 1717, des extraits et des articles de livres italiens et étrangers, mais aussi des opuscules, des relations, des lettres et des textes à caractère scientifique, philosophique, littéraire et religieux. Cette revue contribua très fortement à la culture « moderne », entre autre à travers les articles de Antonio Vallisneri (1661-1730) qui traitaient aussi bien de médecine que d'entomologie, de géologie, de biologie ou encore de botanique, et qu'il publia entre 1696 et 1717.

Nous proposerons donc une sélection des textes les plus significatifs que Vallisneri écrivit pour « La Galleria di Minerva », en essayant de mettre en lumière les stratégies de communication qu'il mit en œuvre pour surmonter les obstacles qui menaçaient le développement des nouveaux réseaux de diffusion du savoir. Ces obstacles étaient à l'époque principalement représentés par le « courant biologique de la pensée aristotélicienne» qui empêcha très souvent à la nouvelle science expérimentale d'inspiration galiléenne d'opérer une espèce de renouvellement culturel en imposant de nouveaux modèles de savoir.

TESTIMONIAL FORMS OF SCIENTIFIC KNOWLEDGE PRESENTATION IN PERIODICALS OF THE EARLY ENLIGHTENMENT

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The transformation of Newtons mathematical science into an empirical program of research in the natural sciences by the Leiden Newtonians in the 1720s had also an impact on the written forms of presentation of scientific knowledge. The epistemological change is basically due to the distinction between mathematical and moral evidence or certainty, the latter describing testimony as a form of proof in the empirical sciences. Im my paper I would like to show that testimonial forms of presentation of scientific knowledge were adopted by scholars and scientists also in their articles for periodicals, considering the reader as a judge in controversial questions. The thesis draws on a number of articles concerning issues in natural sciences published in Swiss periodicals of the early Enlightenment.

MATHEMATICAL INSTRUMENTS IN THE SEVENTEENTH-CENTURY *JOURNAL DES SAVANTS*

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The emergence of the periodical communication system, which the learned journals (created in Europe from 1665 on) eventually established, has had important implications for the production and assessment of reliable knowledge. Savants were quick in appropriating the new medium by publishing their findings in the form of short memoirs or by reacting to the results published by others. This talk will focus on the *Journal des savants*, created in 1665 in Paris, and on how it dealt with a specific topic, mathematical instruments. It aims mainly at studying the modes of presentation of mathematical instruments in the *Journal des savants*, from its start to the beginning of the eighteenth century.

The data base, including all 'articles' printed in the *Journal des savants* from its creation to the end of the eighteenth century, shows that information on intruments and machines was regularly included in the seventeenth-century journal: circa 70% of the nearly two hundred articles devoted to the topic were published before 1700. The study of the functions of 'papers' dealing with instruments and also of the scientific and institutional background will offer some explanations for the decline of the topic in the pages of the eighteenth-century journal.

The main question that will be explored concerns the purposes for which mathematical instruments were published in the journal, and thus circulated among the journal's readership. The audience implicitly addressed by the rhetorical devices, the technicalities, the visual aspects, etc., of the presentation is to be compared to the targeted audience as described by the editors in the para-texts of the journal.

BEYOND INSTRUCTIONS. SCIENTIFIC INSTRUMENTS IN EARLY MODERN ITALIAN PERIODICALS

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The paper aims at highlighting the different ways scientific instruments were described, advertised and appraised in Italian periodical literature in the 17th and early 18th centuries. The visual aspect will be taken into account, as well as the material bibliography of texts and images. The scientific role of learned periodicals in announcing and spreading technical innovation will thus be connected to a sensible area in the development of early modern science, namely, the construction and diffusion of scientific instruments and the related notion of 'objectivity'. Among the learned journals which will be taken into account, the two 'Giornali de' Letterati' published in Rome, in the 17th and 18th century respectively, will be prominent. A special attention will be given to the use of scientific instruments for medicine and 'life sciences'.

NOTES ON ADVERTISING MICROSCOPES IN THE SEVENTEENTH CENTURY ITALY

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The market for optical Italian instruments located in the "advertising" function of the first journals its privileged place. The quality of the instruments, in the absence of objective parameters, was tested and confirmed through the system of " public praise" in literary journals. Behind it one sees a strong link with the correspondence between Italian intellectuals in a fertile plot that puts the history of scientific-technological area between private and social dimension.

ABOUT THE SCIENTIFIC DISCOURSE IN THE *KAISERLICH-KÖNIGLICH PRIVILEGIRTEN ANZEIGEN*

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The *Kaiserlich-königlich privilegirten Anzeigen* (1771-1776) edited by the scholars Dániel Tersztyánszky and Adam Kollar was one of the greatest periodicals in Vienna during the seventies of the 18th century. At the same time it marks the beginnings of scientific journalism in the Kingdom of Hungary. The *Privilegirte Anzeigen* was the first magazine, whose programme reacted to a central request of the Hungarian scholars, namely the comprehensive empiric investigation of the country, its history, geography, anthropology and cultural history, to name only a few disciplines. Therefore, the articles of the journal show a great diversity in disciplines and prove to be valuable scientific resources because of their substantial contribution to the enhancement of knowledge about the Kingdom of Hungary.

A VEIL OF IGNORANCE: ANONYMITY AND PROMOTION OF SELF IN THE EIGHTEENTH-CENTURY REPUBLIC OF LETTERS

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The emergence of learned journals meant that value judgments and personal agendas could be taken to a new level of seeming objectivity, since the common practice of anonymity made journalistic representations look neutral and matter-of-factual. This concealment of identity offered journalists ample opportunities to promote their own interests and ideological positions without the readership noticing the subjective tenor of the objective, reified, and collective voice that narrated the developments taking place within the republic of letters. Anonymous reviewers and writers were thus operating under the cover of a veil of ignorance, which provided them with a considerable ability to persuade and manipulate the reading public.

My talk will focus on how two prominent associates of the internationally renowned review journal *Göttingische Anzeigen von gelehrten Sachen* used anonymity to promote their personal careers and convictions. The German–Swedish botanist and physician Johann Andreas Murray (1740–91) frequently reviewed his own works and actively obscured the fact that he was responsible for the positive evaluations of them. Murray's Swiss colleague Albrecht von Haller (1708–77) exploited his standing as an *Anzeigen* reviewer to attack his long-time Swedish opponent Carolus Linnaeus and to advance an alternative, non-Linnaean botanical teaching. Murray's and Haller's appropriations of the collective voice of the journal gave their subjective statements an objective quality, which most likely enhanced their status among contemporary scholars.

It should be acknowledged, however, that eighteenth-century journalistic anonymity was by no means a straightforward device. A reviewer or writer could dispense with the collective anonymity of a journal and insert himself into the review without discarding his individual anonymity, for example when he wanted to stress his expert knowledge of a certain topic or reproduce transnational networks by reaching out to foreign colleagues. I intend to shed some light on this technique of representation and hence to deconstruct the clear-cut, one-dimensional anonymity that has in many cases been taken for granted by historians studying the early-modern public sphere and republic of letters.

DISSEMINATING THE SCIENCES TO THE PORTUGUESE READERS IN LATE EIGHTEENTH-CENTURY PERIODICALS. THE FIRST PORTUGUESE ATTEMPTS TO PUBLISH LEARNED PERIODICALS.

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From the middle of the eighteenth century on, there were several Portuguese editors who tried to use the periodical form to communicate a diversity of information to the Portuguese readers. The editors tried to follow the titles existing in other European countries, translating and extracting those texts they thought interesting and/or useful for the Portuguese readers. Most tittles were devoted to political, literary and commercial content. But there were also some titles which were devoted to the dissemination of scientific news and publications.

This paper aims at analyzing how some of these periodicals were used, by their editors, to promote and disseminate scientific knowledge. I will try to characterize the place of sciences in several Portuguese periodicals of late eighteenth century, as well as the type and origins of the scientific information they conveyed. Whether as extracts, abstracts or news, it seems that most Portuguese learned periodicals reproduced and resumed texts from other European periodicals. Nevertheless, in some cases there were some visible efforts, private and institutional, to balance the mere import of information, giving the Portuguese men of science the chance to present or to communicate their own scientific work. We know that most attempts failed to do so, not only because many of the learned men did not present any original scientific contributions in these periodicals, but also because most of these periodicals were short-living.

Having in mind the editorial context, namely the censorship system, the prospective number of readers and also the learned societies and the academic context, I will try to understand, through the analysis of the content of several periodicals of the second half of the eighteenth century, if and how the aims of the Portuguese editors regarding scientific information were accomplished.

JACOPO RICCATI, ORGANIZER OF MATHEMATICS KNOWLEDGE AND ADVANCED RESEARCH IN ITALIAN JOURNALS OF 18th CENTURY

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Some periodicals published in Venice in the 18th century played an important role in the transmission of advanced mathematics knowledge in Italy and contributed to put in contact University professors, scholars, engineers and mathematicians of different parts of the peninsula. They were the *Giornale de' Letterati d'Italia*, 42 vols., 1710-1740; the *Supplementi al Giornale de' Letterati d'Italia*, 3 vols., 1722-1726; the *Raccolta di Opuscoli Scientifici e Filologici*, 51 vols, 1728-1757; the *Nuova raccolta di opuscoli scientifici e filologici,* 1755-1787). Among the main collaborators of the editors of the *Giornale de' Letterati d'Italia*, Apostolo Zeno (1668-1750) and his brother Pier Caterino Zeno (1666-1732), and of the *Supplementi*, Girolamo Lioni (1691-1740), were the mathematician count Jacopo Riccati (1676-1754) and his friends Antonio Vallisneri and Giovanni Poleni, professors at the Padua University.

Riccati, who undertook the study of modern mathematics without a teacher, despite repeated invitations never took up an academic position, but was an active researcher in mathematics, physics and hydrodynamics. He had an extensive scientific correspondence with many Italian mathematicians and scientists, among whom were J. Hermann, the young Bernoullis living in Veneto, B. Zendrini, the Manfredi brothers Eustachio and Gabriele, C. G. Fagnani, G. Rizzetti, G. Poleni, R. Rampinelli and M. G. Agnesi.

Riccati shared with Vallisneri the purpose to improve Italian scientific research in the fields of mathematical and physical sciences. He pursued this objective in many directions: by urging the most gifted Italian mathematicians to public in the *Giornale de' Letterati d'Italia* and in the *Supplementi*; by teaching mathematics at his own home to some students, like L. Riva and G. Suzzi, for whom he even wrote a treatise on the methods to solve differential equations; by revising articles for journals and treatises written by other teachers (like the monk Ramiro Rampinelli or his student Maria Gaetana Agnesi) who several times asked him for explanations in dealing with difficult problems.

From the extensive correspondence between Lioni and Riccati (about a hundred letters from 1716 to 1726) we can see the birth of the journal *Supplementi*, its features, the relationships with the publisher G. Hertz and with the patron Francesco I Farnese Duke of Parma, the problems linked to the censure, and especially the direction and organization by Riccati of the mathematics articles, with his own annotations, published anonymous at the end of the paper, on the merits of the author and of his result. They show the great influence that Riccati had on the development of Italian mathematics during the first half of the century.

VULGARISER LE MESMÉRISME : LE MAGNÉTISME ANIMAL DANS LES PÉRIODIQUES ITALIENS AU XVIII^e SIÈCLE

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Mon intervention a pour objectif d'examiner les effets des nouvelles formes de communication périodique sur la diffusion et la transformation des idées scientifiques dans la péninsule italienne à la fin de l'époque moderne. Après quelques réflexions à caractère général sur les différents rôles joués par la presse périodique (à partir aussi de l'analyse des *topoi* présents dans les préfaces des périodiques encyclopédiques et scientifiques contemporains), mon attention se concentre sur la divulgation du mesmérisme (ou magnétisme animal) pendant les années 1780-1790. Il s'agit d'une théorie sans fondement, comme on le sait, et non acceptée par le monde académique de la période, mais qui connut, ainsi que d'autres « sciences populaires », un succès extraordinaire auprès de l'opinion publique française et européenne dans la décennie précédant la Révolution. Quel rôle jouèrent les périodiques dans la vulgarisation d'une fausse croyance ?

Le processus est étudié notamment à travers la réception du *Mémoire sur la découverte du magnétisme animal* (1779), du *Précis historique des faits relatifs au magnétisme animal* (1781), d'autres œuvres mineures et de certains *pamphlets*, où le médecin allemand Franz Anton Mesmer expliquait sa théorie relative à l'existence d'un fluide universel qui fut appliquée dans le domaine médical, mais aussi à travers les comptes rendus et les nouvelles qui passaient de journaux en journaux concernant ses cours publics et les thérapies collectives utilisées pour soigner certaines maladies. Cette analyse – conduite entre autres dans les « Opuscoli scelti sulle scienze e sulle arti » (Milan, 1778-1803), la « Biblioteca oltremontana » (Turin, 1787-1793) et dans d'autres journaux encyclopédiques et médicaux publiés dans l'Italie du Nord – met au jour la fonction complexe de la presse périodique : un véhicule de diffusion neutre de la connaissance, mais surtout un instrument en mesure de transformer la circulation des nouvelles idées scientifiques.

LES *OBSERVATIONS SUR LA PHYSIQUE* ET LES QUESTIONS AGRICOLES ENTRE 1771 ET 1779

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L'Abbé Rozier (1734-1793) dirige les *Observations sur la Physique, sur l'Histoire naturelle et sur les Arts* entre 1771 et 1779. Titre vivotant avant son rachat, l'Abbé va le développer grâce à une stratégie de diffusion rapide des nouvelles découvertes des sciences expérimentales que lui communique le réseau d'informateurs dont il dispose à travers les académies, en France et en Europe. Ce périodique privé est considéré comme un des tout premiers journaux de vulgarisation scientifique. Il deviendra ensuite célèbre avec de La Metherie comme directeur sous le titre de *Journal de Physique.* Les objectifs affichés à ce périodique en introduction au premier numéro de 1771 accorde une place importante à la diffusion des savoirs et des techniques au bénéfice de l'agriculture. Or, à partir de 1780, après la cession des *Observations*, Rozier entreprend, en s'appuyant sur son réseau, la rédaction d'un *Cours Complet d'Agriculture, Théorique, Pratique, Economique, et de Médecine Rurale et Vétérinaire suivi d'une Méthode pour Etudier l'Agriculture par Principes ; ou Dictionnaire Universel d'Agriculture*. Ce *Dictionnaire,* de 8 volumes (1781-1789) à la mort de Rozier, complété à 12 volumes entre 1796 et 1805, va marquer les élites agricoles de la fin du XVIIIème siècle et du début du XIXème, et initier une ligne éditoriale qui durera jusqu'en 1846.

Alors que Rozier est héritier d'une pensée plus botanique que physicienne, et marquée par l'observation plus que par l'expérimentation, nous proposons d'analyser les caractéristiques du discours « agronomique » de ces *Observations* durant la période de direction par l'Abbé. En effet, cette période participe à la transition d'une ère où les savoirs agricoles sont fondés localement sur des connaissances pratiques traditionnelles, vers une nouvelle ère en genèse où la rationalité des connaissances et des techiques se met au service de l'amélioration de l'agriculture pensée à l'échelle d'un territoire. Nous interrogerons la nature et l'importance des questions agricoles traitées dans ces *Observations* en les resituant dans le triple contexte, de la multiplication à travers l'Europe des travaux de laboratoire utilisant les nouvelles sciences expérimentales comme la physique et la chimie appliquées au règne végétal, du développement de la « nouvelle agriculture » initiée en 1750 avec le *Traité de la Culture des Terres* de Duhamel du Monceau (1700-1782) et fondée sur l'observation et l'expérimentation au champ, et de la diffusion d'ouvrages de vulgarisation des savoirs agricoles dont *L'Agronome ou Dictionnaire portatif du Cultivateur* d'Alletz (1703-1785) édité à partir de 1760 constitue un exemple emblématique avec l'invention du terme d' « agronome ». Nous nous efforcerons de discerner l'émergence de la tension nouvelle entre théorie et pratique qui va transformer progressivement l'art de l'agriculture à dimension locale en une exploration scientifique à vocation universelle.

FONCTION ET STATUT DE LA TRADUCTION DANS LE JOURNAL DES SAVANTS

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Alors que réseaux de correspondance scientifique européens relevaient de la communication entre pairs dans la langue de leur choix, le Journal des Sçavants marque le passage à un type de communication médiatique visant un lectorat hétérogène et international dont le seul dénominateur commun est sa curiosité en matière de nouveauté scientifique et la maîtrise de la langue française.

Dans ce cadre la traduction revêt une fonction fondamentale. Par le biais du transfert linguistique, elle canalise la représentation d'éléments novateurs dans les paradigmes du système français de la communication scientifique. Elle assure donc le transcodage de modes de représentation du savoir - empreints des particularismes de leur aire d'origine - dans un système sociosémiotique français. C'est sous cette forme que la connaissance est redistribuée à l'échelle européenne grâce à la large diffusion du Journal à l'étranger. La traduction constitue en ceci un important pivot du rayonnement scientifique et économique, entravant de surcroît le foisonnement de systèmes concurrents d'objectivation de la connaissance.

Le statut des traductions dépend du statut du système de la communication scientifique, de sa structure actancielle et des rapports qu'il entretient avec le champ scientifique, qui lui fournit ses contenus, et le média qui lui sert de vecteur. Le statut de l'activité de traduction est tributaire de la stabilité du système correspondant face à la pression des deux autres.

COMMUNICATING SWEDISH SCIENCE IN GERMAN: THE PERIODICALS OF SWEDISH-POMERANIA

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Swedish Eighteenth century science with Linné, Celsius or Scheele was at the front of scientific development of its time. With the establishment of the Royal Academy of Sciences in 1738 a new form of knowledge-production was created. Science in the horizontal network-type by-passed science as communicated in the vertical hierarchy of university. Part of this process was a new dissemination of research results in vernacular language through the edition of quarterly communications, “Kongl. Vetenskaps Academiens handlingar”. But for the promotion of Swedish science on the international stage, this approach towards applied sciences with an ideal of comprehensibility for large groups of the population was a trap. Therefore German intellectuals in the Swedish possession on German soil, Swedish Pomerania, realized that they could play an active roll in the transfer of Swedish research to a larger audience by translating the communications or parts of them as well as original works to German. The first attempt was made in a periodical called Schwedische Bibliothec (1728-1732), followed by Pommersche Nachrichten von gelehrten Sachen (1743-1747), and later by (Neue/Neueste) Critische Nachrichten (1750-1807). This paper investigates the function of the learned journals of Swedish Pomerania as cultural transmitters of science through translation.

Symposium S43
Science, Space, and Claims to European Domination – The Dynamics of Knowledge from the Renaissance through the Enlightenment

EUROPEAN SCIENTIFIC MISSION IN CHINA SEEN FROM MEXICO: CHALLENGING EUROPEAN DOMINATION FROM THE "PERIPHERY"

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Within the framework of a symposium "Space, Science and Claims to European Domination. The Dynamics of Knowledge from the Renaissance through the Enlightenment", the paper is part of the "clusters" focused on "Scientific networks beyond political boundaries". Its main goal is to offer a decentred analysis of the dynamics of knowledge between Europe and China – still mainly studied as a diffusionist and linear process offering another example of European scientific domination on the early mondern world – by introducing an American perspective.

The scientific jesuit mission in China between 1640 and 1688, corresponding with the activity of Adam Schall von Bell and then Fernand Verbiest as astronomers at court, constitutes the general floor of such a analysis. The first aim of the paper is to highlight the debate, inside the Society of Jesus, about mission and science as conflicting duties. The second aim is to analyse the developments of such a debate outside of the jesuit order, and the part it took in the critic made to the so-called "accomodation" strategy. The Mexican opponents to the Jesuits within the specific context of New Spain and opposition between regular and secular Chuch, and more precisellly Juan de Palaox y Mendoza, took an important part in criticizing the scientific dimension of the "chinese mission", and provided European learned circles with a relevant argument related to what was becoming the "controversy of rites".

NEW KNOWLEDGE ON THE NEW WORLD AND THE SHAPING OF HISTORICAL DISCIPLINE: PROVINCIALIZING THE ENLIGHTENMENT

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This paper sets out to investigate how the dispute on the New World at the end of the Eighteenth century addresses both the construction of a European consciousness and the attempt to "provincialize" Europe as a result of the crisis of European (Spanish and British) Empires. It analyses the outcome of two developments within historiography: first, the fashioning of a progressive stadial conception of history, which was to provide the cultural and epistemological basis for structuring the destiny of non-Europeans to be "civilized"; second, the emergence of voices from Americas (expulsed Jesuit Creoles, in particular), challenging the appropriateness of such a global history written from the centre of the world's commercial expansion, without, however, questioning Eurocentric intellectual and epistemological tools.

In order to deal with this subject, I'll start from recent historiography readdressing new questions to sources. On the one hand, the research agenda offered by post-colonial studies is to my mind a significant epistemological framework in order to rethink the debate about the New World and to problematize the central tension between universalistic claims and Eurocentrism characterizing the Enlightenment. On the other hand, I think important to take into account questions raised by anthropologists (such as Marshall Sahlins) and historians (like Michel De Certeau) on the problematic relation between who writes and the subject of writing, and the complex role of the witness. In the late eighteenth-century debate, questions such as "Who has the right to speak for whom?", or "How to write the history of the New World?", "What is historical evidence, what is proof in history?" were at the core of a broad debate, which yield alternative and competing conceptions of mankind and history.

Knowledge and discipline are the key words of this examination. In the Enlightenment, the questioning of European centrality and the "methodical doubt" lead to new procedures of scientific investigation and shape a different form of knowledge, which also invests the New World. As a result of the fragmentation of knowledge between physic-mathematical, natural and human sciences, history emerges as a discipline and science.

RELEVANT KNOWLEDGE ON THE MARGINS: MAXIMILIAN HELL AND THE EIGHTEENTH-CENTURY ASTRONOMERS' REPUBLIC

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The observation of the transit of Venus between the Sun and the Earth in 1769 was a major international enterprise of eighteenth-century astronomy, one of its episodes being the expedition of the Viennese astronomer Maximilian Hell and his associate János Sajnovics into the Arctic region. The history of the expedition will be examined in this lecture as an instance of scientific self-fashioning in a highly variegated but ultimately coherent context which consisted of national self-assertion on the part of a Scandinavian kingdom, of a peculiar type of transnational collaboration in eighteenth-century field science, of trans-confessional exchange, and of local and global identity making by Central European savants. My case study (work in progress, drawing on Hell's and Sajnovics' accounts of their observations, their letters and some secondary literature) intends to highlight the way in which apparent paradoxes in scientific practice and in the advancement of scholars belonged to the nature and the "nature" of the enlightened republic of letters.

HERDER'S TRAVELS: LANGUAGE, SOCIABILITY, AND THE CONCEPT OF THE NATION

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In 1769 the young Johann Gottfried Herder kept an extensive journal on his travels from Riga to Western Europe. Focusing on this text, and using it as a new angle for understanding some of Herder's better known writings, the paper explores how his concept of an "original nation" (*Originalvolk*) took shape in the tension field formed by his vision of a future Baltic East and his disillusioning encounter with Western European Enlightenment society and culture in its Parisian center. The paper explains the convictions about national consciousness that Herder drew from his experiences of print culture and oral cultures, and will suggest how this approach might yield a more historical understanding of the political dimension of Herder's thought.

USEFUL KNOWLEDGE AND ACADEMIC REFORM IN HUNGARY AT THE END OF THE EIGHTEENTH CENTURY

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The presentation focuses on the consequences of state managed university reform in the second half of the 'long eighteenth century' (1768-1830) on the transformation, development and modernization of university education and scholarly activities of Hungarian scientists and scholars. Looking at the University of Buda, later Pest (former Jesuit university in Nagyszombat/ Sl.Tyrnava, f. 1635) in a larger urban environment, the project analyses knowledge transfer and validation in a comparative perspective. It will look at the new, mostly technical and management-related disciplines that were to be integrated into the university curriculum, to extend its traditional law and theology oriented profile. To what extent was the new type of knowledge relevant in the broadest sense of the word? How did it enhance local improvement that is, social mobility, welfare, and even economic improvement? The question is important not only for our understanding of the modernization of traditional societies, but also in regard to the transformation of the academic field in our present days. What disciplines are considered and by whom as relevant, what should be supported? The case study invites to the investigation of similar questions in a period of rapid and thorough transformation at the end of the eighteenth century, and provides a comparative basis for today's integration of the East-Central European higher education into a globalizing 'knowledge-based society.'

The case study addresses processes within but also beyond the walls of the academe and provides a test case for the public validation of knowledge. The historical backdrop is Enlightenment's quest for 'useful knowledge' about man's physical and social-moral environment, embedded in a set of cultural and communicative practices. How was this articulated in what has been regarded by contemporaries (and also by recent historians) as the relative margins of the European Enlightenment? The study thus takes account of the importance of the optics through which a trans-national 'geography of knowledge' was viewed and represented by intellectuals who understood their civilization as a system formed in emulation with perceived core zones in Europe. An analysis of the intellectual practices and institutional particularities of the Hungarian context is also an inquiry into the larger topic of intellectual marginality on a continental scale.

ERUDITION AS EPISTEMIC CULTURE: IDEALS, STRATEGIES, PRACTICES

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Until the very end of the 18^{th} century the concept “erudition” was used in order to define a sincere, systematic, interrelated , and all-round mode of knowledge. Only in the very beginning of the 19^{th} century “erudition” was replaced by “research” indicating a novel form of scholarship. “Erudition” has convincingly been interpreted as an eclectic compilation (M. Gierl). Thus, the concept did signify a distinct epistemological order and its specific scholarly practices. The paper will focus on the interrelations between the conceiving of “erudition” in the 18^{th} century and its distinct scholarly practices (establishing evidence, scholarly reading habits, modes of arguing etc.) brought about.

Symposium S44
The Transmission of Modern Scientific Knowledge from the West to China

EXPEDITIONS OF THE RUSSIAN ACADEMY OF SCIENCES AND STUDYING OF CHINA IN THE FIRST HALF OF THE NINETEENTH CENTURY

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The Russian government's interests in China had dramatically increased as Russia competed with England, France, and other Western countries, over their influences in China at the turn of the nineteenth century. Though the Russian Orthodox Church had engaged in missionary activities in China, the Russian Academy of Sciences possessed little trustworthy information about the country. Russian Mission constantly stayed in China, in Beijing, since 1715 year. In the first half of 19 centuries to China the 3 expeditions of the Russian Academy of sciences have been sent (1805, 1819, and 1829). Each expedition has been continued during 1 year. In each expedition 2-3 academicians was included, and only in expedition in 1819 year, 4 young scientists have been included - the post-graduate students to whom the task on distribution the European knowledge on topography, mathematics and astronomy among the Chinese scientists has been given. In the Russian Academy of sciences was considered, that the Chinese scientists possess the out-of-date knowledge in these areas, in comparison with the Europe. The core purposes of all expeditions, besides obtaining of new knowledge on topography of China, were the ethnographic and linguistic researches. To students was recommended to be engaged in obtaining of knowledge about the topography of China secretly, that them have not accepted for Russian spies and have not taken into prison. At the same time they were recommended to contact with the Imperial Peking Mathematical Tribunal and inform them on all newest improvements about topographical and geographical parts, made in the Europe. Students also should translate into the Chinese language new European books on the mathematics, topography and astronomy. The Chinese scientists were called to order tools on astronomy in St.-Petersburg, instead of London. Using these new tools Chineses, could improve the quality of their own topographical maps and, having made the modern amendments, to send some copies to Russia, thus having spared the Russian Academy of sciences from difficulties on mapping of such extensive country, as China. Thus, not being at a loss on numerous efforts on mapping such extensive country as China, the Academy of sciences could receive the most detailed and authentic data on this state.

GALILEO'S MILITARY COMPASS IN CHINA

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Galileo designed his military compass around the turn of the seventeenth century. When his book, *Le operazioni del Compasso Geometrico et Militare*, first published in Italian in Padua in 1606, the compass became known to the public. Thanks to Mathias Bernegger (or as Mathia Berneggero), who in 1613 published a Latin translation of the book, Galileo's military compass was well known in Europe. The compass was introduced into China by the Italian Jesuit Giacomo Rho (1590 - 1638), through the book, *Bi Li Gui Jie*, presented to the Emperor Chongzhen by the Imperial Calendar Bureau in 1631. This paper investigates the original sources Giacomo Rho used for his book, and discusses the Chinese reception of Galileo's military compass through a discussion of the relevant works by Chen Jinmo (1550-1640), Mei Wending (1633-1721), and Fang Zhongtong (1633-1698).

WESTERNIZATION OF MATHEMATICS EDUCATION IN CHINA: CALVIN WILSON MATEER'S WORK

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This paper will examine the mathematical textbooks compiled by the American Protestant Calvin Wilson Mateer (1836-1908) for his missionary school in China and for the Educational Association of China, as well as his work on English-Chinese mathematical terms. It will focus on their impact on the modernization of Chinese mathematics education, and on the unification of Chinese mathematical terminology under China's Department of Education in 1909.

DEVELOPMENT OF MATHEMATICAL EDUCATION AND THE PROFESSIONALIZATION OF CHINESE MATHEMATICIANS DURING 1860-1904

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During the period of 1860-1904, in response to the Self-Strengthening Movement, China's mathematical education forged rapidly ahead. This paper first analyzes the development of mathematical education, and presents a statistical analysis of the mathematical teachers. It deals with the opportunity provided by the development of education for mathematicians to achieve economic independence and to secure higher social positions. This paper also discusses the relation between the development of mathematical education and the professionalization of mathematics in China.

THE TRANSMISSION OF WESTERN MECHANICS INTO CHINA IN THE SEVENTEENTH CENTURY

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In the contexts of globalization of knowledge, Western mechanics was transmitted into China by Jesuits and their Chinese collaborators in the seventeenth century. The most important case of this transmission is the book entitled "*A Record of the Best Illustrations and Descriptions of Extraordinary Devices of the Far West*" (1628) by Johannes Schreck (Terrentius) and Wang Zheng. The mechanical theories presented in the book are taken from other books written by such authors as Simon Stevin and Guidobaldo del Monte. The book, however, is not a mere translation, but also incorporates traditional Chinese mechanical knowledge. Accordingly, a new kind of mechanical knowledge took shape as Jesuits and Chinese scholars introduced mechanics and technology. For example, in *A Record of New-built Astronomical Instruments in the Observatory*, Ferdinand Verbiest used mechanical knowledge to explain the reasonableness of his instruments in 1674. By the mid nineteenth century, the introduced Western mechanics had influenced Chinese thinking.

THE MODERNIZATION OF CHINESE INDUSTRY VIA MEIJI JAPAN

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The current studies on the introduction of modern science and technology in China tend to emphasize the contributions of Western missionaries and Chinese students who studied in Europe and America, and more or less neglect the Japanese influence and important roles played by students who were educated in Japan. In this paper I will argue that in many cases Western science and technology have been introduced to China via Japan, and a great number of Chinese students returning from Japan played important roles in the process.

Tokyo Institute of Technology (the TIT), formerly known as the Tokyo Higher Technical School, provided an important channel for the Chinese contacts with Western science and technology. From the end of the Sino-Japanese War in 1895 until the beginning of the Anti-Japanese War in 1937, nearly 800 Chinese students graduated from the TIT. The number is more than the total number of Chinese students who had studied technical subjects at seven other imperial universities in Japan during the same period of time. Renowned scholars like Ren Hongjun, Li Zhuchen, Su Buqing, and Sun Pinghua were graduates of the Tokyo Institute of Technology. In this paper I will discuss the specific functions the TIT had served and the ways in which its Chinese graduates had contributed to the course of education on Western technology in China.

THE ACADEMIC ACTIVITIES OF THE CHINESE PHYSICISTS IN EUROPE FROM 1920s TO 1950s

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The emergence, spread, study and development of the modern physics in China cannot be separated from the work of Chinese students who studied abroad. Early in 1920s the students who studied in Japan introduced theory of relativity and Planck's quantum theory into China. After that, the productions of modern physics of Chinese students most come from Europe and American.

This paper studies the academic activities of the Chinese physical sicentist, who received the doctor's degree in England and Germany during the former half of the 20th century. The Chinese physicists' academic activities including dissertation, instructions of supervisors, academic exchanges in Europe are put in order and analyzed based on the original archive files, correspondences and so on. Furthermore, the influence of western supervisors, society factors and the role to the development of China's modern physics are also analyzed.

ANIMADVERSION ON THE QUANTUM MECHANICAL VIEWPOINTS OF THE COPENHAGEN SCHOOL IN CHINA FROM 1950s TO 1970s

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In the 1920s, the Copenhagen School represented by Bohr and Heisenberg made great contributions to the establishment of Quantum Mechanics. After that, there were great arguments on the explanation of the theory. The interpretation of Quantum Mechanics given by the Copenhagen School induced long-time debates among Einstein and many other physicists. From 1950s to 1970s, a series of animadversion activities had been developed in China with a particular history background, and Bohr's Principle of Complementarity and Heisenberg's Uncertainty Principle had been repeatedly criticized. This article systematically investigates the historical process of the animadversion, analyzes the historical causes of the animadversion, discusses its contents and methods, summarizes the characteristics of these activities, and explores the influence of these animadversion activities on the development of Chinese Quantum Mechanics. This article considers that the animadversion on the Copenhagen School in China is affected by the similar activities in Soviet Union as well as the result of our country's mainstream ideology at that time, this animadversion is a kind of philosophical and political criticism, and the animadversion affects Chinese people's correct understanding of the Quantum Mechanical Viewpoints of the Copenhagen School, so that it blocks the development of Quantum Mechanics in China.

Symposium S45
The Antikythera Mechanism and its Place in the History of Science, Technology and Ideas

THE ANTIKYTHERA SHIPWRECK, THE TREASURE AND THE FRAGMENTS OF THE MECHANISM

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In the Easter of 1900, two ships with sponge-fishers from the island of Syme in Dodecanese, just off the tiny island of Antikythera located by chance a very important shipwreck.

During the underwater exploration which lasted ten months, under very adverse conditions the same sponge-fishers under the aegis of the Greek State retrieved a treasure of 108 objects, made of bronze and marble, mainly statues and statuettes, the fragments of the Mechanism, luxury glass and silver vases, fragments of furniture etc. dated from 4th c.B.C. to 1st c.B.C.

From 1902 to 1970, the scientists who studied the fragments of the Mechanism identified it as an astrolabe or some short of navigation instrument. Professor Derec de Solla Price identified the Mechanism as an astronomical and calendar calculation device.

In 2005 a new research started at the National Museum of Athens with the collaboration of Cardiff University, Aristotle University of Thessaloniki and National and Kapodistrian University of Athens.

During this research all the old fragments of the Mechanism were found in the stores of the Bronze Collection of the Museum. The fragment E (identified in1976) and the new fragment F were also found along with a number of smaller fragments. The detailed form of the lettering can date the construction of the Mechanism during the period 150-100 B.C.

The Sn-Cu-Pb alloy composition of the smaller fragments found, were studied at the Department of Economic Geology and Geochemistry of the University of Athens by Scaning Electron Microscope-Energy Dispersive System in order to identify which of those, are parts of the Mechanism. The identification was based on the comparison of the alloy composition of each unidentified fragment to the alloy composition of known small fragments of the Mechanism.

The alloy composition study of the Mechanism has also shown that more than one Sn-Cu-Pb alloys were used for the construction of its different parts. The Sn content of the alloy has been found to be lower in the mechanical parts as there was a need to access higher hardness.

PREREQUISITES FOR THE ANTIKYTHERA MECHANISM TO BE CONSTRUCTED IN THE 2nd CENT. BCE

T.P.Tassios

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As opposed to the doubts expressed by some authors regarding the authenticity of the Mechanism, this paper is an attempt to confirm the feasibility of its conception and construction, some time during the end of the 2nd cent. BCE.

First, the prerequisites in terms of scientific knowledge are briefly examined. Subsequently, several potential uses of the instrument are enumerated, eventually encouraging its conception and construction.

The main scope of the paper, however, is to examine the required level of technological advances needed for such a project to be realized. Thus, the following aspects are also considered:

a) Design: It is maintained that the advanced knowledge of the newly born science of Geometry was a positive prerequisite to this end. On the other hand, the development of Mechanics and its applications, culminated in the beginning of the 3rd cent. BCE in Alexandria, is thought to be sufficient for the Mechanism to be designed in principle.

b) Further on, the specific developments in Metallurgy and Metal fabrications in ancient Greece are recalled , as another category of favourable conditions for the construction of thin and precisely toothed wheels, of axles, etc.

c) Finally, some previous technological achievements during the Hellenistic period are reminded, regarding mechanical elements similar to several components of the Antikythera Mechanism. The technical feasibility of this instrument is therefore further confirmed.

THE ANTIKYTHERA MECHANISM, THE FIRST MECHANICAL UNIVERSE

Xenophon Moussas[1], Dionysis Kriaris[2]

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...The origin of all technical achievements is the divine curiosity [of Socrates] and the play instinct of the working and thinking researcher as well as the constructive fantasy of the technical inventor... Albert Einstein, speech on the radio at the opening of the *7 Deutsche Funkausstellung* in Berlin, 1930

Astronomy is the oldest science. Humans have been watching the sky attempting to understand their environment and their position and relation to the environment. This eventually led them to try to understand their existence in the Cosmos. This was the birth of Philosophy and Humanity. Form prehistoric times humans develop calendars, astronomy, mathematics. Astronomy develops in all longitudes and latitudes, as it is an applied and practical science, necessary to regulate life and social rhythms in ancient as well as in modern societies. Gradually humans notice and try to understand the regularity of motions of celestial bodies, stars, Sun, Moon and planets. They do observations of the celestial bodies, invent mathematics, initially to measure the time and later to construct astronomical model. They construct astronomical instruments, which sometimes embedded in their buildings, temples, palaces, roads of a city, so that they last long and they are available all, even the layperson who has the common knowledge of calendars and astronomy.

The Antikythera Mechanism is the oldest known astronomical instrument and astronomical computer that we have in hands, probably made between 150 and 100 BC, by a Greek mechanic and astronomer with excellent knowledge of mathematics.

It has been found in an ancient shipwreck of the 1st century BC that was on its way from Greece to Rome with tones of Greek treasures (about 100 marble and bronze statues), merchandise or official war lute. The Antikythera Mechanism looks like an oxidized grand mother's clock made of bronze gears.

The Mechanism is an Astronomical instrument suitable for: Observations, Astronomical computer

Calendar mechanism, Meteorological or Climatological device, School demonstration device

Show up to friends, Measure Geographic latitude, Measure Geographic longitude (with the Moon Mechanism, Hipparchus), suitable for Cartography and Navigation

It calculates the position of the Sun, the position of the Moon, the phases of the Moon during the month, It predicts the eclipses of the Sun and the Moon.

It has several complicated calendars, based on the:Solar year (Egyptian Calendar),

the four year Olympiad period, The lunisolar Saros period, 18 years 11 days and 8 hours, which predicts the solar and lunar eclipses, The lunisolar Exeligmos, 54 years and one month (equal to 3 Saros cycles) , which predicts more accurately the solar and lunar eclipses.

The lunisolar Meton's 19 years which is used today to calculate the Christian Easter, and the 19 year cycle of Hebrew calendar. The lunisolar Callippus cycles 76 years, which is multiple of Meton´s cycle and more accurate.

THE ANTIKYTHERA MECHANISM: AN INSTRUMENT OF MATHEMATICAL ASTRONOMY

Tony Freeth

Antikythera Mechanism Research Project, United Kingdom

The Antikythera Mechanism calculates astronomical cycles, based on the known mathematical astronomy of its era. This paper explores the mathematical and logical basis of the Antikythera Mechanism and how this is embedded in its gearwheels, dials and inscriptions.

All of the thirty surviving gears of the Mechanism (except one) calculate the astronomy of the Sun and Moon. The underlying cycles that explain these gears are the "period relations" of the Metonic and Saros Cycles from Babylonian astronomy of the early 5th Century BC and earlier. The essential "astronomical primes" in the tooth counts of the gears can all be derived from these two cycles.

Fixed-axis gearing can only multiply and divide the tooth counts of the gears. To add or subtract ratios needs "epicyclic" gearing, which represents a major technological advance. It is remarkable for its era that the Antikythera Mechanism included at least two epicyclic systems—in each case, for a process of subtraction. One key example involves the epicyclic gearing for the variable motion of the Moon—the Moon's *First Anomaly*. It is likely that the Mechanism also included further epicyclic systems to calculate the motions of the planets. With its interleaved gear trains, the design of the gear system of the Antikythera Mechanism is extremely logical and economical: the latest model of the Mechanism is a beautiful mathematical solution to the structure of the gears.

The organization of the inscriptions and dials is also mathematical. The inscriptions themselves—sometimes called the *Instruction Manual*—include the mathematical parameters that are the basis of the calculations. The Metonic calendar dial is based on an artificial mathematical structure that maintains fidelity between the months of the calendar and the actual lunar cycle. It also includes a mathematical scheme of "excluded days" that neatly exploits (and indeed explains) the five turns of this spiral dial. The basis of the Saros eclipse prediction dial is the chance resonance between three different monthly periods of the Moon. The "beat frequencies" between these monthly cycles are the basis of the mathematical organization of the eclipse prediction "glyphs" as well as explaining the four turns of the spiral dial.

When the Antikythera Mechanism was first recovered from the sea by Greek sponge divers, no-one knew its true identity. Theories have ranged from a navigation instrument, a mechanized astrolabe and an aid for astrologers. What has emerged is an instrument of purely mathematical astronomy with no references to astrology, superstition or religion. With its extraordinary mathematical and logical structure, it is the forerunner of our scientific and technological age.

A PRACTICAL APPROACH TO STUDYING THE ANTIKYTHERA MECHANISM

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The author's work is based on his own examination of the original fragments of the Antikythera Mechanism, carried out in collaboration with the late Allan Bromley of the University of Sydney. Through his subsequent analysis of the resulting research material the author has developed a reconstruction of the instrument that is radically different from those that preceded it, illustrated by a working model which he himself has made. Further analysis of the research material continues, and the publication of the author's findings remains in progress.

The model, first presented as a partial reconstruction in 2002 and provisionally completed in 2005, is unlike others in including a conjectural restoration of mechanism supporting a display of the motion of the five planets known in antiquity. A more fundamental distinction lies in the author's attempt to replicate not only the general arrangement of the original, but many significant details which had previously been but poorly understood or not recognized at all. The value of this work to date is demonstrated by the extent to which features of the author's reconstruction have been accepted and adopted by others, and by the ease with which it has been found possible to modify the model so that, with quite small mechanical alterations, it now accords fully with the subsequent findings of other researchers.

A significant feature of this work is the extent to which the author has brought to bear practical skill and experience, both in the study of mechanism and in its construction using traditional craft techniques. These resources have been crucial to the interpretation of what remains and the reconstruction of features that are found to be incomplete. They have also enabled the author to visualize elements that have been lost altogether and to devise solutions for their restoration.

The construction of the model has been an integral part of the heuristic process, directing attention to unresolved details and confirming that the solutions adopted are fully workable. It has offered insight into the design process that lay behind the original, and has lent authority to the author's assessment of the range of workshop techniques employed, and the level of skill attained, in the Hellenistic workshop. Finally, it may be argued that, in conveying as clear an idea of the design and function of the instrument as could any verbal description, the model represents a valid if unconventional mode of publication.

These features of the author's approach will be discussed, together with some of the results that have been achieved by their use.

A NEW MODEL OF THE ANTIKYTHERA MECHANISM

Efstathiou Kyriakos, Zacharopoulou Theodora, Anastasiou Magdalini, Seiradakis John-Hugh

Aristotle University of Thessaloniki, Greece

A new accurate model of the Antikythera Mechanism has been built at the Aristotle University of Thessaloniki. The model complies with the current published knowledge of the Mechanism and is based on precise measurements of the fragments of the ancient astronomical device. We believe that it is the most accurate model that has been built until now, incorporating features that have not been included up to now in previous models. Not only has the gearing system of the ancient device been reproduced, the new model bears all the hitherto known inscriptions in their original size and style.

Modern automation techniques were used whenever possible, so that future copies of the new model could be replicated using standard manufacturing processes. Furthermore the model can be easily evolved as new knowledge about the Mechanism is accumulated.

During the design and fabrication stages, the subtleties of the original device were studied in detail, revealing the precision of the construction and the advanced technological capabilities of ancient Greeks.

THE SOLAR ANOMALY AND THE VENUS DISPLAY ON THE ANTIKYTHERA MECHANISM

James Evans

University of Puget Sound, United States

This presentation will situate the Antikythera mechanism in the tradition of *sphairopoiïa*, the division of ancient Greek mechanics devoted to the construction of models of the heavens. In this way we shall analyze the intellectual context of the mechanism and its meanings for the astronomical practitioners of its time. Finally, by analyzing the inscription on the front door of the mechanism, we shall address the controversial question of whether the device included gearwork for the planets.

THE INSCRIPTIONS ON THE ANTIKYTHERA MECHANISM

Yanis Bitsakis, Agamemnon Tselikas and Alexander Jones

University of Athens, Greece; Centre for History and Palaeography, Greece;
Institute for the Study of the Ancient World, USA

The inscriptions on the plates and dials of the Antikythera Mechanism were of first importance for studying its origin and functions, even since its discovery in 1901. For decades, the inscriptions constituted the most important visible part, and they lead to its early characterization as an astronomical device, although the texts were extremely fragmentary. We can now more than double the amount of text read by previous researchers, and, most importantly, reconstitute some complete sentences, which help us to build a comprehensive picture of the functions of the Mechanism.

More than 95% of the inscriptions which are now visible on the remaining fragments can be reconstituted. These inscriptions represent less than one third of the original texts, and are deciphered either with direct inspection of the fragments, with the use of surface digital imaging or computed tomography; the use of archive material is also invaluable in order to match characters from sparse fragments or to read some characters that are now lost.

More than 2500 characters find their place within the following entities: the Front Cover Plate, the Parapegma (or stars calendar), the Egyptian Calendar, the Zodiac Scale, the Metonic Dial, the Olympiad Dial, the Lower Back Dial Inscriptions and the Back Cover Plate.

THE FRONT COVER PLATE OF THE ANTIKYTHERA MECHANISM

Agamemnon Tselikas, Yanis Bitsakis

Centre for History and Palaeography; University of Athens, Greece

One important part of the Front Cover Plate of the Antikythera Mechanism consists essentially by the fragment named "G", which contains one of the most extensive texts of the Mechanism's inscriptions. This text was considered as unreadable by previous researchers. The Computed Tomography has enabled us to read most of its characters, revealing possibilities about lost functions of the Mechanism, like the possible display of planetary data.

After its preliminary publication in 2006, new processing of the Computed Tomography data has revealed more characters and made possible the reading of dubious ones. This is leading to a new, more complete reading of the remaining text, and also to the examination of small features of the fragment that could have matched with other fragments and parts of the Mechanism.

THE ECLIPSE INSCRIPTIONS WITHIN THE CONTEXT OF ANCIENT ASTRONOMY

John Steele

Brown University, USA

The lower back dial of the Antikythera Mechanism is divided into 223 cells representing the 223 lunar months of the Saros cycle. Within some of the cells text is inscribed indicating those months where an eclipse of the moon or the sun was considered a possibility. In this paper, I will discuss a possible reconstruction of the astronomical theory that generated these eclipse possibilities, and describe how they could have been used. I will then compare this with what we know of ancient eclipse theory from Babylonian, Demotic and Greek sources.

THE PARAPEGMA OF THE ANTIKYTHERA MECHANISM

Tony Freeth

Antikythera Mechanism Research Project, United Kingdom

This presentation reports new research on the parapegma of the Antikythera Mechanism by Alexander Jones, Yanis Bitsakis and Tony Freeth.

The Antikythera parapegma has been an intriguing puzzle for more than a hundred years. It was originally identified by Albert Rehm in the early years of the twentieth century and it was studied in detail by Derek de Solla Price. The parapegma consists of inscriptions, describing the customary heliacal risings and settings of prominent stars and zodiac signs. Each line of inscription is preceded by an alphabetical index letter. These index letters correspond to matching index letters between the degree divisions on the Zodiac Dial at the front of the Mechanism, which indicate when the particular star event occurs in the annual cycle.

Price used his own observations, together with Rehm's early photographs and research notes, to try to piece together the parapegma and to understand its organization. Price confessed to considerable confusion about the overall structure of the parapegma and the apparently anomalous arrangement of the index letters.

Our research describes the results of combining all the available data to extend significantly the previous readings of the parapegma inscriptions. Particularly important for this has been the recent imaging carried out by the Antikythera Mechanism Research Project—reflectance imaging of the surfaces of the fragments and high-resolution 3-D x-rays. The identification of degree numbers at the end of the descriptions of star events has been an important addition.

We propose that the parapegma inscriptions were organized into astronomical seasons, defined by the equinoxes and solstices. We offer a persuasive hypothesis about the relationship of the parapegma inscriptions to the seasons on the Zodiac Dial. This implies that Price was correct that the autumn equinox is at the bottom of the Zodiac Dial, but incorrect about the positions of every single one of the fragmentary inscriptions that make up the parapegma. A final consequence of our hypothesis is that we can now give a convincing and surprising rationale for the distribution of the index letters round the dial.

Our analysis does not support Price's contention that the Antikythera parapegma might have been based on that of Eudoxus. We have not succeeded in matching the Antikythera parapegma with other known parapegmata or with calculations of star visibilities at any latitude. We are therefore unable as yet to suggest a plausible reconstruction of all the parapegma inscriptions and the positions of the index letters on the Zodiac Dial.

ASTRONOMICAL IMPLICATIONS OF THE PARAPEGMA OF THE ANTIKYTHERA MECHANISM

Anastasiou Magdalini, Seiradakis John-Hugh

Aristotle University of Thessaloniki, Greece

The term Parapegma was used by the ancient Greeks to describe an astronomical and meteorological calendar of events that was displayed for public use on stone plates and was used to guide agricultural or nautical activities through the year. On the front plate of the Antikythera Mechanism, a Parapegma was displayed, fragments of which have been read.

The astronomical events described in Parapegmata are unique astronomical events for any calendar year and refer to the first and last appearances of stars or constellations at sunrise or sunset (e.g. heliacal rising, heliacal setting), when the sun has a specific angular distance from the star or constellation. The determination of this distance is of great significance when trying to calculate the exact date that these phenomena take place.

In the present analysis, the sidereal time of the heliacal rising and setting of a number of stars, known to be used in Parapegmata, is calculated, taking into account the magnitude of the star and the atmospheric absorption at the time of the heliacal rising or setting of the star. Finally an attempt is made to apply these calculations to the stars of the Antikythera Mechanism Parapegma.

THE ANTIKYTHERA PARAPEGMA

Daryn Lehoux

Queen's University, Canada

This paper looks at the zodiacal and Egyptian calendar dials on the front face of the Antikythera mechanism, as well as the pointers for the sun and moon that rotated on them. We have long known that the Antikythera zodiacal dial is keyed to a 'parapegma inscription' that allows the user to track the phases of the fixed stars by following the motion of the pointer for the sun through the zodiac. We have recently learned that there was also a pointer for the moon's zodiacal motion on this face, as well as a half-silvered disc for modelling the phases of the moon, and possibly also a scale for tracking the age of the moon. This paper uses these findings in conjunction with careful work on recent images of the front face of the mechanism to compare the uses of lunar, solar, and stellar motions in this instrument with those in other (non-mechanical) classical parapegmata. We find that the mechanical possibilities of multiple rotating displays is very ingeniously exploited in this device to show complex and multilayered astronomical and calendrical phenomena in ways not possible in other media (papyri, inscriptions).

MECHANICS, THOUGHT AND THE MARKETPLACE - THE ANTIKYTHERA MECHANISM IN CONTEXT

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The recent investigations of the Antikythera Mechanism Research Project have demonstrated the extraordinary technical sophistication of the device, a sophistication not known again for another millennium. I believe there needs to be a robust debate of its impact on our view of the classical world. Arguing from the mechanical design elements, the inscriptions and contemporary literature, I will explore and try to provoke discussion of its implications for three areas: (i) the development of astronomical and philosophical thought (ii) the development (or lack of development) of marketplace geared technology before 1000 AD (iii) the obvious but unanswered question - what was the device *for*? Avenues for future research will be suggested.

INSTRUCTIONS FOR THE INSTRUMENT-MAKER? PTOLEMY'S *PLANETARY HYPOTHESES* AND MECHANICAL REPRESENTATIONS

Elizabeth Burns

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In the first paragraph of the *Planetary Hypotheses* Claudius Ptolemy states that the two objectives of his work are to provide a concise summary of his astronomical theory for the astronomer, and to give instructions to the instrument-maker for the construction of a mechanical device illustrating the celestial motions. While he clearly achieves the former goal, Ptolemy gives little detail about what the device he wants the instrument-maker to build should look like, what it should be made from, and how it should work. Using textual references to astronomical mechanical devices by Cicero, and relying on the archeological remains of other astronomical devices such as the Antikythera Mechanism and the London Sundial-Calendar I will analyze the nature and type of instrument that Ptolemy proposed the instrument-maker should build, and discuss the feasibility of constructing such a device.

A COMPARISON BETWEEN THE ASTROLABE AND THE ANTIKYTHERA MECHANISM

Vafea Flora

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The Antikythera Mechanism - among other things - displayed the positions of the Sun and the Moon in the Zodiac and the phase of the Moon, and could also give eclipse predictions. This tradition of the Antikythera Mechanism, although in simplified form, can be traced in some Arabic scientific texts on the astrolabe. This paper focuses on some extracts from the treatise of al-Bīrūnī (973-1048 AD) "Comprehension of the possible ways for the construction of the astrolabe" and from the treatise of al-Ṣūfī (903-986 AD) "Book on the use of the astrolabe", in which echoes of this tradition may be found.

Al-Bīrūnī describes in detail the construction of two devices that can be attached on the back side of the astrolabe. The first one, called "the receptacle of the Moon", is a mechanism with gears that displays the positions of Sun and Moon in the Zodiac, the day of the week, the date of the lunar month and the phase of the Moon. Four different models are presented, all of them giving approximate results, as al-Bīrūnī mentions. The second one, called "the disk of the eclipses", is described by authors of the 9th century AD or earlier. It is a disk furnished with a grid that can be attached to either side of the disk and can rotate upon it. Given the date of the lunar month, one can find the time of the Moon's rising and the phase of the Moon, using the front side of the disk. Knowing the latitude of the moon at the opposition, one can determine whether there will be a lunar eclipse or not, using the back side of the disk, and can also estimate the magnitude, the beginning and the duration of the eclipse. The results are again approximate.

Al-Ṣūfī, in his first treatise on the astrolabe (~930 AD), describes how to use the astrolabe to determine whether there will be a lunar or solar eclipse at the next syzygy, and also some characteristics of the eclipse. At the beginning of the work, the exact time of the opposition, the ecliptic longitude of Sun and Moon at that time, the apparent diameter of the Moon, the ecliptic longitude of the nodes, and the size of "falak al-jawzahir", that is the diameter of the Earth's shadow at the point where the Moon enters the shadow's cone, are all determined with the astrolabe. Then there is a study on lunar and solar eclipses, where some characteristics of these eclipses are determined using the astrolabe, such as the magnitude, the duration, and the greatest extent of the eclipse. For the lunar eclipse, the color is also determined. For the solar eclipse 3 tables are used.

The study of the eclipses with the astrolabe or with devices attached to it, as presented by al-Ṣūfī and al-Bīrūnī, can be related to the way in which the dates of the eclipses are shown on the Antikythera Mechanism, and can provide us with ideas for probable reconstructions of missing parts of the Mechanism.

UNE FILLE D'ANTICYTHÉRE: LA CALOTTE ZODIACALE DE CHEVROCHES ET SES COUSINS BOURGUIGNONS

Frédéric Devevey *(Inrap/UMR 6249-CNRS)*
Christian Vernou *(Musée arch. de Dijon / UMR 5594)*
Patrice Cauderlier *(Université de Bourgogne / Ecole Normale Supérieure de Paris)*
Aurélie Rousseau *(Archaeologist)*
Pierre Causeret *(Observatoire astronomique de Bourgogne)*
Claudine Magister - Vernou *(Archaeologist and designer)*

The Gallo-Roman site of Chevroches is located at the north west province of Burgundy in the Nièvre department. During the roman period, the site was included in the Eduens territory. The site was very rich as the Roman occupation lasted from the second quarter of the 1St century until the 5th century AD.

The archaeological site of Chevroches counts among the more important results of preventive excavations in the region. A rich collection of objects coming from metallic deposits was renovated, with a financial help from the Archeological Museum of Dijon. And then, the renovators of the laboratory of metal archaeology of Jarville-Nancy, discovered firstly classified as a decorative phalerae (of a harness ?), was in fact one of theses particularly rare "savant object"...
The dimensions of the curved disc are:
Diam. : 6,45 cm
H.: 1,30 cm
Thickness: 0,5 mm
This curved disc is divided in 12 equal quarters, and in each quarter, you can read 3 layered words, all engraved in Greek letters :
The external line corresponds to the 12 Egyptians months;
The median line to the 12 zodiacal signs at dative
The inside line, to the 12 roman months.

Indeed the civil Egyptian calendar counted regular months of 30 days, which had the consequence of 5 to 6 days addition at the end of each year.
Here, the concurrence between Roman and Egyptian months is obtained in such approximate way...
The use of Greek alphabet, the references at Egyptian's zodiacal signs and months, the attempt to make a correspondence between Egyptian and Roman calendar...
This rare object may have been used by someone with solid astrologic knowledge. If the practice came from a long tradition, it's procedures are really complex to analyse.
The technique of embossing some metal is a speciality in Gaule.
This object is certainly inspired of an Egyptian model, created around the Alexandrian School, because of the ability to use Greek language and its abbreviations.
The stratigraphic context : 340 / 350 AD.
The Epigraphic estimation (P. Cauderlier) : End of 3th century AD / 4th century AD.

THE INSCRIPTIONS OF THE DISC OF CHEVROCHES INTO THEIR CONTEXT

Patrice Cauderlier
Université de Bourgogne / École Normale Supérieure de Paris, France

The curved disc of Chevroches, dated on epigraphical estimations from the 3th century AD to the 4th century AD, is divided in 12 equal quarters, and in each quarter, engraved in Greek letters, there are words for the Egyptians months, the zodiacal signs at dative and the roman months.

The reading starts with Thoth, the first Egyptian month, which begins on our 28th day of august (or 29 for leap year). This object doesn't consider the 5 added days (6 for leap years since Julian calendar's reform). Indeed the civil Egyptian calendar counted regular months of 30 days, which had the consequence of 5 to 6 days addition at the end of each year. Here, the concurrence between Roman and Egyptian months is obtained in such approximate way.

The use of Greek alphabet, the references at Egyptian's zodiacal signs and months, the attempt to make a correspondence between Egyptian and Roman calendar indicate that this rare object may have been used by someone with solid astrologic and/ore astronomic knowledge. If the practice came from a long tradition, it's procedures are really complex to analyse. This object is certainly inspired of an Egyptian model, created around the Alexandrian School, because of the ability to use Greek language and its abbreviations.
The stratigraphic context : 340 / 350 AD.
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Symposium S46
National Funding of Biomedical Research

FROM PRIVATE INITIATIVE TO PUBLIC GOVERNMENT FUNDING OF MEDICAL RESEARCH AND PUBLIC HEALTH IN ITALY: OPPORTUNITIES AND CONSTRAINTS

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Despite the creation - as early as 1923 - of the Centro Nazionale per le Ricerche - CNR- (a governmental body whose aim was to support research in several fields, including biomedical research) the main innovations in the field of medical research and public health came from private initiatives, particularly from international sources. In fact, the system of making grants based on seed money by stimulating the government to invest in specific areas of research after an initial installment of private money, was begun by the Rockefeller Foundation during the interwar period. One of the most interesting results of this external impetus given to institutionalizing public health was the creation of a central institute: the Istituto Nazionale di Sanità during the fascist era.

Starting with an analysis of these processes, this paper also focuses on the long term analysis of the side effects of the policies of private external support to public institutions, which had an impact not only within the specific field of medical research and public health but also the research outcomes of other disciplines. For example, Enrico Fermis' physics laboratories served as the model of the facilities created by the Istituto Nazionale di Sanita. Another side effect was the competition among laboratories. and research institutes generated by external funding opportunities. A case study illustrated in this paper is the evolution of the Zoological Station in Naples during the 1960's. Paradoxically, a famous geneticist, Giorgio Montalenti, was attracted away from the Naples station to create his own laboratory at the University of Rome with autonomous funding as a consequence of his previous success with the Rockefeller Foundation. The paper concludes with some consideration about the global effects on research dynamics from the long-terms interaction between public and private institutions.

THE MEDICAL RESEARCH COUNCIL IN BRITAIN: SCIENCE, UTILITY AND POLITICS SINCE 1913.

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In 1948 British medical services moved from a mix of liberal medicine and state welfare to a tax-funded National Health Service (NHS). Since 1990 the NHS has been variously marketised, but also subjected to increasing central control of practice, often using evidence-based assessments. The paper will analyse the strategies of the MRC under these different regimes, as it triangulated between clinicians, academic scientists, governments — and industry.

Born in 1913 from a government concern with public health, the MRC soon became an instrument for the advance of bio-medical science, distanced from clinicians and from public health studies which were seen as mundane. After the leading hospitals were nationalised in 1948, and amidst fears that the independence of the medical profession was being compromised, the MRC became more involved in certain kinds of clinical research, but still at a distance from research funding within the NHS. Recently, this separation has been questioned and reduced, as governments have demanded short-term results and clinical trials have become a major expenditure.

The phases of this history may prompt reflection on more general links between the politics of knowledge, professions and government.

THE FIRST MEDICAL RESEARCH INSTITUTE IN CHINA: THE NORTH MANCHURIAN PLAGUE PREVENTION SERVICE

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Peking University (China)

Abstract: In 1910-11, a terrible epidemic of pneumonic plague invaded the north China, the Qing government found the powerless of the old-fashioned medicine against such severe outbreaks and had to rely upon the modern-trained physicians. After the plague was successfully put down by Dr. Wu Lien-teh, the International Plague Conference was held at Mukden (Shen Yang) in April, 1911, which was the first scientific international meeting ever to be held in China. One of the results of the conference was the establishment of the North Manchurian Plague Prevention Service.

As the first medical research institute supported by official in China, North Manchurian Plague Prevention leaded by Dr. Wu carried out a lot of tasks in prevention and control of epidemics and research of pathogenesis. From 1912 to 1931, the two decades of North Manchurian Plague Prevention Service witnessed the first systematic organisation of public health and modern medicine in China. It was not only a model for the public health system but also a pioneer of research of scientific medicine in the country. However, it had to stop as a result of Japanese invasion on September 18,1931.

In this paper, the author reviews the history of North Manchurian Plague Prevention Service and its contribution to the development of public health and modern medicine in China.

THE MEETING OF MEDICINE AND BIOLOGY IN FRANCE: SUCCESS AND LIMITS OF POLITICAL PLANNING

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In 1945 French clinicians led by Prof. Robert Debré created a plan to modernize French medicine. For clinical care they proposed the merging of university medical schools with hospitals, following the model recommended by the American Abraham Flexner a quarter of a century earlier. This part of their plan was not immediately successful. For preventive medicine, the Government lead by general De Gaulle supported the creation of a social security system as part of a national public health policy. Debré was named Chair of the board of the Institut national d'hygiène (INH), which had been established by the Vichy regime in 1941 with assistance from the Rockefeller Foundation. It created a social security study committee which eventually financed research, and one of whose first accomplishments was the creation of the Centre national de transfusion sanguine (CNTS) following the discovery of the new Rhesus blood group.

The INH decided, in accord with the new World Health Organization, to give priority to biophysics (radiation and nuclear medicine) rather than medical research, plus its budget was limited by the postwar financial difficulties. As a result, in the early 1950s the INH director, Louis Bugnard, indicated that for every one franc the French government spent on medical research, the UK spent ninety francs and the US one thousand. For this reason, a new generation of clinicians of the Assistance publique de Paris (the main hospital administration in France), therefore, decided to establish their own system of research support. They were more concerned by chronic diseases such as cancer, nephritis and cardiovascular diseases, since infectious diseases were close to being eradicated by the new antibiotics (sulfamides, penicillin, etc). They created the Association Claude Bernard (ACB) in order to support preclinical research laboratories within their hospital wards. The ACB budget doubled during its first five years of its existence, from 50 million francs in 1956 to one hundred million in 1961. Sixteen new laboratories were created for such distinguished researchers as Jean Bernard (hematology), Jean Hamburger (nephrology) or Georges Mathe (oncology).

With the Fifth Republic a new impulse was given to French scientific research. While, the ordinance of 1958 called for the fusion of clinical and medical teaching faculties into the Centre Hôspitalo-Universitaires (réforme Debré), a new public agency for scientific research, the Délégation Générale à la Recherche Scientifique et Technique (DGRST) took charge of the overall budget of French government research. Its budget of 400 million francs in 1959 was almost the double the support for research the year before. In order to support research in the life sciences and its medical applications, in 1964 the DGRST established the INSERM (Institut national de la santé et de la recherche médicale). Among its specific goals was to develop molecular biology applications to medical research and to merge the functions of the former INH in public health research with the ACB support of clinical research. Successes in immunology research were reflected in the overall growth of INSERM whose researchers quadrupled in number between 1964 and 1984, while its budget surpassed 54 billion francs. Other developments included the creation of new laboratories devoted to basic research and biotechnology — such as the Institut Cochin de genetique moléculaire, the Centre d'immunologie de Marseille Luminy, etc. One indication of success was the Nobel Prize awarded to Jean Dausset in 1980 for his discovery of the human leucocyte antigen (HLA).

Today while medical research extends its hegemony over all the life sciences in France, problems are less the result of insufficient funding devoted to this sector (which amounts to a quarter of all research and development in France), than the multiplication (and duplication) of different funding sources. This includes established ones, such as the Pasteur Institute and INSERM, as well as new ones aimed at specific diseases such as cancer (INCA) AIDS (ANRS) or genetic disorders (AFM) which causes difficulty in planning and complication of support for medical research.

THE BIRTH OF THE FIGHT AGAINST CANCER IN EUROPE: THE CASE OF EORTC

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The study by the European Organisation for Research and Treatment of Cancer (EORTC) allows the dynamics of Europeanization of health policies including the fight against cancer is an important issue. The EORTC has its own foundation (headed by the Queen of Sweden) and receives substantial financial support from the European Commission, private donors, European organizations in the fight against cancer and the pharmaceutical industry (for evaluation of new drugs). Hence the value of a sociological analysis of the various activities of such institutions who are looking to network in Europe, advances in clinical cancer research. The richness of the archives collected EORTC us to reorient our research specifically in the study of the organisation as an indicator of the historical process of Europeanization of the policy against cancer and to better understand the current effects. Founded in 1962 to address, according to its leaders, the failure of various European countries in the field of cancer chemotherapy, it has evolved very rapidly. Initially limited to a relatively small group of specialists (about fifteen), the EORTC has largely professionalized and has increased its activities and expertise in clinical trials.

The goal in our commucation to trace the origins and history, nearly 40 years, this institution that tries multiforme through the European institutions (European Commission in particular) to impose standards in the conduct of clinical trials pan while retaining genuine autonomy vis-à-vis its funders. From this point of view, we show how the EORTC has established specific links with other institutions in the fight against cancer and in particular the National Cancer Institute (NCI) in Bethesda, USA. This prestigious institution and dominant on these issues has rapidly entered the field of European research in the fight against cancer by funding significantly the activities of the EORTC and particularly clinical trials. There is also since 1973 a permanent office at the NCI EORTC. So, we seek to show how the close relations maintained by the EORTC with the NCI could not affect or promote a policy of standardization of clinical trials or to promote it.

INTERNAL AND EXTERNAL INFLUENCES ON THE ESTABLISHMENT OF THE NIH EXTRAMURAL FUNDING PROGRAM IN THE UNITED STATES

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Government funding of medical research in the United States was preceded by substantial support from private philanthropy such as the Carnegie and Rockefeller foundations. As a result, the beginning of government research support between the world wars was greatly influenced by the examples set, especially by the Rockefeller Foundation which began in 1913, and in the 1920s and 30s attempted a variety of mechanisms for supporting medical research, from individual fellowships to institutional endowments and building construction.

This paper examines the NIH extramural research program which began modestly in the 1930s, but greatly expanded and quickly surpassed private medical research support after it took over research programs begun during the war. The history of government and private medical research support in the United States has been studied separately, but this paper will examine the extent to which these developments influenced one another. The focus of the paper will be the early period of government funding when fixed-term research grants were adopted and became the model for government medical research support in the United States and around the world.

SHAPING SCIENTIFIC RESEARCH WITH DECISIONS NOT TO FUND: THE U.S. GOVERNMENT AND HUMAN-EMBRYO RESEARCH

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National research agendas are frequently seen as solely attributable to a multitude of funding decisions, each made to promote specific areas of science. However, decisions that are made NOT to fund lines of research – that is, to embargo research funding so that it cannot be used to pursue particular topics – also contribute to the shaping of national research agendas. In the United States, a series of public advisory panels since 1979 have endorsed the value of human-embryo research (albeit with some restrictions and with careful governmental oversight). Despite this consensus, the unresolved ethical and political debate surrounding the moral status of the human embryo has created a situation in which governmental support is denied to such research programs. By default, research in assisted reproduction can only be carried out with private funds and research involving stem cells is severely limited. The end result is not only an impaired national research effort in the crucial biomedical areas of assisted-reproduction and stem-cell science, but also an absence of regulation of the clinical applications as exemplified by the recent birth of octuplets.

RESEARCHING PUBLIC HEALTH IN THE AGE OF BIOMEDICINE: POPULATION-BASED SCIENCE AND EXPERTISE IN FRANCE AND BRITAIN (1940s-1980s)

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The influence exerted by the rise of biomedicine on style of thoughts, research practices and, crucially, organizational settings has rightly attracted a great deal of scholarly attention. The aim of this presentation is to enlarge the scope of these analyses by shedding light on the consequent transformation of public health research and expertise in France and Great Britain. Although hygiene had been an important part of the activities undertaken both at the Institut National d'Hygiene (later INSERM) and the Medical Research Council, the increasing, cumulative effects of the 'molecular turn', in the decades after WW2, challenged the soundness and utility of much population based research. The presentation traces the contrasting results of French and British epidemiologists' attempts to adjust to the new configuration and secure state funding by providing useful assistance to both clinical research and bench science.

Symposium S47
Letters at War - Scientific Controversies in the Correspondences of the 17th and 18th Century

THE INTERPLAY BETWEEN THE PRIVATE AND THE PUBLIC DIMENSIONS IN 17th AND 18th CENTURIES SCIENTIFIC DEBATES

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The late seventeenth and early eighteenth centuries witnessed the appearance of the first scientific journals. These journals not only disseminated scientific information, but also stimulated debate through critical reviews of recent publications followed by authors' replies, and published challenges calling for solutions of resilient problems.

Scientific academies' public sessions and memoirs, prize-awarding competitions on selected issues of current interest, public demonstrations of scientific results, the first scientific museus, and other forms of the institutionalization of science, along with the increasing role of the specialized and general journals, contributed to the creation of a public dimension of science, which functioned both as a vehicle of scientific communication and as an arena of scientific controversy. Scholarly correspondence, which had earlier performed these public functions (e.g., through the wide circulation in the scientific and philosophical community, thanks to figures such as Mersenne and Oldenburg, of letters not originality intended for diffusion), progressively lost them. Concomitantly, however, the special characteristics of its private dimension acquired a new significance, due to those forms of interaction between scientists – either regarding cooperation or dissension – that required the privacy not affordable by the public dimension.

I will focus on certain parameters of scientific debates in the 17th and 18th centuries and examine the role of the private and public dimensions in the arising, evolving, and ending of such debates. Employing a typology of debates and argumentative moves I have proposed, along with results of research in historical pragmatics, I will inquire which debates, public or private, belong typically to which categories in that typology, and which typical moves are characteristically used or banned in the public and/or private spheres. As far as the content, rather than the form, of scientific controversies is concerned, the parameter I am particularly interested in is to what extent the public or private modality affects the intervention of philosophical, theological, social, political, or other non-scientific factors in the conduct of a scientific controversy. Hopefully, put together this inquiry will supply evidence for identifying the respective functions of the public and the private in the management of scientific controversies at the time, as well as some insight in the nature of their interplay and complementarity.

GEOMETRIZATION OR MATHEMATIZATION: CHRISTIAN HUYGENS' CRITIQUES ON INFINITESIMAL OUTINE

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The rise of new infinitesimal methods at the end of the seventeenth century accelerated the change of the Galilean style in natural philosophy. The history of this turning point in physics usually considers it as a continuous and quite fast change in the way physicists dealt with coordinates, motions, accelerations and their differential aspects. Accordingly, twenty years after Leibniz gave the rules of infinitesimal calculus, followed by the Bernoullis, L'Hospital or Varignon, the change was completely done and gave birth to a rational or analytical mechanics, as if the end of the so called "geometrization" of nature had been a change without any discussion at all. However, at the time in which this revolution took place, some physicists strongly rejected the new methods, though using them in an informal way, because nothing could be said about the legitimacy of the infinitesimal quantities. Christiaan Huygens, in his correspondence with Leibniz and other mathematicians, was one such physicist. His attachment to geometrical methods led him to define precisely what, in his mind, was the meaning of natural philosophy. This attitude can be related to the way Huygens rejected Newton's gravity theory as a purely mathematical, not physical, account of matter and motion.

ROUTINE CONTROVERSIES: MATHEMATICAL CHALLENGES IN EARLY MODERN FRANCE

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Mathematical challenges punctuate the history of early modern mathematics, from the bitter Tartaglia-Ferrari dispute of 1547–1548 concerning algebraic equations to the European dimension of the cycloid problem a century later. While cultural historians have attempted to contextualize these challenges among contemporary practices, in particular duels or advertisements in a competitive market, thus emphasizing their interpersonal and social dimensions, historians of mathematics have generally treated them as somewhat childish remnants of a pre-scientific age, that the advent of modern science and its Baconian ideal of efficient collaboration would soon bring to an end. However, the number of challenges did not decrease but rather multiplied inside one of the first scientific organizations aiming at cooperative work—Marin Mersenne's network. This paradox has suggested the focus of this talk: to examine the role of challenges in the economy of mathematical exchange (and mathematical creation) in early modern France. Through examples of successful, but also of unsuccessful challenges, we shall see how challenges operated, not only as "mises en scène" of methodological oppositions, but also, and primarily, as links in a mathematical environment structured inside correspondences around the resolution of problems. This situation also exemplifies how controversies may have been a constitutive part of normal scientific activities—and not their disruption—while shaping their development in specific, limited directions.

LA CONTROVERSE ENTRE G.W. LEIBNIZ ET DENIS PAPIN : DE LA POLÉMIQUE PUBLIQUE À LA CORRESPONDANCE

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Entre 1689 et 1695, les *Acta eruditorum* sont le théâtre d'une controverse qui oppose Leibniz à Denis Papin. Cette controverse porte principalement sur deux points : la pertinence du principe leibnizien de conservation des forces vives et la notion leibnizienne d'effet formel. Elle met en jeu deux conceptions physiques opposées et conséquemment deux idées de la science et de ses ressources démonstratives.

Or, les stratégies argumentatives mises en œuvre par Leibniz dans la controverse publique doivent, pour être comprises, être replacées dans le contexte général des échanges privés qu'eurent Leibniz et Papin. Il semble en effet que Leibniz ait utilisé sa correspondance avec Papin (celle qui a débuté en 1686 à la suite de la *Brevis demonstratio*, mais surtout celle tenue entre 1695 et 1700) pour lever les réticences de Papin et lui dévoiler la démonstration a priori du principe de conservation de l'action motrice. Ce qui nous importe essentiellement est de montrer de quelle manière Leibniz utilise la correspondance avec Papin dans le cadre d'un dispositif de diffusion de la Dynamique bien plus vaste qui fait de cette correspondance un *espace argumentatif spécifique* dont l'intérêt ne peut se comprendre que *par rapport* à d'autres correspondances (essentiellement celles avec Johann Bernoulli et Burcher De Volder). Nous sommes ainsi reconduits à considérer les correspondances elles-mêmes comme un seul texte déroulant ses procédures démonstratives au gré des objections ou mûrissant la sémantisation de ses concepts fondamentaux, mais également à comparer et confronter les adresses différenciées sur un même objet.

Nous voulons, dans cette intervention, confronter les arguments mobilisés dans l'espace public de la publication dans les journaux savants et ceux mis en œuvre dans le cadre de la correspondance afin de montrer à la fois quel usage Leibniz fait de la controverse publique dans la constitution de ses théories scientifiques et quelle fonction est dévolue, dans ses multiples dispositifs argumentatifs, à la correspondance.

ANATOMIE D'UNE CONTROVERSE ÉPISTOLAIRE : LA « CORRESPONDANCE » LEIBNIZ-CLARKE (1715-1716)

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L'échange d'écrits entre Leibniz et le théologien et disciple newtonien Samuel Clarke, sur les principes de la philosophie naturelle et la religion, l'une des discussions les plus profondes sur la question de l'espace absolu et sur l'identité métaphysique du newtonisme, constitue aussi pour l'historien des idées un cas exemplaire susceptible d'être mobilisé pour la constitution d'une grille de lecture structurelle des controverses épistolaires de cette époque. La dizaine d'écrits qui constitue la controverse elle-même, et qui fait l'objet de deux publications (l'une en Angleterre, par Clarke lui-même en 1717, l'autre à Amsterdam en 1720) n'est que la partie publique et visible d'un débat extraordinairement complexe dont l'analyse requiert la prise en compte de déterminants multiples, internes et contextuels. C'est un débat à plusieurs voix, engageant une multitude d'acteurs dont certains restent dans l'ombre (Newton, Keil) d'autres agissent comme des transfuges (Conti), d'autres comme des partisans (Remond, Bernoulli), d'autres enfin comme des médiateurs, et/ou éventuellement des juges impartiaux dont on se dispute l'assentiment (la princesse Caroline). Ce débat en outre vient se superposer à d'autres controverses qui ne manquent pas d'exercer leurs effets sur la nature même de ce qui s'écrit : le débat avorté avec Locke qui avait donné lieu, quelques années plus tôt à la rédaction des Nouveaux essais, mais aussi l'amère querelle de priorité sur la découverte du calcul, qui bat encore son plein à l'époque de la correspondance avec Clarke et ne laisse pas de la marquer de façon implicite mais profonde. La prise en compte de cet ensemble de déterminants externes permet de définir 'l'espace' dialogique de la controverse théorique sur l'espace, et il permet aussi d'en délimiter les possibilités (par exemple, compte tenu des circonstances même du débat, les deux adversaires savent d'avance qu'ils ne pourront parvenir à un accord, et la correspondance ne fait d'ailleurs que rendre de plus en plus patent leur dissentiment). Il reste que ces déterminants externes ne peuvent suffire à l'explicitation de ce qui se joue dans l'échange. Il convient de les composer avec d'autres forces de nature interne qui procèdent de l'échange des arguments lui-même et en déterminent l'évolution dans le temps : dans le cas de la correspondance Leibniz-Clarke, on montrera sur l'exemple de l'espace, qu'en dépit de l'irréductibilité des positions, l'échange permet à chacun des adversaires de raffiner une position initiale et de lui donner une plus grande cohérence métaphysique dans des cadres conceptuels et méthodologique qui restent hétérogènes.

LA VIOLENCE SOUS LE VERBE ACADÉMIQUE. ASPECT RHÉTORIQUE D'UN « DÉBAT » SUR LA CERTITUDE EN HISTOIRE À L'ACADÉMIE DES INSCRIPTIONS ET BELLES-LETTRES AU XVIIIE SIÈCLE.

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La rhétorique des académiciens sous l'Ancien régime est soumise à une double contrainte. Elle doit impérativement se conformer aux règles de bienséance et d'urbanité, et soutenir des controverses dans les débats savants ou érudits. La présente communication se propose de mettre l'accent sur les marques assourdies de la polémique, dans un ensemble de mémoires lus à l'Académie des Inscriptions et Belles-lettres sur la question de la certitude en histoire (1715-1725).

Ce débat sur la certitude ne relève pas que de la discussion savante pour décider, par exemple, si l'historien doit tenir les mythologies collectives comme des preuves d'événements lointains, ou si le calcul des probabilités doit intervenir dans la décision de la preuve. Il est aussi traversé d'autres enjeux dont les échos passent les murs de la studieuse compagnie. Enjeu métaphysique, dans la mesure où le doute sur certains types de faits lointains pourrait confiner au pyrrhonisme ; enjeu politique surtout, puisque toute interrogation sur les origines des nations débouche sur celle des origines, héroïques ou non, de la monarchie.

Ces questions, capitales pour cette institution nouvellement fondée, sont aussi hérissées de dangers, et se révèlent embarrassantes pour des académiciens soucieux de leurs recherches érudites, et des privilèges que le monarque accorde à leur assemblée.

Quand la polémique s'élève, ces savants ne peuvent contourner les écueils. Mais l'effet de sourdine se fait alors indispensable.

ENLIGHTENED CONTROVERSIES OR CONTROVERSIES IN THE ENLIGHTENMENT? ALBRECHT VON HALLER VERSUS COSCHWITZ AND LA METTRIE

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Relying on two exemplary debates, I will discuss in my paper the question whether controversies can be regarded as impetuses rather than obstacles of the European Enlightenment. I will highlight how the "controversy," which was rhetorically limited at the beginning of the eighteenth century (Hanspeter Marti), expands to a specific type of polemical exchange, using media orchestration in order to initiate an enlightened debate. This process not only requires an "epistemological liberalization" (Sergio Moravia), but also the opening of a discursive space in and through the Enlightenment.

The controversy between Albrecht von Haller and the Halle professor of anatomy, Georg Daniel Coschwitz (1725-29), begins within the framework of traditional academic polemical exchange. The two opponents draw on well-known academic forms, e.g. Haller's dissertation *Dissertatio inauguralis sistens experimenta et dubia circa ductum salivalem novum Coschwizianum.* Before long however, this controversy manifests a discrepancy between two diverging ways of staging academic practice and of acting as a savant in the eighteenth century. Whereas Haller, by stressing empirical certainty, argues in a way that seems more in line with Enlightenment demands, Coschwitz mostly relies on the trustworthiness of his own reputation. Yet both strategies soon reach their limits.

Haller's disagreement with Julien Offray de La Mettrie (1745-51) further illustrates the development of the uses of controversy. Ignited by the issue of the role and usefulness of God in nature, this controversy represents a debate of utmost importance in the history of eighteenth-century thought (Karl S. Guthke). Yet I propose to read this controversy also as an exchange on Enlightenment practices of knowledge. Competing genres (satire and academic textbook), both of essential importance for the progress of Enlightenment, develop diverging functions for a controversy that – albeit enlightened – goes beyond rational arguments.

In my talk, I will demonstrate how the process of Enlightenment (and of enlightening the public) was spurred on by a developing understanding of Enlightenment as a culture of controversy. The Age of Enlightenment thus emerges as a period of multiple uncertainties concerning scientific evidence and, furthermore, concerning the scope of propositions capable of providing evidence. Types and forms of "controversies" (sensu Marcelo Dascal) became just as seminal for the development of modern thinking as the increase of knowledge during the eighteenth century. My paper will therefore conclude that specific forms of polemical exchange turn out to be characteristic impulses for the Enlightenment.

LE RÔLE DES CORRESPONDANCES DANS LA QUERELLE DE LA CIRCULATION SANGUINE

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La découverte de la circulation sanguine par le médecin anglais William Harvey, rendue publique en 1628, fait certainement partie des avancées scientifiques les plus contestées et controversées au XVIIe siècle.

Les correspondances jouent un rôle essentiel pour comprendre la manière dont la découverte a été diffusée et transmise sur le continent, dans les années 1630-1640, en France (via Gassendi, Mersenne, Pereisc) mais aussi en Italie (via le médecin George Ent ainsi que l'ambassadeur anglais ami de Harvey Lord Arundell). Elles sont aussi le lieu d'expression d'une guerre sans merci menée par les partisans de l'ancienne médecine contre ceux qui défendent la circulation sanguine.

Nous proposons dans le cadre de ce symposium d'étudier parallèlement les lettres de Guy Patin à Charles Spon, éditées en 2006 chez Honoré Champion par Laure Jestaz, et l'échange de lettres entre Harvey lui-même et le médecin allemand Caspar Hoffmann (1636, lettres reproduites dans Gweneth Whitteridge, *William Harvey and the Circulation of the Blood*, London : MacDonald, 1971). Alors que la correspondance de Patin se caractérise par un ton extrêmement polémique et vise à présenter Harvey comme un charlatan (« circulateur »), l'échange de lettres entre Harvey et Hoffmann témoigne d'un réel respect réciproque et permet surtout de comprendre que le véritable débat ne se situe pas sur le terrain de l'utilité thérapeutique de la découverte de la circulation sanguine, mais engage des conceptions de la nature et de la perfection du corps humain opposées.

ROUTINE CONTROVERSIES: MATHEMATICAL CHALLENGES IN EARLY MODERN FRANCE

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Dans les vastes espaces configurés par la République des Lettres au XVIII^e siècle, la question des consultations épistolaires tient une place considérée habituellement comme marginale. Or, sous l'angle de l'épistolarité, plusieurs caractéristiques, rapportées à cette forme spécifique où le rapport a lieu entre le malade ou son entourage et le médecin, complexifient l'idée toute faite qu'il ne s'agirait que d'un simple support descriptif destiné à suppléer, faute de mieux, la consultation directe. Tout d'abord, l'étonnante place que prend, dans l'échange épistolaire en général, et non pas uniquement entre un malade et son soignant, le récit du corps et de ses souffrances, thème privilégié de « l'écriture de soi », qui lie l'acte même d'écrire à une expérience spécifique de la corporéité. Puis, dans le genre proprement dit de la consultation épistolaire, la temporalité particulière induite par l'échange, suscitant à travers le jeu des questions et des réponses, un type particulier de retour réflexif sur soi-même. A cela s'ajoute le fait de l'autorité sur son corps propre que permet, voire qu'exige la description de ses maux, qui transforme nécessairement toute demande, aussi banale en apparence, en espace de négociation, voire de controverse. Enfin, en rapport avec la question de la République des Lettres, cette circonstance historique de la présence conjointe de la médecine et d'autres disciplines, arts ou sciences, au sein d'un même savant, d'où il ressort que dans les échanges épistolaires, préoccupations scientifiques et soucis du corps se mêlent très souvent de façon inextricable. A l'aide d'exemples tirés d'une recherche systématique sur la correspondance de quelques savants et médecins suisses de la deuxième moitié du XVIII^e siècle, Nous tenterons, à de souligner la complexité et l'intérêt d'une prise en compte de ce phénomène apparemment périphérique de la « maladie en lettres » dans le cadre d'une réflexion sur la controverse dans la République des Lettres.

SPREADING THE WORD: REPORTING AN EIGHTEENTH-CENTURY CONTROVERSY ABOUT LIGHTNING RODS

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One of the more spectacular controversies of eighteenth-century science concerned the best shape for the conducting rods with which, following Benjamin Franklin's proposal in mid-century, increasing numbers of buildings were furnished to protect them from lightning strikes. Should they have sharp points and project high above the roof of the building, as Franklin recommended, or should they have rounded ends and terminate inside the roof-line? Initially fought out at meetings of the Royal Society of London, the argument later spilled into the public arena, culminating in dramatic experiments performed before large audiences at the London Pantheon by the chief opponent of the use of points, Benjamin Wilson, FRS. In this paper, I consider how scientific authority was deployed, and in Wilson's case destroyed, in the course of the controversy, focusing especially on the scientific correspondence that kept the international scientific community *au fait* with developments in London.

UNE RÉCONCILIATION CONTROVERSÉE DE SÉLÉNÉ ET NEWTON CLAIRAUT, D'ALEMBERT, EULER ET LA THÉORIE DE LA LUNE

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À partir des années 1730, les thèses newtoniennes commencent à vraiment s'imposer sur le continent européen. Parmi les principaux acteurs de ce changement, on compte trois mathématiciens de renom. Le premier, Alexis-Claude Clairaut, prit une part active à l'expédition en Laponie (1736-1737) qui prouva l'aplatissement des pôles, vérifiant ainsi les assertions de Newton à ce sujet. Il s'appliqua par ailleurs à corriger les prévisions d'Edmond Halley pour le retour de la comète de 1682. Lorsque cet astre apparut dans le ciel en mai 1758, le publique n'eut plus qu'à porter son regard vers le firmament pour se convaincre de l'attraction newtonienne. Le second, Jean le Rond d'Alembert, s'attela à répandre et à promouvoir les idées du savant anglais au sein de l'*Encyclopédie*. Enfin, le troisième, Leonhard Euler, vulgarisa Newton dans son ouvrage le plus célèbre, ses *Lettres à une princesse d'Allemagne*.

Aucun de nos trois protagonistes n'accepta pourtant les théories newtoniennes sans les avoir tout d'abord dûment vérifiées. Newton avait par exemple laissé beaucoup d'obscurité dans sa théorie du mouvement de la Lune et plus particulièrement de son apogée. Attirée à la fois par la Terre et par le Soleil, la Lune décrit une orbite aux nombreuses irrégularités, qui, traduite mathématiquement, confronte les géomètres à un difficile problème à quatre équations ne pouvant être résolu qu'approximativement. Dès 1747, Clairaut observait, dans le cadre de ses recherches sur cette matière, que la loi du carré inverse formulée par Newton ne pouvait rendre compte des variations du mouvement lunaire. Il proposa alors de modifier la loi newtonienne en ajoutant un terme $1/r^4$ qu'il rétracta pourtant peu après. Une compétition endiablée s'engagea alors entre d'Alembert, Euler et Clairaut pour résoudre ce problème et tenter d'accorder les observations à la théorie. Elle devait bientôt se transformer en une controverse que nous nous proposons d'analyser au travers des correspondances qu'entretinrent nos protagonistes – aussi bien entre eux qu'avec leurs contemporains.

Plus qu'un simple pas de plus dans l'acceptation des thèses newtoniennes sur le continent, la dispute de priorité autour du mouvement de l'orbite lunaire nous présente la science qui se fait. Elle met en scène le savant du dix-huitième siècle, échangeant ses résultats, activant ses réseaux d'informations, mettant en place des stratégies de défense et de persuasion pour convaincre ses confrères ainsi que le public de la véracité de ses conclusions et de ses méthodes. Elle révèle par ailleurs que si la science est une œuvre collective, elle se définit aussi au travers de disputes, polémiques et controverses qui viennent relativiser l'idéal d'une République des lettres unies et qui interrogent sur les valeurs et pratiques d'une telle communauté.

Symposium S48
Networks of Instrumentation in the Neurosciences

TECHNICAL ADVANCES IN NEUROCHEMISTRY: HISTOFLUORESCENCE AND IMMUNOHISTOCHEMISTRY, THEIR INFLUENCE ON SLEEP PHYSIOLOGY

Claude Debru

Ecole Normale Supérieure, Paris, France

Starting from the mid sixties, sleep physiology could develop in the biochemical direction thanks to several advances in neurochemistry : radioactive labeling of monoamines inducing a better knowledge of brain metabolism ; histofluorescence leading to the first localization of monoamines in nuclei of the brain stem and thus to physiological models of the sleep cycle ; immunohistochemistry coming later on, in the late seventies and early eighties, provided a much detailed view of the plurality of

neurotransmitters and of their localization in/on the neuron, with much better physiological implications. More recently, immunohistochemistry played an important role in helping to localize several neurotransmitters involved in sleep regulation, and thus in providing evidence to build much improved models of sleep mechanisms.

A FINE BALANCE: THE CULTURAL IMPLICATIONS OF INDIRECT MEASUREMENT

Gabriel Finkelstein

University of Colorado Denver, USA

This talk describes a mid nineteenth century controversy over the interpretation of experiment. It concerns the claim of the Berlin physiologist Emil du Bois-Reymond (1818-96) to have arrived at a technique of manifesting nerve signals in living human subjects. Du Bois-Reymond's method was based on two tenets of classical physics: first, that absolute measurements can be inferred from relative measurements, and second, that parts can be integrated into wholes. The *Académie des sciences* in Paris, however, rejected du Bois-Reymond's findings when he was invited to demonstrate them. Here I will discuss why, along with what this controversy between French and German scientists implies about contemporary practices of cultural history.

ACTION POTENTIALS AND THE "DIGITIZATION" OF THE NERVOUS SYSTEM BY EUROPEAN SCIENTISTS BETWEEN 1900 AND 1950

François Clarac

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At the beginning of the XXth century, Gotch (1853-1913), Lucas (1879-1916) and Adrian (1889-1977) established two fundamental laws, the all-or-none response (Gotch 1902, Lucas 1909) and the absolute and relative refractory period between two stimulations (Adrian and Lucas 1912). These laws demonstrated that the nervous conduction corresponded to a "digitization" of its activity. Nervous activation seemed to correspond to a conversion of the information into a digital format. These trains of action potentials were recorded both in motor and in sensory nerves. The signal was similar in amplitude with a very short duration; the intensity of the phenomenon was expressed by the frequency and the duration of the discharge. This expression of motor and sensory conduction, with frequency coding, unified the vision of the central nervous system (CNS). The metaphor comparing the CNS with a telephone system was confirmed, nervous centers corresponding to central offices.

It was not easy to record such very short and very rapid activities. In US, Gasser and Erlanger (1922) were using an cathodic oscillograph very early which allowed a fine analysis of complex waves. In Europe, apparatus were more primitive, using capillary electrometer or string galvanometer. However some new apparatus were built and gave the possibilities of better recordings (Matthews 1928, Fessard 1933).

The following work confirming this "CNS wiring vision" was done mainly by the Cambridge school. They isolated single sensory as motor fibres, demonstating the ubiquity of digitization. The responses were recorded from specific mechanoreceptors like the Pacini corpuscle (Umrath and Adrian, 1929) or like the muscle spindle (Matthews 1931). Concerning motor command, Adrian and Bronk (1929) recorded motor neurones, confirming the reflex activation (Liddell and Sherrington, 1926).

Around 1930, the description of the cortical brain waves seemed a global responses of these isolated fibres. At that time, the CNS was in fact considered as completely "electrical", rigid and composed of an ensemble of inputs and outputs. Arvanitaki (1901-1983) studied the activities of the invertebrate nerves with Fessard (1900-1982) and Cardot (1886-1942). In 1942, she demonstrated that large cuttlefish fibres could communicate by electrical connection, confirming the nervous electrical synaptic hypothesis developed mainly by Eccles (1903-1997).

First studies on synaptic contents were not accepted easily and induced fighting between "the soups and the sparks" (Valenstein, 2005). It ceased abruptly, in 1950, when Eccles recorded intracellularly the spinal cat motorneurones. Recording excitatory and inhibitory postsynaptic potentials, he was admitted electrical conduction at the level of the synapse was not possible. Further developments in electrophysiology and on neurochemistry demonstrated analog signals seemed the law in the CNS and that actions potentials corresponded to digital signals necessary to relay information throughout the body!

THE PPI NETWORK : FROM SPIRITUAL BRAIN TO FUTURE ANTIPSYCHOTICS?

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Measured by San Diego Instruments' Startle Response System SR-LAB, prepulse inhibition (PPI) of the startle reflex is a widely used operational measure of sensory motor gating in biopsychiatric and neuropsychopharmacological research. PPI is based on the nineteenth-century idea that the brain filters out an overabundance of external stimuli. In the 1950s, the British writer Aldous Huxley interpreted mystical states of mind, including his own hallucinogen intoxications, as the perception of an ethereal reality caused by an impairment of this cerebral "reducing valve": detrimental to biological survival, but spiritually enriching. Since the 1970s, the inhibition of the startle reflex through non-startling prepulses has been taken as an instantiation of such filtering mechanisms. But instead of pursuing Huxley's neurotheology, the psychopharmacologists Mark Geyer, David Braff, and Neal Swerdlow demonstrated PPI deficits in schizophrenics and began to use hallucinogen-induced PPI deficits in rodents as an animal model of psychosis that could help to screen for new antipsychotic drugs. By marketing a standardized version of their startle response system, Geyer managed to build an extensive research network around PPI. However, until today no novel antipsychotic has been discovered through PPI. The measure and its network are also in crisis since discrepancies between the animal model and its human counterpart have recently come to the fore. This presentation explores the formation (and, possibly, the beginning disintegration) of the PPI network in the context of hallucinogen research and the secularization of Huxley's conception of the spiritual brain.

EPILEPSY, A DISEASE BETWEEN THE FIELDS OF CLINICS AND SURGERY IN THE TWENTIETH CENTURY

Céline Cherici

Ecole Normale Supérieure, Paris, France

The epilepsy is a disease which between 1850 and 1960 follows many different theoretical ways of thinking within medicine and/or neurosciences. From researches of John Huglings Jackson considered the father of modern epileptology, to surgical techniques developed by Jean Talairach and electroencephalographic representations, we will analyze the ways the epileptic symptom becomes a pathological and clinical entity: epilepsy.

Many questions should be answered: In what manners electroencephalographic studies, surgical developments and clinics contribute to the renewal of the medicine of epileptic disorders?

Through this vast problematic, we will examine the works of Antoine Rémond, Jean Talairach, Henri Gastaut and Robert Naquet.

ELECTRIC FISH DISCOVERIES IN MODERN AGE: COMPLEX NETWORKS OF SCIENTIFIC ENDEAVOUR AND HISTORICAL INTRICACIES

Marco Piccolino

University of Ferrara

Research on electric fish played a fundamental role in our understanding of physical and physiological electricity. It contributed to Luigi Galvani's discovery of the electric nature of nervous signals (in 1780) and also to invention of the electric battery by Alessandro Volta (designated as *organe électrique artificiel* to acknowledge the inspiration from the natural organ of fish). Earlier studies on the history of electric fish research had focused mainly on the investigations carried out from 1772 to 1776 by John Walsh, first on torpedoes at La Rochelle in France, and afterwards on electric eels imported from Surinam to London. Although Walsh's endeavours played a crucial role in indicating that electricity could be involved in animal economy, the electric nature of shocks from fishes had first emerged from observations of electric eels and the African electric catfish. Recently, in collaboration with Stanley Finger, Peter Koehler and Jean-Gaël Barbara, I have been investigating the pre-Walsh phase of electric fish research. Electric eels were studied by Dutchmen, and they profited from complex social and cultural networks, particularly those expressed in the Low Countries. These involved many factors including: interests in voyages to exotic countries, colonialism, strong commitment to collecting natural specimens and their systematic classification, great development of natural philosophy and experimental science, presence of an important publishing houses, foundation of scientific societies with their associated scientific journal and magazines. The historical pathway that brought the relatively neglected electric catfish to the attention of Western literati was even more complex. In addition to some of the factors mentioned above other, more specific factors were involved. The blossoming of Catholic missions and specifically those of Jesuits in Ethiopia were significant. Ethiopia was considered a mysterious country that had attracted the interest of Europeans because of its religion and its legends (and mainly that of its mythical Emperor, the so called Prester John). The initial important contact between Ethiopia and Europe occurred in the first half of the sixteenth century, in a particularly dramatic phase of Ethiopian history which resulted in a glorious epic of the Portuguese army. One consequence was that Jesuits were allowed into Ethiopia and eventually, at the beginning of the next century, they seemed to have great success in converting members of the local high class to orthodox Catholicism, including the Emperor himself. In this context a controversy exploded among the Dominicans and the Jesuits regarding the importance of their respective roles in the Christianization of Ethiopia. This led to the publication in 1610-1611 by the Dominican Luis de Urreta of one of a most fanciful work in which old legends of Ethiopia were presented as true historical facts. The first printed descriptions of the electric catfish emerged within the climate of this controversy and in this way news about the "African torpedo" spread throughout Europe. Much later (in 1757) this led to the first proposal of the electric nature of its discharge by the French naturalist Michel Adanson during his voyage in Senegal.

FROM LEIPZIG TO CAMBRIDGE, FROM WUNDT TO JAMES: HUGO MÜNSTERBERG AND HIS LABORATORIES FOR EXPERIMENTAL PSYCHOLOGY

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Hugo Münsterberg (1863 - 1916) is often referred to as a pioneer of applied psychology. Münsterberg is also well-known for his philosophy of values and his early theory of the cinema (*The Photoplay*, 1916). Less familiar is Münsterberg's role as a creative experimenter and energetic director of psychological laboratories – in Germany and the United States. In this role, Münsterberg contributed significantly to the transition from a cognitive and/or idealist "Physiological Psychology" in the sense of Wilhelm Wundt to the pragmatist and/or functional "Science of Mental Life" as advocated by William James and others.

The paper argues that this transition was not only grounded in theory and epistemology but corresponded to significant changes in the material culture of Münsterberg's psychological laboratories. In particular, Münsterberg collaborated with the Freiburg based precision mechanic Hermann Elbs (1861-1936) for setting up innovative experiments that transgressed the tight conceptual and practical boundaries of Wundtian chronometry. Instruments such as the "Muscle Sense Apparatus" and devices for investigating the power of the eye to compare lengths ("Augenmassapparat") permitted Münsterberg to investigate the psycho-physiological periphery of the body, whereas Wundt and his research school had remained focused on centralized, i.e. conscious phenomena. Based on unpublished sources, this paper shows how Münsterberg developed and used these instruments and transferred them from Europe to the US.

TRAVELS OF A BIOASSAY: THE ESERINIZED LEECH MUSCLE IN HENRY DALE'S LAB AND BEYOND

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In 1933 a young German refugee physiologist, Wilhelm Feldberg, arrived in Sir Henry Dale's lab at the National Institute of Medical Research (NIMR) in North London. He brought with him the 'key' (in his own words) to a series of successful experiments in the lab, which contributed to the award of the Nobel Prize to Dale, and the adoption of his experimental technique in physiology and pharmacology labs around the world. What was that 'key'? It was the use of the acetylcholinesterase inhibitor eserine on the dorsal muscle of the leech as a bioassay to detect minute quantities of acetylcholine. In 1918 the German pharmacologist Fühner had noted that adding eserine to an organ bath in which a leech muscle was suspended made the muscle extremely sensitive to acetylcholine, and he used the system as an assay for eserine (Fühner, H, 1918, 'Ein Vorlesungsversuch zur Demonstration der erregbarkeitssteigerndend Wirkung des Physostigmins' Archs exp Path Pharmak 82:81-85). Feldberg merely reversed the procedure and used the eserinized muscle as a sensitive and simple assay for acetylcholine.

As early as 1914 Dale had suggested that acetylcholine, then known only as a synthetic molecule, was an ideal candidate as an endogenous mediator in the parasympathetic nervous system. However it was not until 1929, after his chance discovery that it occurred naturally in animals, that research in Dale's lab focussed on the physiology and pharmacology of acetylcholine. Feldberg's arrival with his eserinized leech muscle heralded a period of enormous scientific productivity – 14 full papers in the Journal of Physiology alone in just three years, and the first direct experimental evidence for acetylcholine in ganglionic transmission, at the parasympathetic post-ganglionic junction and at the neuromuscular junction of the voluntary nervous system was soon available (see Tansey, E M , 1991 'Chemical neurotransmission in the autonomic nervous system: Sir Henry Dale and acetylcholine' Clin. Auton. Res. 1:63-72 for a summary).

Dale's lab, known by its room number 'F4' attracted people from around the world (Tansey, E M, 1995, An F4-vescent episode: Sir Henry Dale's laboratory 1919-1942 Brit J Pharm 115: 1339-1345). Visitors and co-workers took away techniques and concepts they had learned in F4, and the eserinized leech muscle travelled via G L Brown, W S Feldberg, J G Gaddum, F C MacIntosh, W D M Paton, Marthe Vogt and others, to, inter alia, many British labs including Cambridge, Edinburgh, Oxford, and UCL, and further afield to Australia, Belgium, Canada and New Zealand.

'EX-RADAR FOLK WITH BIOLOGICAL LEANINGS': MODELS, ELECTRONICS AND THE NERVE IMPULSE AT WWII

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Around 1945, the 'nervous impulse' ascended as a premier scientific problematic and a great many accounts, representations, theories, and models were floated in matters of fundamental bioelectric mechanisms underlying nervous activity. If the ideological lure of basic science and the worrisome state of the mental health of the world provided much of the rationale, war-induced advances in instrumentation, notably electronics, provided the means that shaped mid-century approaches to nerve. In the post-war world, the 'behaviour' of nerve was zeroed in with a vengeance from the vantage points of biophysics, biochemistry, cybernetics, energetics, biomolecular structure, or colloidal science.

Arguably the most consequential of these approaches transpired in Cambridge, UK, and would be handed down to posterity as the Hodgkin-Huxley 'model' of the action potential: a complex assemblage, in fact, of 'theory' and 'hypotheses', differential equations, circuit-diagrammatic representations, organismic preparations, computational practices, and a set of novel experimental technologies – electronically controlled recording techniques, microelectrodes, and radioactive tracers. Despite its eventual hegemony, it wasn't obvious at the time that the model should exhaust the issue: indeed it was, in many ways, a model without referent. The 'mechanism' it gestured at remained shrouded in microphysical darkness, its mathematical splendor meant horrors to the average nerve physiologist, and it blissfully ignored the metabolic dimensions of nervous activity.

Explaining the relative success of this relatively particularistic vision of the nerve cell, or so I argue here, requires taking into account the broader mid-century transformations in attitudes towards biological research and modelling practices.

This paper presents an account and contextualization of the model's relative success by examining the impact of the 'radio war' on the state of British biological science. This paper analyses first, Britain's war-time radar training schemes – including large-scale 'conversion' efforts at imparting non-physical scientists with electrical engineering skills - and how biologists, exposed to an ideology of science suffused with 'teams', 'mixing up', and crossing boundaries, in the process came to appropriate engineering modes of research, and their emphases on 'design', 'prototypes' and 'models'. Second, it attempts to gauge the subsequent transfer of such frame of mind, skills, instrumentation and its impacts on the state of post-war neuro-physiology. The model, the argument goes, derived its persuasiveness from a historical context that not only or merely saw the diffusion of electronics-based research techniques, but the incipience of a model biological persona who prioritized schematic simplicity to exhaustive complexity. It attained critical mass not least thanks to what one may think of as a generational effect: the post-war emergence of a small but influential population of electronics-and-models-minded biological scientists - 'ex-radar folk with biological leanings'.

"WHAT WAS IN THEIR LUGGAGE? GERMAN REFUGEE NEUROSCIENTISTS AND THE EMERGENCE OF INTERDISCIPLINARY RESEARCH NETWORKS IN NORTH-AMERICA, 1933 TO 1963"

Frank W. Stahnisch

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It is a well established fact of 20th century history of science and medicine that with the seizing of power of the Nazi party in Germany, numerous anti-Semitic laws became established, which aimed at the expulsion from service of most Jewish scientists and doctors at universities and other state-funded medical and research institutions. The neurosciences (broadly understood to include neurologists, psychiatrists, and neuropathologists, etc.) were one of the areas, which were most strongly affected by the political pressures that eventually led to the expulsion from Central Europe of up to a third of the leading doctors in this medico-scientific field.

As a result of their holistic, healing-oriented approach, many of the protagonists of the emerging neuroscientific and psychiatric cultures in the early 1930s – such as the Goldstein group in Frankfurt, the Munich neurohistologists, or the private clinicians of Berlin – were faced not only with expulsion from academic work circles, but also prohibited from pursuing their career as medical doctors. Many of them searched to escape this and establish a new professional life elsewhere. Those who were socially adaptable and economically well-off were able to react quickly when political conditions deteriorated; they decided that it was better to leave Germany before things worsened, often with nothing more than suitcases filled with clothes, a little seed money, and the addresses of relatives, friends, or international colleagues in their pocket.

Until recently, this exodus of German-speaking scholars is frequently portrayed in the historical research literature by the "brain gain" theory of the forced-migration of academics, intellectuals, and scientists, when most notably the United States (in North America) and Great Britain (in Europe) were "enriched" through receiving the émigré neuroscientists, and German-speaking science underwent the loss.

The perspective presented in this paper challenges this received historical view, by drawing attention to the often neglected immigration rules, social relations, and contingent patterns of re-adaptation into scientific working groups. By focusing on the travelling ideas and instruments of the émigrés, during what many saw as a process of "parachuting from Europe into the new world of North American psychiatry" (Heinz Lehmann, 1911-2000), some new light will be shed on the difficult re-integration of the German-speaking refugees in the North-American neurosciences. When taking books, journal articles, brain slides, microscopes, etc. as essential utensils of modern neuroscientific research, the luggage of such individuals as Hans Lehmann, Martin Silberberg (1895-1969), or Kurt Goldstein (1878-1965), etc. shall historically be unpacked and scrutinized as to its role and influence in the process of re-integration of the exiled neuroscientists in North America.

Symposium S49
Mediators of Sciences. Women Translators of Scientific Texts 1600-1850 – Mediatrices de Sciences. Femme Traductrices de Textes Scientifiques 1600-1850

WOMEN TRANSLATORS IN 19th CENTURY GREECE: THE CASE OF "LADIES' NEWSPAPER" AND "ESTIA"

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My paper, proposed to the symposium "Mediators of Sciences. Women translators of scientific texts 1600-1850" in XXIII International Congress of History of Science and Technology, concerns the popularization of scientific knowledge during the second half of 19th century Greece. The emphasis is placed on the ways that Greek women of the given period participated in scientific activities and transmitted their knowledge in journals of wide circulation, introducing and translating articles from the enlightened western Europe.

In the 19th century Greece, there were peculiarities resulting from two main factors: first, Greece was a newly founded state, which struggled to form its institutions and to function according to the standards of the European states. Second, production of novel scientific ideas was absent. Thus popularizing science entailed its introduction from Europe. At the same time, women were refused access to university education. It is indicative that the first female student, Ioanna Stefanopolis, enrolled at the University of Athens as late as 1890. In such a sociopolitical setting, the daughters of the Greek bourgeoisie were able to transmit scientific knowledge by popularizing scientific ideas through mainly two newspapers of wide circulation: that of *"Ladies' Newspaper"* and *"Estia"*.

The *"Ladies' Newspaper"* was published weekly at first and fortnightly later by Kallirroe Parren, from 1887 to 1917. It is significant that in this particular newspaper women authors signed by their full-name. This was unusual at that time, because most women columnists signed by their initials or didn't sign their articles at all. Through the pages of this newspaper, women expressed their two main demands: first of all claimed their right for better education, hoping to improve their social life and work. As a second step, by translating major scientific texts, they demanded their access to science. Their strategies were to translate various scientific subjects informing their audience; to communicate with women's representatives in Europe; to make their way into the international suffragette movement and partly to the scientific community, by participating to international congresses.

The *"Estia"* was published weekly, each Sunday, from 1876 to 1895. In this newspaper, published and addressed mainly to men, female columnists signed by their initials and seldom by their surname. Thus although it is too difficult to know their identity, there were a number of translated articles that indirectly show women's specific interest in scientific topics.

The paper argues that in 19th century Greece, where scientific theories were too limited, a few women were trying to overcome sociopolitical obstacles. Despite their incomplete education, there were able to establish a presence in science through its popularization and translations. These articles are valuable for the historian, who is willing to challenge the dominant view of women's absence of science.

TRANSFORMING THE TEXT: TRANSLATION PRACTICES OF THE *PHILOSOPHE* EMILIE DU CHÂTELET

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"Transforming the Text: Translation Practices of the *Philosophe*, Emilie Du Châtelet"

In this paper, the translation practices of Emilie Du Châtelet, the eighteenth-century French *philosophe* will be described. Her two major translation projects will be discussed: Bernard Mandeville's *Fable of the Bees* and Isaac Newton's *Principia*. Although the first concerns the nature of human society and the second that of the universe, both constituted part of Du Châtelet's natural philosophy, her understanding of the cosmos. This particular understanding and the audience she hoped to reach colored the choices that she made in her translation of Mandeville, and the ways in which she expanded the very definition of translation with her commmentaries on her French rendition of Newton. Du Châtelet never claimed translation as a woman's task, but did imagine it as the contribution of those blessed with intellect, though not necessarily, with genius. The total of her works, culminating in her translation of and commentary on the *Principia* meant, however, that she escaped the traditional designation of a bright woman as a "prodigy." Instead, she gained acceptance as an equal to her male contemporaries, as a participating member of the Republic of Letters, and its gendered trans-European scientific community.

MARIANGELA ARDINGHELLI: POETRY AND ELECTRICITY IN 18th-CENTURY NAPLES

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«(…) par les connaissances en physique & en mathématique, qui la mettent aujourd'hui á la tête des femmes illustres de l'Italie & même de l'Europe.»

At the end of the 18th century Abbé Delaporte thus described Maria Angela Ardinghelli (1728-1825). But who was this brilliant young woman? And why did all foreigners in the Kingdom of Naples want to meet her?

In 1727 Stephen Hales published the seminal work *Vegetable Staticks* which initiated a new idea of the "air": no longer a mere physical instrument, but rather a chemical capable of binding. How did Italian scholars get access to this volume? Most of them probably read the first and only Italian translation by Ardinghelli, published in Naples in 1756. She had already dedicated herself successfully to translating Hales since 1750, when she was only 22 years old. Indeed, she had even published the Italian text of *Haemastatics* (1733), becoming somewhat famous amongst scholars, with the English physician even calling her "my sweetheart".

The name of Ardinghelli in the Republic of Letters is linked moreover to the 18^{th} century fashion for electricity. Just think, the *Abbé* Nollet chose her as the addressee of the first of his *Lettres sur l'electricité* (1753).

Maria Angela Ardinghelli's studies were tutored by the greatest personalities in Neapolitan culture of the period, such as Father Giovanni Maria Della Torre and Abbot Vito Caravelli. She even wrote poetry in Latin and Italian, which was much appreciated. She was in contact with numerous academies and in her drawing room lively conversations, of Newtonian inspiration, took place.

The purpose of this paper is to reveal Ardinghelli's peculiarities and evaluate the role of her translation work in creating the image of this Neapolitan scholar which has come down to us, through an analysis of her writings and of those (both coeval and later) who wrote on her, using Latin, Italian, French and English sources.

MME THIROUX D'ARCONVILLE AND THE USES OF TRANSLATION : ANONYMITY, AUTONOMY AND AUTHORSHIP IN WOMEN'S CONTRIBUTION TO CHEMISTRY IN THE XVIIIth CENTURY

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When talking about of women in chemistry in the XVIIIth century, the figure of Marie-Anne Paulze comes immediately to mind, sometimes described as a the able assistant or collaborator of her husband Antoine-Laurent Lavoisier. In Madame L. indeed (as her name was given on one of her translation), we seem to meet all of the specific roles available to women wanting to participate to the increase and dissemination of scientific knowledge at that time : hold a salon and a correspondence, as well as provide translation and other helpful but ancillary work (notetaking, drawing, engraving…) useful to a male mentor. Labelled as "domestic science" by Patricia Fara (1), this does not lead to authorship and personal contribution, not to mention autonomy. But Marie-Anne Lavoisier was far from being the only women devoting her time to scientific conversation, translation and assistance to a husband, lover, father or friend. Only in France, we can mention Claudine Poullet, ep. Picardet, lover and later wife to Louis Guyton de Morveau, Albertine Necker-de Saussure, daughter of the famous naturalist and geologist Horace-Benedict de Saussure and Geneviève-Charlotte Thiroux d'Arconville, close friend of the chemist Pierre-Joseph Macquer.

The latter is particularly interesting because she published alone, though anonymously, some original research on top of several lengthy annotated translations and authored on history, literature and moral. Introducing the *Essai pour servir à l'histoire de la putrefaction* published in 1766 (2), the author (anonymously referred to as the translator of P. Shaw's Lectures on Chemistry – which was hardly anonymous) tackles the issue of being second rank figure in scientific publication, insisting modestly on her input but arguing at the same time for the need of such minor contributions. This is more than rhetoric since in the last part of her book, she adds a supplement to incorporate the recent works of David Macbride on the same topic and elegantly subscribe to his conclusions as being more sound than her own.

Compared with the defence written by the enigmatic Mrs Fulhame (3) on the value of female contribution, Arconville's strategy seems to be more subtle and also more in line with her having a reputed mentor on the scientific scene. Furthermore her experience as a translator for chemical and medical literature from the English have most probably allowed her to situate herself better inside the flow of science publications of her time.

(1) P. Fara, *Pandora's breeches. Women, science and power in the enlightenment* (London : Pilmico, 2004), p. 107-186, esp. 167-186.

(2) *Essai pour servir a l'histoire de la putrefaction par le traducteur des Leçons de Chymie de M. Shaw* **(**Paris : P. Fr. Didot le Jeune, 1766). A similar argument though in filigrane already appears in the introduction of her translation of P. Shaw *Leçons de chymie : propres à perfectionner la physique, le commerce et les arts par M. Pierre Shaw ... Traduites de l'anglois* (Paris : J.T. Herissant, 1759).

(3) Mrs Fulhame, *An essay on combustion : with a view to a new art of dying and painting. Wherein the phlogistic and antiphlogistic hypotheses are proven erroneous* (London : Printed for the author, by J. Cooper, 1794; Philadelphia : James Humphreys, 1810).

MADAME LAVOISIER, UNE NEGOCIATRICE DE LA REPUBLIQUE DES LETTRES

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(English summary will be distributed)

Le dix-huitième siècle est souvent appelé "le siècle des femmes," avec de nombreuses femmes intelligentes, comprenant d'excellentes traductrices. Le lien des femmes à la traduction ne peut être discuté sans une réflexion sur la place des femmes à cette époque. Mme du Châtelet, seule traductrice des *Principia* de Newton, par exemple, insistait d'un coté sur son rôle du traductrice en tant que "négociant de la république des lettres," et de l'autre, d'être un génie créateur, rôle réfusé, de son point de vue, à cause de l'inégalité des deux sexes. Dans ces conditions, sa décision d'être traductrice, peut-elle être considérée comme de sa propre initiative? Pouvaient-elles, celles du "siècle des femmes", avoir un amour-propre pour leur travail? Ma communication analyse le cas de Mme Lavoisier (Marie-Anne-Pierette PAULZE-LAVOISIER : 1758–1836), une autre traductrice, dans ce même contexte.

Marie-Anne collaborait avec son mari (Antoine-Laurent LAVOISIER : 1753-1794) qui était à l'origine de la révolution chimique. Elle assistait aux expériences, prenait des notes, dessinait et gravait les instruments de laboratoire, et organisait des réunions afin de promouvoir la nouvelle chimie ; en apprenant l'anglais, un point faibre de son mari, elle traduisait un grand nombre d'ouvrages de chimie, dont les deux ouvrages de Richard Kirwan. Traduire permet, par exemple, de s'opposer à Kirwan, un chimiste irlandais, qui defendait le phlogistique, l'ancienne théorie chimique ; Mme Lavoisier y ajoutait une préface et des notes pour y montrer les fautes de l'auteur.

Grâce à ces activites, Mme Lavoisier était réputée comme une vraie "négociatrice de la république des lettres." Elle montrait sa fierté d'être traductrice à un collègue de son mari, mais elle avouait à un ami chimiste son manque d'amour propre en écrivant qu'elle n'avait eu d'autre mérite que de traduire, ne connaisant la chimie que par son entourage. Ces collègues possedaient une éducation solide, refusée aux femmes de l'époque. Elle devait avoir conscience de l'abîme, entre eux et elle-même du niveau scientifique. Il est vrai que les femmes traductrices, fortes en langues comme Mme Lavoisier et Mme du Châtelet, permirent la communication dans la république des lettres.

Ainsi nous ne devons pas oublier la question du genre derrière ces échanges culturels.

WOMEN TRANSLATING SCIENCE IN THE SPANISH ENLIGHTENMENT

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As P. Findler, M.Terral, M.Benjamin, and others have pointed out, eighteenth century female authors carefully chose the topics, editions, foot-notes, prefaces, dedications, strategies of publication, etc. of their works so that women could gain access to the gendered *Republic de les Letres.* This paper analyses these strategies in the contributions of three Spanish women, Josefa Amar y Borbón (1749-1833), María Catalina de Caso, and Josefa Alvarado, Marquise of Espeja. Among other things, they translated, respectively, Francisco Griselini's *Discurso sobre el problema de si corresponde á los parrocos y curas de las aldeas el instruir á los labradores en los buenos elementos de la economia campestre* (1783), an agricultural treatise encouraging clergymen to participate in the improvement of agriculture; Charles Rollin's pedagogical essay *Modo de Enseñar las bellas letras* (1755); and Condillac's innovative treatise on the philosophy of science and language, *La lengua de los cálculos* (1805).

These were hot topics in eighteenth-century Spain. Griselini's book was translated under the patronage of one of the *Sociedades Económicas de Amigos del País* (Economic Societies of Friends of the Country), reformist societies that proliferated all around Spain backed by the Crown. Given the high proportion of clergymen among the population and their special, powerful status, the question of how to engage them in practical tasks was one that highly concerned the reformist elits of the country. The translation of Rollin's treatise was one of the crucial elements in the pedagogical agenda of the Spanish Enlightenment. Along with Pluche's *Espectáculo de la Naturaleza,* (1755) and Verney's *Verdadero método de estudiar* (1760-1768), Rollin's treatise was one of the main venues for the new theories of the experimental philosophy to spread throughout the country. Caso, who dedicated her translation to the Queen Bàrbara de Braganza, defended new pedagogical methods and the need to properly educate girls. Condillac's big success in Spain has not been yet addressed although it is probably related to Condillac's role as tutor of the would-be Queen Maria Luisa de Parma, spouse of Carlos IV. His *Logic* was printed in Spanish five times before 1820, the last three being an adaptation in dialogue format. The Marquise of Espeja, the active member of the Economic Society of Ciudad Rodrigo who engaged herself in the translation of Condillac's postume *La lengua de los cálculos*, dedicated her work to Godoy, the powerful minister of Charles IV.

The paper will also address what seems a peculiar feature of the social role of the three authors under consideration, i.e. their direct political engagement in the implementation of reformist agendas. Amar explicitly argued in favor of such direct participation in political matters in her discourse *On defense of women talent and their aptitudes for government and others employments for men (Discurso en defensa del talento de las mujeres y de su aptitud para el gobierno y otros cargos en que se emplean los hombres,* 1786).

MME PICARDET AND THE TRANSLATION OF EUROPEAN CHEMISTRY AT THE END OF THE EIGHTEENTH CENTURY

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Though long lastingly underestimated by historiography, translation played an increasing role in the dissemination of science at the end of the eighteenth century, either in books or in learned journals. Mme Lavoisier's famous translation of Richard Kirwan's recent *Essay on Phlogiston* has unfairly rejected into the shadow other translators—men or women—who contributed to the Chemical Revolution. One of the most productive of them was Claudine Picardet (1735-1820), later Mme Guyton de Morveau. Through her case, we would like to question both the social and intellectual status of a woman performing scientific activities in France at the end of the Old regime, and the place held by translation in the strategy of a provincial academy to promote itself onto an international level.

A provincial learned lady in Dijon, and even a Salonnière, Mme Picardet had married a barrister and councillor at a high judicial court, later a member of the local academy and the director of its botanical garden. Her brother-in-law was an academician too. She was acquainted with Buffon and, above all, Guyton de Morveau, whose courses of chemistry she attended at the academy. Beside him, she participated in the translation strategy he developed. Thus, she met outstanding French chemists (Lavoisier, Fourcroy, Berthollet…) and foreign travellers (Fontana, Angulo, Tennant, Elhuyar, Landriani, Beddoes, Young…). Her scientific work included meteorological observations made for Lavoisier, that were published under her husband's name. But her most prominent activity was translation in chemistry and mineralogy—and, once only, astronomy. On the whole, she produced more than one thousand pages translated from some twenty chemists, mainly Swedish and German, but also British, Italian—and a unique Danish astronomer.

Mme Picardet's masterpieces are the first collection ever made of Carl Wilhelm Scheele's separated minor works, translated from Swedish and German (*Mémoires de Chymie*, Dijon, 1785, 2 parts, 528 p.)—a model for editions in other languages—and the first foreign translation of Abraham Gottlob Werner's *Von den äusserlichen Kennzeichen der Fossilien* (*Traité des caractères extérieurs des fossiles*, Dijon, 1790, 382 p.). Though she published anonymously, her name was soon publicised by Lalande and Haüy, who highly praised the linguistic capability and editorial quality of both these works. But her reputation mostly arose from the dozen translations she published in the various learned journals (*Journal de physique*, *Journal des savants*, *Nouvelles de la République des lettres et des arts*, *Annales de chimie*) as "Mme P*** de Dijon" until 1785, then usually under her name, after she has been duly recognised among the Republic of letters. In other words, we can observe how amateurs did participate in constructing science, while the public space of science was being spread through public courses and journals.

GOD IN TRANSLATION: MARY SOMERVILLE AND THE MORAL GUARDIANSHIP OF SCIENCE

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Translation is a process that begins with motive and ends with public response to the translation. Why is *this* text important to translate? What cultural niche does the translation end up occupying in its host society? And how does the translation affect the position of the translator? Mary Somerville (1780-1872), who translated and amplified Marquis de Laplace's *Mécanique céleste*, wrote under her own name and was celebrated for her work.

Somerville's translation, *The Mechanism of the Heavens* (1831), emerged out of personal Scottish connections and broader cultural collisions. Originally commissioned by liberal politician Henry Brougham for use in popular education, the translation proved too mathematically complex to be of use. Edinburgh-educated Brougham's liberal and French mathematical bent developed under his teacher John Playfair, the Edinburgh professor of natural philosophy, and Somerville's mathematical mentor.

By the late 1820s, the backwardness of English science concerned scientific reformers, who hailed Somerville's work for its gloriously complicated mathematics. Somerville's book could be used to prove that British science had both declined and not declined, depending on political preference. Yet in post-Napoleonic Britain, Laplace proved an awkward font of wisdom. While recognized as Newton's great successor, Laplace also removed Newton's God from his physics. The atheism and materialism perceived in Laplace might rattle a British public used to receiving its science clothed in natural theology.

Somerville's translation made Laplace's work safe for British readers and British science. The translation was as much cultural mediation via feminine moral guardianship – Somerville herself – and via the English scientific language of the day, which easily incorporated religious sensibility into science.

Symposium S50
Plants as Ideas and Instruments: A Symposium in Memory of Philip J. Pauly

IN THE NAME OF THE BOURGEOISIE. EARLY BELGIAN PLANT COLLECTORS IN AMERICA (1830-1865

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Belgian plant collectors are best known for their work in the Congo during the colonial period (*circa* 1880 to 19??). Yet before Belgians were involved in Africa, there had been considerable plant collecting activity. However, this remains poorly known particularly for the period between 1830 and 1865.

The fact is, Belgian plant collecting expeditions originated from the passion of the bourgeoisie for exotic plants. This is why some of the first naturalists relied on private money to make Atlantic crossings to Brazil and Mexico. Van Houtte, Linden, Funck, Ghiesbreght and Galeotti all depended, at least in part, on rich amateurs to pay for their hazardous journeys abroad. In the "*société bourgeoise*" of the early XIXth century, in a venerable and newborn Belgium, supporting young orchid collectors was not a priority for Government. All in all, it is obvious that the bourgeoisie sent young people to the America's only to fill their private greenhouses that were popping up all over Belgium. It was the bourgeois tastes that first shaped the collecting policy. Only later did the the Belgium State become involved.

The paper will address the following questions: What were the choicest plants for the bourgeoisie? What did the young naturalists collect and what future had they in mind? What were the rich and famous searching for? Did the collectors bring new trends or fashions to horticulture? Had the Belgian State a real influence on the collecting policy or not? Did the bourgeoisie keep on supporting collectors, and how?

'SEEDS OF WEALTH': THE CHANGING LIFE OF COTTON PLANTS IN NINETEENTH CENTURY WESTERN INDIA

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This paper proposes to explore both narratives about and experiments with the cotton plant in nineteenth century western India under the impact of British colonial rule. It views cotton as part of the wider story of the attempted imperial conquest of plants, in both the material and knowledge spheres. Plants were seen as embodying the 'seeds of wealth', and this perception constituted a powerful motive for the colonial expansion of Europe as from the sixteenth century.

India was home to a varied range of species of the cotton plant. Particular indigenous species such as 'Broach' and 'Surat' were the source of the high quality calico and finely woven muslin cloths that enabled India to dominate the global trade in cotton textiles from the seventeenth to the late eighteenth centuries. It was the popularity and increasing consumption of these Indian cloths in Europe that led to attempts to imitate them through new machine manufacturing processes, thus triggering the Industrial Revolution in Britain. As a result, the centre of gravity in global textile production and export moved from the Indian subcontinent to north western Europe, particularly northern Britain. For the first time, mass cotton manufacturing was undertaken in regions where the plant was not grown. In Britain, this meant the emergence of botanical, commercial, and political networks designed to ensure the colonial availability of particular kinds of raw cotton for manufacturing purposes.

When the American Civil War interrupted raw cotton supplies from the southern states of the USA to Britain, these interests pressurised the imperial government into facilitating a projected transformation of the cotton growing provinces of western India into a cheaper and more reliable source of supply. The district of Dharwar in western India became one of the main centres of colonial experiments in cotton cultivation. This involved the physical transformation of rural space through the introduction and extensive cultivation of a foreign species of cotton plant, 'New Orleans'. Through the efforts of botanists based at Kew Gardens, this was brought in and initially acclimatised by American planters and came to be known as 'Dharwar American'. The new cotton variety now co-existed and competed with indigenous 'country' cotton known as 'Kumta' which peasant cultivators had been growing since ancient times. Colonial botanists regarded the fibre of Kumta as too weak to undergo the process of mechanical saw ginning. Much of the efforts of the colonial authorities, and in particular the new Cotton Commissioners, therefore went into persuading peasants of the superior benefits of growing Dharwar American at the expense of Kumta.

The paper will explore how the activities of botanical and commercial networks made cotton supply an issue of national political economy, and hence of primary imperial importance; how they engineered a new approach to cotton plant cultivation based on discourses of 'indigenous inferiority', 'improvement' and 'scientific botany'. The paper will also examine the colonial experiments in New Orleans cotton cultivation; a particular focus will be on Indian peasant cultivators and their responses to these experiments.

PURE LINES, MODULAR GENOTYPE AND ENTRENCHED GENETIC IDENTITY: A CULTURAL HISTORY OF THE RISE OF MODERN GENETICS (1860-1915)

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Traditional history of genetics has tended to focus on conceptual and experimental experimental breakthroughs, with the implicit assumption that science is a form of specialized knowledge that is best covered in the laboratory. But, beyond being a form of exemplary practice, science and its historical transformations can also be fruitfully analysed as a form of cultural activity. From this wider cultural history perspective, if there was a revolution in the study and mastering of heredity at the turn of the twentieth century, it cannot be reduced to the diffusion of Mendelism, nor to any exemplary ideas or practices internal to experimental biology. This revolution is better understood within a larger cultural shift in the ways in which information was processed, in which identity, efficiency and connectedness of living beings through time and space were framed. These new pratices and understanding of heredity arose in the cultural matrix of the rationalisation practices of late 19th century (second industrial revolution, control revolution, rise of systematic management) which developped and circulated in a variety of contexts such as manufactures, large organisations, agricultural experiment stations, food markets, hospitals, biological laboratories, etc.

The paper will demonstrate how presuppositions for increasing industrial productivity were projected into new conceptions of the order of nature through the industrialization of experimental practices. We will document, from Vilmorin to Johannsen via Pasteur and Carlsberg Breweries, the genesis of the "pure line concept" within late 19th century industrial culture, which demanded to design new "pure" and stable life forms for industrial processes and large markets. Finally, we will argue that early 20th century's "gene" concept constitutes a devitalization and a disciplining of older views of the "units of heredity" (such as Darwin's pangenes) and that this new gene concept co-emerged with the new epistemic space that arose with the "control revolution" for mapping the circulation of things through industrial scales, large organisations and expanding markets.

A TASTE FOR THE SPOILS OF EMPIRE: DAVID FAIRCHILD AND AMERICAN PLANT COSMOPOLITANISM

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The current practices of globalized agriculture, gardening, and landscaping have reinforced centuries of more or less self-conscious interpositions of foreign life and landscapes into the native life and landscapes of every continent. More recently, scholars across many disciplines have begun to examine the uses and meanings of such terms as "native" and "foreign" within the cultural realities of imperialism, economic exploitation and global competition. With regard to the U.S. specifically, scholars including Philip Pauly, to whose memory our symposium is dedicated, have analyzed the domestic debates pitting American plant "nativists" versus "cosmopolitans." I want to continue this discussion by examining more deeply the meaning of American agricultural and horticultural cosmopolitanism through a consideration of the priorities and policies of David Fairchild, whose leadership of the U.S. Department of Agriculture's Division of Plant Introduction in the first half of the twentieth century made him a crucial participant in the agriculture and culture wars of the early twentieth century. For Fairchild, the introduction of new crops for American fields and new tastes for American tables went beyond economics—it became a kind of Jamesian cultural commentary on his native country as he analyzed and deplored the resistance to novelty on the part of American farmers and cooks. Using Fairchild's autobiographical books as well as his scientific publications, I will argue that cosmopolitanism was other than simply an openness to novelty and an embrace of the "foreign." Rather, for Fairchild and others, it was an imperial gesture that aimed to transform America's cultural identity through the possession, cultivation, and Americanization of the foreign and appealed simultaneously to European imperial sophistication, Orientalist exoticism, and American economic patriotism during a time in which the United States' role on the world stage was transformed and enlarged.

WHAT HAS BEEN LEARNED FROM PAST GREEN REVOLUTIONS?

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For plant-breeders working in a development context, the plant-variety is an instrument designed to improve third world farmers' well-being through increased crop-yields or quality. During the 20th century a wide range of development programmes based on plant-breeding have been undertaken with variable results. In recent years there have been renewed calls for a 'second green revolution', focused especially upon Africa, but if such programmes are to be successful, planners obviously need to understand the reasons for past programmes' successes and failures. In this paper I will identify some of the key features of previous green revolutions (GR), in developing countries since the 1940s as well as in Europe earlier, in order to assess the extent to which the lessons of past experience have been learned.

Following the extensive media coverage given to the various GR programmes in the third world during the 1950s and '60s, agricultural economists and other experts began during the 1970s to look closely at the programmes' impact, and many were critical. Although the high-yielding cereals varieties developed by GR breeders had often doubled yields on large commercial farms, allowing several countries to become self-sufficient in key crops, small peasant-farmers had gained relatively little, and in some places rural poverty had actually increased. The reason, critics argued, was that the new varieties' characteristics were well-suited to the conditions - both economic and ecological - on large farms but were quite inappropriate for the needs of peasant-farmers. During the 1970s and '80s, apparently in response to this criticism, a number of new approaches were developed, at international agricultural research centres and elsewhere, which paid more attention to the circumstances of peasant agriculture. Some brought small farmers into the breeding process itself ('participatory plant-breeding') while others tried to develop improved cultivation techniques better adapted to the conditions of peasant-farming (agro-ecology). By the late 1990s some observers were optimistic, therefore, that subsequent GR programmes would be much more helpful to small farmers.

In the spring of 2008, however, an international commission of agricultural experts (IAASTD) published a lengthy report arguing that development research was still seriously neglecting the needs of small farmers and that the currently dominant approaches were destined to fail once again. The report is controversial, but it finds support from recent discussion of the potential of the new agricultural biotechnology. Despite claims that the next GR can only succeed if its varieties are genetically engineered, the evidence suggests that this line of research is very unlikely to assist peasant-farmers.

THE CO-EVOLUTION OF POTATOES AND PIGS AND POLITICAL ECONOMY OF NAZISM

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Food issues have become a major subject for anyone interested in the political economy of the Nazi regime. No scholar speaks of Lebensraum and German imperialist ambitions without referring the crucial problem of how to feed the population of the Reich. Thus, it has come as no surprise that plant breeding occupies now central stage in discussions of the relationship between Nazism and Science, with close scrutiny of the work done at the institutes of the Kaiser-Wilhelm-Gesellschaft. Nevertheless, potatoes and pigs are a strange absence in most of the literature interested in connecting research undertaken at breeding institutions and Nazi policies. Such absence is even more striking taking into consideration that not only Germany was the first world producer of potatoes but also hogs were a major source of both proteins and fat for Germans.

This paper looks in parallel at the research produced in the Biologische Reichsanstalt to develop blight resistant potatoes and the work undertaken on hogs at the Institute for Animal Breeding at the University of Berlin. These two institutions are usually missing in discussions of plant and animal genetics too much focused on the Kaiser-Wilhelm Institutes. But more than filling-in gaps in the historiography the paper aims at demonstrating how the breeding work at both laboratories was intertwined with the growing of the Nazi regime, namely of the Reichsnährstand, the mammoth Nazi institution responsible for organizing the peasant world. Potatoes and hogs, for their economic and social relevance, are two great objects to follow such relation, going beyond simple tales of Nazis supporting or hindering scientific research for ideological reasons. Interestingly enough, about half of the potato production by the end of the 1930s was fed to hogs, making it difficult to talk about one while ignoring the other. The paper will explore how breeding blight resistant potatoes had deep consequences for pig breeding changing the geography and breeds of hog production. By highlighting the co-evolution of pigs and potatoes I hope to place plant and animal breeding at the heart of the political economy of Nazism.

INSTRUMENTAL THINKING ABOUT THE GENOTYPE AND PHENOTYPE OF IRRI'S HIGH YIELDING RICE VARIETIES

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The international effort to increase foodcrop production through plant breeding, known as the Green Revolution, was driven by a small number of specialized research institutes. This paper focuses on the work of one of these institutes, the International Rice Research Institute (IRRI), located near Los Baños, the Philippines. Where the scientific approach of the Green Revolution has often been characterized as a 'genetic fix' the argument laid out here is that the technical orientation of researchers at IRRI comprised a mechanical view on plants that was not only related to genetic mechanisms. Known as 'ideotype', plant breeders, agronomists and others worked on an integrated and optimized plant design. Moreover, the ideotype was based on a broader mechanistic understanding of ecology. The background of this particular understanding of ecology is sketched as well as the application to the rice ideotype, as developed at IRRI. The concept of the ideotype and its background helps to explain the research trajectories and technological orientation of IRRI concerning the type of plants it produced as well as strong focus on a particular agro-ecological environment, intensified wet-land irrigated rice systems.

BOTANICAL EDUCATION: CONTESTED TERRITORIES IN PUBLIC EDUCATION 1900-2000

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Botany was a contested territory in British and American educational spheres for much of the 19th and 20th centuries. In the latter part of the 20th century it became absorbed into a generic biological education, in which it has struggled to remain visible. Botanical education in the early 19th century was strongly evident, although rife with specific notions of femininity and class, through a proliferation of popularisations. As the century unfolded, and moved into the 20th century, the identity of botany, as a distinct curriculum subject, became a frequently contested territory. By the late 20th century botany had become an indistinct feature of a generic biological education. Drawing on Philip Pauly's work on the development of high school biology in New York City between 1900 and 1925 I will examine the role of plant specimens, (both living and dead), throughout this period and highlight key pedagogical debates surrounding their use, and what pertinence these debates might have for contemporary science education.

Symposium S51
For Better or for Worse? Collaborative Couples in the Sciences

CHANGING STRATEGIES FOR COLLABORATIVE COUPLES IN THE SCIENCES

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In our l996 book, I examined the ways in which couples who worked in Ecology and Botany in the latter part of the 19th and the first part of the 20th century managed their collaboration. To what extent did they do their research together? How did they try to separate out their own roles or specialties within the field? Which partner or partners did the publishing, and which got the credit and became the better known? There is no Nobel Prize in these fields; other aspects of recognition had to be examined. Three couples, the Brandegees, the Brittons, and the Clements used different strategies. Kate Brandegee and Elizabeth Britton were successful partners in their collaborations; their differing strategies will be reexamined. Edith Clements, Ph.D., was not successful in terms of recognition for her constant "helpmate" role in their joint research; Frederic Clements became the best-known American ecologist of the first three decades of the 20th century. None of these couples had children; child-raising aspects of scientific collaboration were not involved in their strategies.

With that introduction, I examine later couples who collaborated on their research in a variety of scientific fields including Evelyn Hutchinson and his wife Grace Pickford, aquatic ecologists in the 1920s, and Cecelia Payne-Kopochkin and Kopotchkin, astronomers at Harvard in the 1930 and later. In the 1940s and even until the 1980s, there were many scientific couples who continued in the Clements' pattern; the couple collaborated in their research, the wife often working in her husband's laboratory or with him the field. The husband, however, had the tenured academic position and the wife at best was a research associate, although she sometimes had her own funding. I have taken specific examples of this pattern from marine developmental biology, avian behavioral ecology, and plant ecology from the 1940s into the 20th century, but it was true in many other fields. In each case, the books, awards and most of the credit went to the husbands. Until recently this kind of collaboration was accepted by both the couples themselves and by American society; most of these couples raised children. In the 1970s and 1980s came joint appointments; both the husband and wife shared an academic position, though tenure was usually a separate process. More recently some universities have sought to hire both halves of scientific couples on full salaries.

There have been major changes in society affecting the strategies of collaborative couples in all fields. In the United States these include, especially since the 1970s, affirmative action and its role in the hiring of women scientists at universities. Societal attitudes toward women scientists have changed greatly since my own experiences in the 1950s and 1960s. Also important was the belated, compared to European countries, widespread availability of day care. One other aspect, not entirely successful has been the effort of NSF and other organizations to provide programs to encourage young women to enter and stay in science. Nevertheless, contemporary scientific couples I have interviewed in a number of fields are employing new strategies to have successful joint careers in science both in academia and other institutions. Barriers still exist, especially at the top, to be discussed.

THE ALLOCATION OF SCIENTIFIC CREDIT TO COLLABORATIVE COUPLES: THE LEDERBERGS AND THE 1958 NOBEL PRIZE IN PHYSIOLOGY

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This paper explores whether the half share of the 1958 Nobel Prize in Physiology given to Joshua Lederberg, (1925-2008) while two other co-laureates received a quarter each, was meant to signify recognition for the work of two, his own and that of his collaborative spouse Esther. (1922-2006) Discoveries that feature the Lederbergs as co-authors include "replica plating", the phage "lambda", "transduction", and "sex compatibility", all landmarks in microbial genetics in the early 1950s. While the Lederbergs were sole authors of the former two discoveries, with each being first author once; they co-authored the latter two with others, most notably Norton Zinder of Rockefeller University and Luigi L. Cavalli-Sforza of University of Pavia, and later of Stanford, respectively.

In order to understand how the scientific community handled the allocation of credit to collaborative work in general, and collaborative couples in particular, we first examine the deliberations of the 1958 Nobel committee. Second, we compare the 1958 process of indirectly acknowledging the female spouse, to other challenging cases of both including and excluding female collaborators from the Nobel Prize at that time. (E.g. the exclusion of physicists Lise Meitner and Chieng-Shiung Wu, and the inclusion of biochemist Gerty R. Cori) Along these lines, we also examine the public perception of the Lederbergs as a leading collaborative couple, within the scientific community in the 1950s, while studying both collaborators and competitors for clues to the 1958 outcome. In order to explain the erosion of the public standing of the female spouse as an equal collaborator in science in the 1950s, we focus on the impact of:

1) <u>The ideology of domesticity</u> following WW2 viewed women as consumed by their families and households. In a culture of such pervasive gender inequality, most scientists tended to underestimate the actual contributions of female collaborators, and especially those of collaborative female spouses.
2) <u>The ideologies of racism and anti-semitism</u> in the 1950s precluded recognition to an all-minority team, such as giving a Nobel Award to the two Lederbergs for their many pioneering contributions to microbial genetics; or to them jointly with Norton Zinder, for the discovery of "transduction", which was to become uniquely important.
3) <u>Strategic mistakes made by both partners in this collaborative couple</u>: while the male partner engaged in the practice of publishing widely circulating summaries and reviews as a sole author; the female partner tended to prioritize the management of their lab as if it were a household (this couple had no children) over guarding her primacy over her own discoveries, (most notably the singularly important phage "lambda", or campaigning on behalf of her major place in the couple's joint results.

IDA AND WALTER NODDACK: A COLLABORATING COUPLE IN CHEMISTRY

Brigitte Van Tiggelen* and Annette Lykknes**

**Université catholique de Louvain, Belgium,*
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Ida Tacke studied chemical engineering at the Technische Hochschule in Berlin during 1915-1921 and was soon employed as a chemist at AEG. She later volunteered at Siemens-Halske and at the Physikalisch-Technische Reichsanstalt (PTR) in Berlin. In 1926 she married Walter Noddack, who was head of the chemistry department at PTR. As a married woman in interwar Germany Ida Noddack-Tacke was not entitled to a career of her own. However, she was able to continue doing unpaid work, following her husband wherever he was appointed; to Freiburg, Strasbourg and eventually, Bamberg.

Walter Noddack obtained his doctorate in photochemistry at the University of Berlin under Walther Nernst in 1920 and worked for two years as an assistant at the Institute for Physical Chemistry in Berlin before he took up his position at the PTR. From the early 1920s Ida and Walter Noddack looked for missing elements 43 and 75 in ores as their first joint project. Eventually the couple was acknowledged for the discovery of element 75, which they named rhenium after the river Rhine. This achievement led to three joint Nobel nominations, besides another two for Walter. Their claim for element 43 was however never taken seriously in the scientific community.

Throughout their careers the couple collaborated on several projects, including investigations on chemical properties of elements, and geochemical issues. Their joint work comprised about half of Ida's publications, and one third of Walter's. In this paper we will have a closer look at the nature of their collaboration analyzed through the use of publication records, laboratory notebooks and other archive material. Central to our discussion are questions such as: Were Ida and Walter Noddack equal collaborators? How did they divide the work between them? Is it possible to identify separate research interests and specialities? How did Ida's (and Walter's) work progress as the couple moved from one place (and position) to another?

INVISIBILITY AND PARTNERSHIP: FAMILIES IN EARLY TWENTIETH CENTURY SWEDISH SCIENCE

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After their marriage in 1908, Ebba Hult worked as an assistant to the Swedish geology professor Gerard De Geer for thirty years. He was an esteemed geologist in Sweden and abroad while she only received some official recognition for her work towards the end of their collaboration. The partnership between Hult and De Geer will serve as the first empirical examples in this paper. The second example is the marriage between Swedish physics professor Bernhard Hasselberg and his wife Julia. Hasselberg was a professor in experimental physics at the Royal Academy of Science in Stockholm in the early twentieth century. In his unpublished autobiography he describes the importance of his wife, and this paper will explore the nature of their partnership.

More generally, the paper will discuss how family relations were integrated in influential networks of science, and the boundaries between family, friendship and scientific collaborations were blurred. The partnerships discussed here generated authority and official recognition for the male professors. Consequently, this paper will explore how scientific partnerships in science entailed power relations and "invisible" scientific work. The family is an important instance in understanding how power was distributed in early twentieth century science and the family is a pertinent place to study historical norms and structures producing invisibility in science.

Despite many empirical examples, the small scale collaboration within the scientific family has not been conceptualised within dominant analytical frameworks in the history of science. The issue of partnership and invisibility within the family will thus also be discussed in relation to some influential interactionist models in science studies dealing with scientific collaborations (e.g. "trading zone" and "network").

SCIENTIFIC COUPLES IN HUNGARY

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Scientific couples always enjoyed general favour in Hungary.This could be observed as soon as in the 19th century with the first Hungarian lady with a university diploma., Vilma Hugonnay (1847-1922), who acquired her degree in medicine in Switzerland, and returned to Hungary in 1890. From among her scientific works "Olfaction as guardian of health" (1896) and "Lectures on hygiene for women" became the most popular. Her second husband, Professor Dr. Vince Wartha (1844-1914) was the founder of the Department of Chemical Technology at Budapest Technical University. Professor Wartha supported his wife's ambitions in medical practice and research and, owing to his high reputation, helped to make „scientific researcher" as female role socially accepted.

The Hungarian Academy of Sciences has had, since its existence, a total of 27 women members. The husbands of five of them were scientists engaged in similar branches. The paper is giving a detailed analysis of their co-operation and common research strategies. The five couples are enlisted in the Table.

No.	Name, surname, (place and date of birth)	Speciality studied/ practised	Doctor of the Academy, Ph.D. (year/age)	Family relation, scientist or other researches
1	Klára Ambrus-Bayer (Rome, 1924)	Medicine, fibrinolysis, thrombosis, etc.	1954/30	Gyula Ambrus, M.D., member of the Hungarian Academy of Sciences.
2	Veronika Ádám, (Nagykanizsa, 1949)	Medicine, biochemistry	1989/40	Szilveszter E. Vizi, M.D., past president of the Hungarian Academy of Sciences
3	Mária Kliburszky-Vogl, (Rákoscsaba, 1912- +Budapest, 1996)	Chemist, geochemist	1957/45	Husband: Béla Kliburszky; the couple developed together an instrument for differential thermal analysis
4	Gertrud Anna Szabolcsi (Nagyvárad – Oradea, Roumania, 1923- +Budapest, 1993)	Biochemist	1964/41	Second husband: Bruno F. Straub, biochemist, member of the Hungarian Academy of Sciences, last president of the Presidential Council
5	Magdolna Hargittai (Pécs, 1945)	Physical chemistry, inorganic chemistry	1991/46	Husband: István Hargittai, chemist, historian of chemistry, member of the Hungarian Academy of Sciences

Beyond the analysis of the co-operation of the couples, the paper will mainly deal with the common work of chemist and biologist couples.

MARRIED FOR SCIENCE: SUCCESS AND FAILURE IN THE COLLABORATION BETWEEN ASTRID CLEVE AND HANS VON EULER-CHELPIN, 1902–1912

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In May 1898, Astrid Cleve (1875–1968) successfully defended her PhD thesis in botany and became Sweden's first female PhD in science. She was determined to make a career in science and started working as a chemistry assistant at Stockholm College the same year. Though she enjoyed her position, the job did not pay sufficiently to guarantee financial security and in 1902 she solved that problem by marrying Hans von Euler-Chelpin (1873–1964). He was a Privatdozent in physical chemistry and by marrying him, Cleve also secured a place in science as her researching husband's unpaid assistant.

Hans von Euler-Chelpin was born German, moved to Sweden to do research on an invitation from physicist Svante Arrhenius in 1897 and, like Cleve, was employed at Stockholm College in 1898. Barely two weeks after marrying Cleve, he applied for Swedish citizenship. The application was granted and as a Swedish citizen he was free to hold higher academic positions in the country. He embarked on a very successful career: by 1906 he was professor of general and organic chemistry at Stockholm College and in 1929 he became not only director of a new biochemistry institute in Stockholm but also a Nobel Prize laureate in chemistry.

von Euler and Cleve co-published several works during the first years of their marriage, but their last joint article was printed in 1907. Parallel to their scientific work, the couple fulfilled the role of a traditional family and had five children before they divorced in 1912. While the divorce seemingly did not affect von Euler's career, it left Cleve in a new financially precarious situation as a sole custodian of their children and with no possibility to return to her previous position at Stockholm College.

The short marriage between Astrid Cleve and Hans von Euler-Chelpin raises several interesting questions which this paper aims to investigate: Which expectations did Cleve and von Euler have on their marriage? How did they collaborate in science; what did they do, who did what and how did they choose research topics? What function did the couple as a unit play in their respective careers? Which relationships and power structures were created, upheld or restructured by them as a scientific couple? Why did the collaboration end? How did their joint research affect their scientific careers after the divorce? What was the relationship between their scientific collaboration and the family they built; how was the public affected by the private and vice versa?

SCIENCE AT TERLING: PLACING COLLABORATION IN THE CONTEXT OF THE VICTORIAN COUNTRY HOUSE

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In this paper I reconsider one of the most notable examples of British "country-house science" from the late-nineteenth century, the collaborative work of Lord and Lady Rayleigh at Terling Place, Essex. A celebrated physicist, John William Strutt, Third Baron Rayleigh (1842-1919), contributed to a wide range of experimental and theoretical studies in acoustics, optics, and heat based on research conducted privately at his country-house. Based on the accounts of biographers and popular writers, Rayleigh's private science has emerged as a representative image of the halcyon days of "little science" characterized by individual initiative and genius, an image supplanted by modern laboratory science characterized by institutional configurations and collaborative research teams. But a closer analysis of the details of the work routines, domestic context, and patterns of assistance in science at Terling suggests a form of research that was complex, collaborative, and critically dependent upon a familial infrastructure of support. I will suggest how this alternative interpretation of Terling science offers more general lessons concerning the nature of collaboration with the Victorian country house and how, in turn, such lessons may impact broader interpretations of the professionalization of science and the role of women's contributions.

PIONEERING COUPLES IN CHEMISTRY AND IN ITS POPULARIZATION. WITH AN EMPHASIS ON MARIE ANNE PIERRETTE PAULZE AND ANTOINE LAURENT LAVOISIER (MARRIED FROM 1771-1794) AND JANE HALDIMAND AND DR ALEXANDER MARCET (MARRIED FROM 1799-1822)

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In 1794, Lavoisier, a wealthy public servant of the former French royal administration and the founding father of modern chemistry was beheaded. His widow, Marie-Anne, who had been an active co-worker of her late husband, obtained his rehabilitation and spent much time to get his unpublished observations into print. Theirs is the best example of a fruitful and intense collaboration on scientific matters, and of a happy marriage, although without children.

The French Revolution and the feuds with lead to the 1794 Terror also affected the free town of Geneva (ca. 20'000 inhabitants). In 1794, members from the upper class families were imprisoned and judged by a popular tribunal. Alexandre Marcet (1770-1822) was among a group of people who were sentenced to five years of exile. As a result, several wealthy young men moved to Edinburgh in order to study medicine. Alexander got his MD degree in 1797 and then moved to London for further training. There he met Jane Haldimand, born and raised in Geneva, in a wealthy family of bankers and businessmen who moved to London in the wake of Napoleon's wars on the Continent. Jane and Alexander were married, had three children and are an example of a stable couple in life as well as in their endeavours in and for chemistry.

He applied chemistry to medicine and was one of the early investigators who tried to correlate chemical tests with symptoms of a particular disease to reach a more reliable diagnosis. He was an authority on urinary calculi, wherein he discovered the existence of known and previously unknown chemical compounds. He wrote a popular book on the *Chemical History and Medical Treatment of Calculous Disorders*. From 1804 to 1819, he held the appointment as a physician at Guy's Hospital. He gave chemical lectures to the medical students and illustrated them by demonstration experiments. He was a fellow of the Royal Society.

Jane Haldimand Marcet is better known that her husband She and her brothers and sisters were educated at home by the best available tutors. She studied chemistry, biology, history and Latin, in addition to the more usual lessons for girls in art, music and dancing. Through her marriage with Alexander, she was brought into contact with many distinguished personalities of the period in science, literature and philosophy. Her *Conversations in Chemistry*, first published anonymously, became the most popular book on chemistry in the first half of the 19th century: 16 editions between 1806 and 1853 in Great Britain alone, translations into French, German, Spanish, Dutch. Altogether, she published nearly 10 books using the same conversational pattern, to present: political economy (1816), vegetable physiology (1828), etc.

If time permits, I shall briefly mention another couple, that formed by Voltaire and Marquess Du Châtelet, who were lovers between 1733 and 1749. He encouraged her to study mathematics under Maupertuis, she assisted Voltaire in a study on Newton, translated Newton's *Principia mathematica* into French. That her interests included chemistry is attested by her participation in a contest sponsored by the French Academy of Sciences in 1737 on the nature of combustion. Emilie was actually born in 1706 as Emilie Le Tonnelier de Breteuil, she married the Marquis de Châtelet when 19 years old. The Châtelier had three children, she died after the birth of a 4th

Symposium S52
Formation of Experimentation in Plant Sciences from 18th to 19th Centuries

STUDIES ON THE BALSAMS IN THE 18th CENTURY: A MODERN EXPERIMENTAL APPROACH

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Balsams present problems in identification and nomenclature from the earliest of times to the present day. Highly valued since Antiquity for their fragrance and healing virtues, their scarcity added to legend, giving rise to the myth of an "original balsam" of unsurpassable quality. These reasons triggered both the search for fitting substitutes as well as continuous attempts of adulteration. Regarding botanical difficulties, the case of Balsam of Copaiba (genus *Copaifera* L.) represents an illustrative example: in spite of more than 200 papers published in the literature, many data regarding the chemical composition and pharmacological activity of copaiba oils remain contradictory. Misunderstandings range from botanical identification to chemical composition, as these oils are frequently mixed to others and are involved in adulterations.

Our initial studies focused on the earliest reports on American balsams by European travellers, their botanical description and medical applications as well as their initial inclusion in Portuguese sources, from the 16th century onwards. The present stage of research concerns studies on the balsams performed by 18th century scholars who aimed at several goals: 1) to explain the nature of aromatic substances ("volatile oils"), the smell of which presented a true enigma at that time; 2) to achieve proper identification, in order to avoid adulteration, which as mentioned above, is a recurrent concern in the history of balsams.

The 18th century context is particularly significant as it has been argued that the modern experimental approach to the pharmacological properties of substances, particularly plants, did not begin in the 19th century, as traditionally held, but in the previous century, belonging with the very same context in which modern science arose, as the well-known examples of research on Opium and Peruvian Bark illustrate. On the other hand, whereas the emergence of Iatrochemistry from the 16th century onwards had pushed vegetal research to the background, the 1700s show a remarkable increase in studies seeking to identify the active principles in plants (called 'virtues' at the time).

Our study will address more specifically balsams as represented by the main authors on *Materia Medica* in the 18th century, including Hermann Boerhaave, Friedrich Hoffmann, William Cullen and Charles Alston, as these transitional characters made systematic appeal to experimental procedures in their botanical studies in their attempts to elucidate the composition and properties of matter. More particularly, the theories on the volatile oils by Boerhaave and Hoffmann exerted significant influence on the studies on the subject all throughout the century.

PLANTS, PRIVATE ESTATES, AND PUBLIC ASSISTANCE: FORMATION OF PLANT BREEDING EXPERIMENTATION IN RUSSIA, 18th – 19th CENTURIES

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Russia had a long tradition of plant experimentation which dated back to the acclimatization of exotic cultures at the medieval monasteries. The historical and socio-cultural aspects of plant breeding experimentation in the 18th –19th century Russia will be discussed in the proposed paper. The paper also argues that the formation of Russian plant breeding had predominantly non-governmental sources of support, namely individual and public ones. The focus of the study is on the private estate experimentation and on *the zemstvo's* plant breeding institutions.

Like many other important novelties, from fox hunting to the theatre, the first examples of plant breeding experiments in Russia owed much to the boredom, curiosity and ambitions of Russian grandees. Wealthy *Boyars* liked to hire Dutch, French, or English gardeners and botanists to lay out parks and gardens with fancy foreign plants, and to experiment with plants. The Tsarist family – starting from Peter I the Great and his farther Alexei – took part in establishing this fashion in late 17th – early 18th centuries. They cultivated *exemplary estates* as models of advanced agriculture, established *private Tsarist gardens*, wrote guides on flower-growing, and patronized *medical* (later *botanical*) *gardens* where breeding experiments also took place. Tsarist gardeners produced a number of new plant varieties, such as *cherry Tsarist*, *pear Tsarist*, *wheat Bushed*, etc.

Second half of the 18th century – the period associated with Catherine II the Great, was a time of prosperity for private plant experimentation in the empire. Russian nobility (gentry), who would normally spend all their lives "at the Tsar's service" were now permitted to retire from the military and were granted their own estates. Thus *the estate gentry* were formed as a separate class and estates quickly acquired a representative significance. Experiments with plants became part of a *noble culture* for the estate gentry. Some noblemen took a more sophisticated interest in the *"science of plants"*: they turned their efforts from gardens towards crop fields. Usually, they would invite specialists (not only foreign but also local ones) to visit their estates and carry out experiments. A few amateurs were involved in *"science of plants"* personally: they made observations, experimented with crops, wrote articles on farming, and bred new varieties. For example, A. Bolotov, a noble landowner from Tula province, was a prominent amateur who collected rare flowers, bred new varieties of tulips, carnations, roses, apples, pears, etc., experimented with crops, and even published private journals on agriculture.

In the first half of the 19th century numerous varieties of fruits, vegetables, and other agricultural plants were bred in the newly organized Emperor's botanical gardens in colonized territories of Crimea and Caucasus (plant breeders Ch. Steven, N. Gartvis, G. Bitter, and others).

Reformatory activities in agriculture received a strong boost from the abolition of serfdom in 1860s. The broad social reconstruction of the country encouraged changes in the public perception of agriculture, from a routine and traditional form of peasants' life – to a field where the latest achievements of science could and should be applied. A number of young specialists had an opportunity to visit best plant breeding institutes in Germany, England, Sweden, and Denmark due to the support of agricultural societies and *the zemstvo* – a local body of self-government and community administration, independent from the state's bureaucracy. A number of the plant breeding stations were also set up under *zemstvo*'s patronage. Yet inevitably, building up the new discipline resulted in the development of some specifically Russian forms, as reflected in the newly invented name, *selektsya* (from Latin *selectio*), which was understood as different from the traditional plant breeding, or *sortovodstvo*. The new term established an ideological and institutional distance between the new generation of scientifically trained and motivated plant breeders and their more traditional counterparts – *sortovody*. The emphasis on new science became much more pronounced in Russia, with important consequences for the ethos, identity and research choices of the discipline members. In fact, *selektsia* in Russia to the end of the 19th century was a mostly publicly supported discipline; among leading plant breeders one finds many names of the *zemstvo's* scientists (A. Sapegin, A. Stebut, P. Budrin, and others).

FROM EXPERIMENTATION ON PLANTS TO AN EXPERIMENTAL ANALYSIS OF PLANTS IN EARLY ELECTROPHYSIOLOGY

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At the beginning of experimentation on electrical phenomena in the 18th century all kind of natural products were objects of scientific research. The naturalists presupposed the general conjecture: all natural objects comprise "the electric fluid", which shows its effects not before being moved. Their experiments with plants, understood as "electrification", were tests confirming the positive effect of the moving "electric fluid" on plant's growth. The 18th century utilitarian botany used electricity as a fertilizer in agriculture, what may be interpreted as a test on a large scale of the philosophical interpretation of the role of electricity in nature. After the discovery of the phenomena of electrochemistry by J. W. Ritter around 1800, the naturalists supplied or replaced the earlier interpretation. They described now a plant organism by including the recent observations on cellular structures of tissues as a great composition of "galvanic elements". Their experiments on "galvanic" effects of plants and their parts remained tests of the general theory.

The early speculations and experimental methods were criticized by the physicist A. C. Becquerel between 1830 and 1850. He tried to clarify the different components of the experimental arrangement by performing experiments with inorganic patterns of plant parts before using the natural products and their parts themselves. In addition, he took into consideration the recently discovered phenomena of diffusion and osmosis in plants, and he could use new instruments for measuring low-voltage currents. He opened the eyes of scientists for watching into a plant organism itself by discovering the currents produced by a plant organism itself. After some contemporary critics and skeptical voices against the new insights, botanists developed really physiological questions and specified the experimental arrangements, in order to find out the causes and conditions of producing currents by a plant and discussed their physiological significance.

The talk will emphasize the changes of experimentation, belonging to research questions and results as well. It will discuss the changes of philosophical interpretations of the role of electricity in nature and of the impact of instruments and experimental methods on physiological theories based on empirical knowledge.

18th CENTURY UTILITARIAN BOTANY AND THE MANUFACTURING OF POTASH IN COLONIAL BRAZIL

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Potassium carbonate (also known as potash) was the most important industrial chemical of the 18th century as it was essential for producing glass, soap, saltpeter, dyes, and an assortment of medicinal drugs. Potash was also used for bleaching linens, paper, and sugar. Before Nicholas Leblanc introduced his process for its industrial production, potash was obtained by boiling wood ashes to leach potassium carbonate, followed by heating to induce evaporation and thus precipitate the leached salts dissolved in water.

We will discuss here a book entitled *Alographia dos alkalis vegetal ou potassa, mineral ou soda e dos seus nitratos*, published in 1798 by the Brazilian author José Mariano da Conceição Veloso (1741-1811) under the patronage of the Portuguese Crown. This book consisted of a compilation of several excerpts, chapters and articles translated into Portuguese from English and French, and included chapter written by Veloso himself. Veloso was a Franciscan friar from the Minas Gerais region, in central Brazil, who went to Lisbon in 1790 to collaborate with a small group of Brazilian intellectuals in a publishing enterprise with the aim of printing books that could stimulate the development of Agriculture, Botany and the Natural Sciences in Brazil.

Veloso's stated purpose was to put forth a complete chemical operations manual, hoping to convey to his countrymen a set of the detailed procedures that would boost the nascent indigenous production of potash from plants available in Brazil. In a single volume with over 300 pages, Veloso gathered translations of articles, brochures, advertisements, letters, patents, and chapters of books by more than a dozen European authors who had written about the scientific background and the practical knowledge necessary for the industrial production of potash.

The final section of Veloso's book, entitled "flora alografica", is not a translation but his own original work, consisting of prints and botanical descriptions of 22 Brazilian plants judged appropriate for producing potash, together with their botanical classification, and a set of drawings and illustrations that detailed the design of a factory for the production of potash from the burning of plants. Banana, sunflower and maize are among the plants listed by Veloso as suitable for this process. It is interesting to note that Veloso, the author of the *Florae Fluminensis*, which included 1,700 original prints of plants from the Brazilian flora, apologizes here for the poor quality of the prints, which had been reproduced from other sources.

Considering his extensive work and the diversity of themes that Veloso tackled despite not having a European university education (as it was usually the case for other protagonists of Brazilian science during that time), his book is a remarkable testimony of sophisticated science as it was being practiced at the end of the 18th century in Portuguese America. It makes a strong argument to challenge the notion that there was no science in colonial Brazil, or even that the research activities of that time should be deemed 'pre-scientific'.

THE EXPERIMENTAL DISCOVERY OF THE NATURE OF PLANTS – THE EMPIRICAL SPIRIT OF THE SCIENTIFIC REVOLUTION

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In this paper I am examining the details of the experiments and questioning the theoretical advances made by the "vegetationists" Henri-Louis Duhammel du Monceau (1700-1781) and especially by Jean-Etienne Guettard (1672-1732). I am focusing, among other things, on their reception and development of the propositions previously made by Stephen Hales in his "Vegetable Statics". I want to contrast the connection between their studies and some previous essays published by the "mechanists" or "circulationists" like Claude Perrault or Nicolas Dedu, who, in the second part of the seventeenth century got tangled up in analogical statements. Nevertheless, as already wished by François Delaporte in his outstanding essay from 1979 "Le second règne de la nature", I do not want to treat the opposition of "mechanists" and "vegetationists" again, but I want to develop a constructive thought about the development of a scientific method in botany at the turn of the seventeenth century. Aiming to demonstrate the importance and the role of experimentation in the context of the formulation of the vegetable laws and systems of vegetation on the one hand, I am trying to understand the identity of the experimental modi in botany on the other hand. This will be investigated in the context of the co-evolution of knowledge in the field of physics, physiology and chemistry referring to the organisms and their environment. Such a work based on a large spectrum of authors from Hermann Boerhaave to Patrick Blair, as well as on numerous less studied materials, should investigate and enlighten the scientific discovery of the nature of plants during the seventeenth and eighteenth centuries, with a special focus on such questioned groups of organisms as the cryptogams and zoophytes.

THE HUMAN INSTRUMENT IN THE 18th CENTURY LABORATORY

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The evaluation of natural effects in the late 18th century was dependent on an array of new experimental apparatus. But the most common and potent instrument was the experimenter himself. This paper will explore the place of the experimentalist as a laboratory instrument in his own right, in the assessments of natural qualities and effects ranging from new gases and substances to electrical charges. Thus the laboratory interiors included the everyday relations between experimenters and their instruments, the reports of experience by technicians and philosophers, and the subjective bodily impact of newly discovered phenomena. From Joseph Priestley's electrical effects, to James Watt's chemical incidents, to Thomas Beddoes' pneumatic agenda, and the adventures of the itinerant lecturer James Dinwiddie, this paper seeks to reveal the everyday experience of the human as instrument in the late 18th century.

Symposium S53
Communicating Science in 20th Century Europe: Comparative Perspectives

NEW INITIATIVES IN POPULAR SCIENCE PUBLISHING IN EARLY TWENTIETH-CENTURY BRITAIN

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In the period 1910-1930 a number of British publishers offered what were proclaimed as major new initiatives to promote wider interest in academic and scientific subjects. These included series of 'self-education' books such as the Home University Library and serial works published in a magazine-like format, of which the best-known is H. G. Wells' *Outline of History* (which included material on evolution). These were low-priced items aimed at more prosperous working and lower middle-class readers. The book series had some limited success, often selling tens of thousands of copies of the more popular titles. The most effective serial works sold hundreds of thousands of copies.

But how new were these initiatives, given that low-priced book series and serials had existed in the Victorian period? One innovation was that many of the tiles in the area of science were written by professional scientists, whose expertise lent an air of authority to the publications. The format was also more attractive to the reader looking for entertainment as well as education, especially in the serial works. By adopting the format of the latest magazines, including much better illustrations than had been possible in Victorian times, the serial works had a very different appearance to anything available at a low price in the late nineteeth century. The advertising techniques used were also new, often involving campaigns the modern mass-market newspapers such as Lord Northcliffe's *Daily Mail* (some serials were issued by the same publishers as the papers). The publishers thus believed they were providing a service to a new and expanding market among readers hoping to improve their education and employability despite the unavailability of college and university places.

One final point, however: given the success of the book series and serials, why were popular science magazines comparatively less successful? The Victorian popular science magazines all disappeared by or during the Great War, and although new titles were founded after the war, none gained a wide readership and several closed down after a few years. It seems that the magazines 'fell between two stools'; if they tried to attract a wide readership they became too trivialized for the serious readers, but there were not enough of the latter to keep a magazine profitable. The most serious magazine, *Discovery*, was kept alive by a publisher who accepted its losses because he felt it was important to promote science – although only those who already had an interest in the topic actually read it.

TWO MODELS OR ONE? POPULARIZATION OF SCIENCE IN POLAND BEFORE AND AFTER THE COLLAPSE OF THE SOVIET BLOC

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Within a few years after the collapse of the Soviet bloc in 1989 printed channels for popularization of science in Poland had dramatically changed. Old periodicals for conveying scientific knowledge to the laity became extinct and new titles emerged. Newspapers rearranged theirs „science departments". And the market of popular science books encountered the earthquake. In this paper I shall present a preliminary analysis of these changes, keeping in mind that the weakness of that account is the attendant tendency to equate description with explanation.

POPULAR SCIENCE BOOKS AND HUMAN-ORIGINS-RESEARCH IN CONTEMPORARY SPAIN ATAPUERCA - THE MAKING OF A MAGIC MOUNTAIN

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Popular science books do not only popularize knowledge. They serve as “enlarged battlefields” in controversies, as a meta-forum to expose new ideas and as a mean to win over the public. The field of Human-Origins-Research is a point in case. To write about their discoveries and interpretations of fossils in a popular genre is very common among paleoanthropologist.

Within the last ten years the Spanish researchers Juan Luis Arsuaga, José Maria Bermúdez de Castro and Eudald Carbonell, have in sum (co-)authored more than twenty popular science books. They did not only write the “typical” books about how they found what kind of skull and what that means for “our” origins. Their publications also include exhibition catalogues, a history of the excavations, a novel, a children’s book and several rather philosophical or epistemological works.

The three scientists are the leaders of the Atapuerca team. Atapuerca in Northern Spain is arguably the most important prehistoric site in Europe. The little mountain near Burgos yielded by far the most and the oldest hominid fossils (ca. 1,2 million years old). The thesis of this paper is that the enormous success of the excavations cannot only be explained by the sheer quantity and quality of the finds.

The paper will try to pinpoint in how far these popular science books helped to create the magical mountain of Atapuerca, a site that in the meantime represents the (imaginary) beginning of Spanish history. The following questions will be addressed: What narratives do the authors use to tell their “story”? Do the authors construct some kind of Spanish national identity? How do they use the popular format to expound their own paleoanthropological theories? Do they argue differently in comparison with their scientific papers? How do they address controversies within human-origins-research?

THE POLITICAL BACKGROUND OF POLISH AND SOVIET SCIENCE POPULARIZATION IN THE POST-WAR PERIOD

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A characteristic feature of the science popularization in the late post-industrial epoch during the 20th c. was the dissemination of scientific information among the large groups of society (the so called: masses in Marxist-Leninist vocabulary). This information however was used on the both sides of the iron curtain for different aims. Western democracies in general run for popularizing the latest scientific knowledge within the society for its own educational worth, though often it might had been used also to achieve a media sensation. In the countries of the Eastern block after the Second World War, especially in the USSR and in Poland – which will be here a main example - the scientific information fulfilled the function of essential element of the political propaganda (term: scientific consciousness, means materialistic point of view). Science had to show the superiority of the real socialism (the communism „in spe”) over the capitalism as a whole. One can acknowledge several stages - in the Eastern reality - of spreading science. These stages occurred simultaneously to the subsequent periods of the political history of the Eastern block. The most tragic was the period directly after the Second World War up to the year 1956 and the 20th congress of CPSU. The decadent period of Stalinism was characterized - on one hand – by ubiquitous influence of ideology on science and its popularization (continuous opening and closing quotations from the classics: Marx, Lenin and Stalin). On the other, the global elimination of research and the information concerning forbidden disciplines as: the cybernetics, some fields of biology, the chromosomal theory of heredity, the behavioral psychology, some limited areas of linguistics etc., was constant phenomenon. Many spheres of the humanities were subject to considerable censorship limitations. Within the framework of fight with the cosmopolitism most of scientific relations have been torn off, and many of the mentioned spheres were ex officio found as „bourgeois” or „backward”. Simultaneously obligatory propaganda of the successful Soviet science flourished. Books and articles convincing about that success were published in incredible mass editions, up to the millions of copies. There came into being the administrative system of science popularizing created on the USSR model. In Poland one central institution was appointed - the Society of Universal Knowledge formed in 1950. However science issues were managed by the Central Committee of Polish Communist Party. The essential part performed first of all the censure, decisive often about the direction and the character of books in print, about the press articles and broadcasts. After 1956 both in Poland and – in a lesser degree – in the USSR those limitations diminished. It is easily to notice that Poland at the decline of 1950s was one of the most broad-minded state in the camp, growing even more liberal while relations with the West caused a considerable improvement of the situation. Although still were many areas which remained under an overpowering influence of the ideology (political sciences and economy). In 1960s and 1970s the diffusion of science in Poland gradually became depoliticized. Among other things appeared mass editions of the Western scientific literature. By Polish translations this books and journals were available also in the USSR.

PUBLIC POLICIES OF PUBLICISATION OF SCIENCE IN POST-WAR FRANCE. TOWARD A "STATE AFFAIR"

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Paris, France

The talk focuses on the second half of the 20th century and discusses the public policies concerning "publicisation" of science in France.

Publicisation of science in France developed largely during the 1980's under the appellation "culture scientifique et technique" (scientifical and technical culture) in connection with an important redefinition of French science policy. This well-known episode is often considered as a starting point of strong public involvement in this domain. I will here show how, in the contrary, public concerns in publicisation of science emerge early in post-war France connected to different domains of public policies and then evolved toward what could be considered as some kind of a "state affair". In looking at this issue I will develop some points of view partly complementary to the analysis that concentrate on the political impact on science communication.

A COMPARATIVE APPROACH TO THE REPRESENTATIONS OF SCIENCE AND TECHNOLOGY IN THE PORTUGUESE PRESS AT THE BEGINNING OF THE 20th CENTURY

Ana Simões, Ana Carneiro, Maria Paula Diogo

Centro Interuniversitário de História das Ciências e da Tecnologia –CIUHCT, Portugal

In this talk we present the preliminary results of a project aimed at analyzing the representations of science and technology stemming from the Portuguese generalist press covering a period from the end of the monarchy to the end of the first Republic (1900-1926).

The first decades of the 20th century were particularly eventful from the viewpoint of science and technology in their proper right as well as from the point of view of their impact on society. At the national level, both the end years of the monarchy, and especially the First Republic (1910-1926), used science and technology as part of their political agendas and promoted many popularization strategies, at times associated with the adult education movement.

Having in mind the high illiteracy rate of Portugal (around 70% at the turn of the century), which restricts the audience for popularization to an elite of people, we consider that a bottom-up approach is particularly suited and therefore opted to use mainly daily generalist newspapers as our primary sources. Newspapers were chosen on the basis of their broad ideological scope and different geographical locations. Such is the case of *Diário de Notícias* (1865) issued in Lisbon, *Comércio do Porto* (1854) published in Porto, the northern city rival to the capital, and *Diário dos Açores* (1870), published in the Atlantic islands of Azores. Our survey enables us to discuss the role and functions of science as well as public perceptions of science and technology in a peripheral country such as Portugal. Furthermore, it enable us to unveil differences in the models of popularization of science and technology adopted by each newspaper under scrutiny according to particular ideological stance and geographical location, and more generally to reconstruct the cultural life of three different cities of a country of the European periphery, and specifically to unveil how scientific culture integrated their respective lives.

SCIENCE AND TECHNOLOGY IN THE EARLY-20TH CENTURY GREEK DAILY PRESS

Eirini Mergoupi-Savaidou, Faidra Papanelopoulou, Spyros Tzokas

University of Athens, Greece

This paper discusses the results of our analysis of over 2,500 articles related to science and technology found in the daily newspapers *Åmbros* and *Skrip*, between 1908 and 1910. In view of the importance of this historical period for Greece, we examine the public images(s) of science and technology and interpret the multifaceted discourse used by journalists when accounting for science and technology in their articles. We aim to bring to the fore the richness of the daily press as an archival material, and legitimate its complementary use in the history of science. In our view, newspapers can be considered to be a privileged medium for the examination of the role of science and technology in modern societies, but also a privileged medium for the cultural meanings of science and technology for countries of the 'European periphery', such as Greece. From the wide range of articles studied, we have discerned four broad themes: the introduction and cultural appropriation of new technologies in Greek cities, the concern with public hygiene and general health issues, attempts to control Nature, and lastly the presentation of the scientific and technological advances taking place abroad. Our empirical study has shown that i) all scientific and technical fields were covered in both newspapers, ii) science and technology were not only addressed in special columns dealing with science popularisation, but permeated the entire newspaper, iii) the term 'science', with all its derivatives, was used for science proper, but also in expressions employed in order to write about the advanced technology of the period, iv) the concept of science was associated with the notion of modernity and that of progress.

THE POPULARIZATION OF SCIENCE IN HUNGARY, 1867-1945: TEXTBOOKS, MEDIA, PERSONALITIES

Tibor Frank

Eötvös Loránd University, Budapest (Hungary)

The talk will provide an overview on the development of science popularisation in Hungary both during the time of the dual monarchy and the newly established independent Hungary after 1920.

The integration of Hungary into the Austro-Hungarian Monarchy (1867-1918) strengthened the effect of German speaking European science the results of which were quickly channelled into the school system and the publishing trade. The impact of British science, particularly Darwinism, became marked. The Hungarian Academy as well as the University of Budapest (today Eötvös Loránd University) played a leading role in the Magyarization of European science in popular science publications.

Scientific developments in Hungary strengthened the position of rational and secular thinking in a highly religious society and contributed to the erosion of the mental power of the church tradition, particularly that of the Roman Catholic Church. Toward World War I, influenced by the Protestant Churches, the Jewish tradition, and agnosticism, the public picture of science became more international, occasionally ready to consider challenges of the accepted world view, and sometimes less dogmatic. Leading Hungarian figures with an international reputation who did not refrain from popularizing science included the physicists Baron Loránd Eötvös and Sándor Mikola, the orientalist Ignácz Kúnos, as well as the biochemist and Nobel Laureate Albert Szent-Györgyi.

Emigration, mostly Jewish, after World War I, also contributed to the curtailment of popularisation efforts as some of the best people left Hungary for mostly Germany, Britain, and the United States. However, the interwar school system, the Hungarian version of the *Gymnasium*, continued to disseminate scientific thought in Hungarian society. Much of the information was foreign and appeared simply in translation – but the results paved the way to a larger educated middle class then in the making.

SCIENCE PROGRAMS AS INTEGRAL PART OF WEIMAR AND POST-WAR GERMAN RADIO

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When in the 1920s radio meant an audible revolution to mass communication in general, it both offered new opportunities for science communication to wider audiences than popular science journals could reach and at the same time had to cope with the loss of the visual that had just given attraction to modern colorful science publications. I will hence analyze the polyvalent impact of this "medialization" process on science communication and describe the internal considerations of the program makers for the early German radio. Here, a specific German approach can be identified that is characterized by a dominant role of state regulation that left almost no influence to radio industry (as in France) or private broadcasting corporations (as in the US). German radio pioneers, first of all engineer and ministerial director Hans Bredow, were eager not to repeat the mistakes of the cinema, which was considered inferior and common, but to establish radio as a cultural means of elevation and education of the masses. Interestingly – and in part necessarily – radio programs and printed radio magazines established a "multimedia system" rather than a "media change", a phenomenon that only the television would alter.

While historical research on radio and its program in general is widespread and advanced, the analysis of science content has been mostly neglected. It, however, turns out that science and technology was an integral, regular and differentiated part of the audible media and maintained these qualities rather constantly through political changing times. My focus will be to exhibit the specific qualities of science communication in the radio for the Weimar period, when already in 1926 a special nationwide educational radio station was established, and on the two different systems in West and East Germany after the World War II, when science and technology played different political roles in the two German states.

SCIENCE IN THE FRENCH POPULAR MEDIA IN THE 1930s AND 40s: FROM RADIO TO MOVIES, SONGS AND CABARET

Daniel Raichvarg

University of Burgundy

In the 30s and 40s, odd jobs reviews or fashion magazines, movies – documentaries or others -, Radio programs, daily papers when news allows it (a crime, a scientific event or others), theater plays, popular songs, cartoons, floor shows, were fostered by Science and Technology. Ready to vanish quickly, extremely diverse, these Popular Media Forms – neither new nor old, neither old nor new - received a large audience, if not an infinite one and they are hardly submitted to scientific investigation

So the question would be : what can we do with all these popular media forms ? They refer to various – if not conflicting – problematics :

- cultural pictures of Science and Technology,
- relationship between knowledge and daily practice of Science ?
- evaluation of forms taking into account cultural diversities and changes,
- have they something to deal with « l'espace public », « citizenship » (assessment, action, criticism ?)

This failure to find an apposite solution to our dilemma – how difficult those impacts or effects are to measure ! – might be taken as evidence of the disappearance of most of these popular from our modern consciousness. But many misunderstandings may prevent us from appreciating their great value as a witness of a period in which a true popular scientific culture was trying to emerge. This communication would like to offer some examples of these forms as topics of discussion.

Symposium S54
Sources of East Asian History of Science, Technology, and Medicine

TEXTUAL SOURCES OF THE TRADITIONAL CHINESE LIFE SCIENCE FENG SHUI

Manfred Kubny

Horst-Goertz-Institute, Charité-Medical University Berlin, Germany

Feng Shui "Wind and Water" is the traditional Chinese life science of the diagnostics of environmental shapes and figures, created by nature or constructed by human hand. From its early cultural beginnings approximately 4000 years ago its development went through different cultural stages: First it had been a technique for selecting appropriate places in natural landscapes to design graveyards and for evaluating invisible conditions of spaces by using a specialized geomantic compass called Luopan.

At the end of its most far reaching process of sublimation it became a philosophy about how human beings have to be placed in natural spaces and how to create a healthy design for human living space. Due to the fact, that on the one hand Feng Shui refers to psychological influences on the human mind provoked by environmental atmosphere and shapes, and on the other hand to the technique of examining conditions of a landscape itself and the creatures living there, it might be possible to call it the "traditional Chinese life science of space psychology and space physiology".

In this last context, Feng Shui theories came to reflect a notion that earth is a living body, which has flesh, bones, organs, blood and vessels like the human body and in which a vital Qi is flowing, which must be controlled in order to bring it into balance.The Chinese life science Feng Shui is based on a broad classical literature produced throughout all dynasties since early Han time. It is characterized by an enormous diversification of specialized methods and theories and based on a diversity of contemporary expert literature, which is still very much alive in contemporary Chinese society.

This paper will introduce Chinese classical literature on Feng Shui and present a brief history of its cultural and historical development. The focus is on the history and origins of classical Chinese Feng Shui literature and the most important schools that have emerged over the centuries.

"MISTER CHEN'S INSTRUCTIONS ON THE INNER CINNABAR": A SOURCE FOR TRANSFORMATION

Rudolf Pfister

University of Basel, Switzerland

The paper will discuss aspects of "Mister Chen's Instructions on the Inner Cinnabar" («Chen Xiansheng Nei Dan Jue», after 1078 C.E., Northern Song dynasty), a text of which I am preparing a critical edition and first full translation. Extant are two versions of the text, which include differing commentarial materials: (a) See ‹Daoist Canon› fasc. 743/1096, and (b) «Cui Xu pian» ‹Treatise of Cui Xu› (‹Daoist Canon› fasc. 125/263, pp. 1a-22b).

This extraordinarily rich and unique source provides ample material for the study of (i) inner light experiences and inwards-directed sight: on phosphenes, hallucinations, visualisation, and meditative techniques; (ii) on states of consciousness: out-of-body experiences, directed flows, all-body reactions, euphoria, feelings of lightness and levitation; and (iii) on the sensorium: aural and gustatory phenomena during specific /techniques.

The source elaborates on the nine stages of a transformative process in great detail. The paper will discuss mainly the phosphene descriptions of the first stage, called 'lowering of the cinnabar', and elaborate on its further implications from the perspective of the history of techniques intended to promote individual wellbeing and meditative techniques.

A SOURCE FOR THE COSMOPOLITAN MEDICINE OF THE MONGOL ERA: HUIHUI YAOFANG

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The Mongol Era in China and, to some extent, in the rest of the states of the then Mongol world order, was characterized by remarkable mixture of medical traditions and a free exchange of medical ideas of every sort. In China this meant the practice of Arabic and Tibetan medicine, as well as Chinese and Mongolian, side-by-side, to suit different clienteles, primarily but not exclusively the various components of the Mongolian elite. In Iran the mixture involved most notably a significant importation of Chinese medicine but also, Mongolian medicine and, it is likely, Tibetan traditions, as in China, although this aspect of the complex medical traditions of Mongol Iran remains unevaluated. In the present paper, I will explore the medicine of our most important source for the mixed, cosmopolitan medicine of the time, the Chinese- and Persian-language Huihui yaofang, "Muslim Medicinal Recipes," in which a base of Arabic medicine has been adapted to Chinese and Tibetan traditions to produce a system ancestral to the mature Mongolian medicine of the period of Lamaistic influence, a medicine which is still practiced in Mongolia and currently seeing a renaissance of renewed interest.

THE SIGNIFICANCE OF RESEARCH ON ANCIENT CHINESE MEDICAL LITERATURE PRESERVED NOT IN CHINESE ARCHIVES BUT IN FOREIGN LIBRARIES ONLY

Prof. Zhen Jinsheng

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For a long time already Chinese medical texts have found their way to foreign countries. Japanese, Korean, and Vietnamese libraries in particular have hundreds of ancient Chinese medical texts that have been lost in China herself. Following research in Asia as well as in some European countries and the USA we have gained a rather accurate knowledge of the holdings in foreign countries of Chinese medical literature no longer available in China. Approximately 400 such texts have been edited in China in photocopy versions in recent years. A closer look at these reproductions has shown their extraordinary scientific value. They include works entirely unknown to Chinese medical historiography, and they help to correct certain erroneous views on Chinese medical history. Hence the ancient Chinese medical texts that have been returned to China in recent times through photocopy reproductions prove to be a most valuable source material.

MICHAEL BOYM, LE CHÉRON D'INCARVILLE AND JOÃO DE LOUREIRO - THREE IMPORTANT SOURCES IN THE HISTORY OF BOTANY OF CHINA

Manuel S. Pinto

University of Aveiro, Portugal

Noël Golvers

University of Leuven, Belgium

Flora Sinensis, published in Vienna in 1656, is the *opus magnum* of the Polish Jesuit Michel Boym (1612-1659) who conducted field work mainly in the island of Hainan from 1643 to 1647. It has 16 nice pictures in color (not always very accurate) and gives descriptions of 4 Chinese plants showing provenance, common Latin names and medical properties. Another book related to Boym's name is *Specimen Medicinae Sinicae*, published in 1682 in Frankfurt, where the botanical part is hardly comparable in importance to *Flora Sinensis*.

The French Jesuit Pierre Noël d'Incarville (1706-1757) prepared from 1740 onwards a herbarium with 149 plant species collected in Peking and surrounding mountains and 144 species from Macao. It was sent to France together with grains of Chinese plants. The herbarium is still kept in the Muséum National d'Histoire Natural in which gardens some plants that have been cultivated from the grains may be seen. Only some 140 years after the herbarium reached France were the specimens subject to a study by Adrien Franchet (1834-1900) who presented it in 1882 to the Société Botanique de

France. Franchet pointed out that a) many rare species from Northern China and most of the genera that were described by de Bunge on later dates existed already in the Muséum; b) the Jesuit had been very careful in giving information about the common names and provenance of the plants and in some cases their common uses. However, no medical applications were mentioned. d'Incarville published in 1812 1nd 1813, in the Mémoires de la Société Impériale des Naturalistes de Moscou, a *Catalogue alphabéthique des plantes et autres objets d'histoire naturelle en usage en Chine, observés par le P. d'Incarville* that is now under study by the present authors. It certainly relates to plants, but also to animals and minerals.

João de Loureiro (1717-1791) was a Portuguese Jesuit who in 1741 or 1742 went to Cochinchina (Vietnam) where he showed interest in the medical use of plants by locals. Having received a copy of Linneo's *Genera Plantarum* , he started studying plants based on it. He spent 34 years in Cochinchina and in returning to Portugal in 1778 he spent about 3 years in Canton where he continued his studies. His *Flora Cochinchinensis*, published in 1790 in Lisbon by the Academy of Sciences, describes some 560 species from China, mostly from the Canton area, with a few from Macao too. The curative properties of the plants deserved special mention. Controversy has occurred about the correct classification and nomenclature of several genera described by Loureiro, as well as the chronological priority of some of his descriptions. This occurred right after *Flora Cochinchinenis* was published in Germany in 1793. He prepared all along his life in the Far East a herbarium, sections of which he kept conveying to several botanists in London, Sweden and Paris with whom he corresponded. He gave the Academy of Lisbon part of his herbarium and two volumes with sketches of 397 plants that the present authors try to study now.

Such sources are important because: 1) except Boym's they were the first Linnean studies made in China by Westerns, pioneering ethnobotany there; 2) through herbaria, drawings etc., they made known to Europe many Chinese plants; 3) the medical and other uses of many plants were made known to Europe; 4) they contributed to the progress of botany in general and of Chinese botany in particular, namely of the Peking, Canton and Macao areas; 5) they pointed out the role of the Jesuits in the West-East scientific exchange at that time.

MANCHU TEXTS ON NATURAL SCIENCE IN THE EARLY QING PERIOD: THE *MANCHU ANATOMY* AND OTHER MANCHU BOOKS ON MATHEMATICS AND MEDICINE

Junsei WATANABE

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In the 17th and the 18th centuries the Manchu language, the first official language of the Qing Empire, played an important role in exchanging cultural and scientifc information between the East and the West, and Jesuits wrote Manchu books on Western science under the orders of the Emperor Kangxi. In spite of their importance in history of science, the texts in these Manchu books were not objects of systematic study because of a language barrier. The purpose of this paper is to show that these written Manchu materials are useful in the sense that we can derive information which cannot be obtained by investigating Chinese sources. The main topic in this paper is the Manchu Anatomy, an introduction to Western anatomy translated and compiled by a Jesuit, Parrenin. We first consider the tradition of its several manuscripts owned by libraries in Japan, France and Russia. Next we see the medical and philosophical contents given in its texts, not in its figures. Parrenin introduced up-to-date and detailed knowledge on Western anatomy into the Court. We compare the features of the *Manchu Anatomy* with those of Manchu and Chinese books on mathematics based on translation done by other Jesuits. A Chinese rearrangement of Western materials is common to them..

SOURCES, CONTENT AND INFLUENCE OF THE BOOK *LES SECRETS DE LA MÉDECINE DES CHINOIS* (1671).

Éric MARIÉ

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During the last third party of the 17th century, the first monographs written by Westerners on the theoretical and practical aspects of the pulse diagnosis in Chinese medicine are published in Europe. Their influence was important as for the interest and for the knowledge about the far eastern practices of health in West. The first one of these books, a work written in French, entitled ***Les Secrets de la Médecine des Chinois consistant en la parfaite connaissance du Pouls***, published in 1671, was initially awarded, by mistake, to Louis Augustine ALLEMAND. Historians and sinologists wondered a long time about the real author and about the precise Chinese sources of this treatise of sphygmology.

The first aim of this communication is to reconstitute the circumstances of creation of this work and to demonstrate that the biggest part of this book is, in fact, a translation of a Chinese medical text written during the 14th century. The content of the treatise, the methods which allowed identifying it and the internal and comparative analysis of both of the texts (Chinese and French) will be also exposed.

A NEW REALM OF SOURCES FOR CHINESE MEDICAL HISTORIOGRAPHY. THE CHINESE MEDICAL MANUSCRIPTS OF THE 16th TO THE 20 CENTURY IN TWO COLLECTIONS IN BERLIN

Paul U. Unschuld

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The historiography of Chinese medicine has been based on printed texts for many decades. Translations and contents analyses of books from the imperial era have been major sources for the image of Chinese medical history that has formed in the West. It is only recently that an awareness has grown of the social limitations of such a data base. Central to a new perception of Chinese medicine has been the "discovery" of handwritten books prepared by Chinese authors over many centuries. Their examination suggests that a medicine based on the Chinese sciences of systematic correspondences (yinyang and five agents doctrine) may not have spread beyond an educated elite of traditional upper social echelons in pre-modern China. A majority of the population appears to have trusted in rather different means when confronted with illness and a need to seek expert help. This paper will introduce the broad range of authors and topics of a unique collection of Chinese handwritten books in the Staatsbibliothek zu Berlin and in the Ethnology Museum of Berlin, to draw attention to a huge treasure of information on the ethics, the theory, and the clinical practice characterizing health care among wide circles of the Chinese population from the 16th through the mid 20th century.

NEW PERSPECTIVES ON LATE IMPERIAL MEDICAL TEXTS

Angelika C. Messner

Christian-Albrechts-Universität Kiel, Germany

Whereas in late imperial China new editions of old medical texts are mostly presented as reviving the knowledge of ancient medical heroes and their recipes and strategies of therapy, historians of medicine today by contrast often focus on identifying the actual authorship and authenticity of a text.

Newer insights in the processes and facilities of book production in late imperial China brought to light an image of authorship whose authenticity in many cases are impossible to trace. The production of a text often took several decades and involved many people, not just the author named on the title page. Even the very act of writing was often intermitted. Friends and family members read and commented on the text, which again sometimes was printed only some hundred years later. The polyphonic character of such texts impedes what many historians search for, i.e. singularity, originality and authenticity.

My paper will introduce reading strategies, which allow to take advantage just from these volatilities prevalent in late imperial medical texts and thereby to achieve insights into the ways and modes medicine became interconnected with literature and other fields of intellectual engagement during this period.

CHINESE MEDICAL PRACTICE ON THE WESTERN FRONTIER: A CASE STUDY IN ADAPTATION

Christopher Muench

Lewis Clark State College, United States

The American frontier during the second half of the nineteenth century consisted of widely dispersed, mixed ethnic communities situated within a variety of locations and environmental contexts. Trauma and disease, both endemic and epidemic, posed constant threats to the lives and livelihoods of the frontiersmen. When available, medical care was often rudimentary, ineffective, and administered by practitioners with minimal formal training. It was within this context that Chinese medical practitioners achieved prominence in their local communities as skilled, primary care providers with a client base that extended beyond the Chinese enclaves.

In a medical practice spanning ninety years, the Ah-Fong family of Boise, Idaho provide a case study of this phenomenon, illustrating the methods and manner in which traditional Chinese medicine was innovatively applied to the evolving health environment of the late 19th and early 20th centuries. Using translated Ah-Fong family manuscript casebooks, analysis of the remaining *materia medica*, and interviews with surviving family and patients, we present a profile of Chinese medical practice as a flexible and adaptive system, that was both responsive to the prevailing health environment of the surrounding community and capable of integrating non-Chinese elements when necessary. Furthermore, the Ah-Fong practice's sub-specialization in the treatment of gynecological disorders provides an early example of non-Chinese clients utilizing Chinese medicine in situations where western medicine proved unsatisfactory. The Ah-Fong materials provide a unique insight into the important role played by Chinese medicine and its practitioners in the treatment of disease and illness on the American western frontier.

Symposium S56
Communities and Communication in East Asian Sciences

SEARCHING FOR THE COMMUNITY OF 'ASTRONOMERS' IN EARLY IMPERIAL CHINA

Christopher Cullen

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I have recently published work discussing how far it is reasonable to talk about 'mathematics' and 'mathematicians' in early imperial China (by which roughly speaking I mean the Qin and Han dynasties from the late third century BCE to the early third century CE): see Robson and Steadall, *Oxford Handbook of the History of Mathematics* pp 591-618 'People and Numbers in Early Imperial China', Oxford 2009. There is no doubt however that the study of the heavens was seen as a much more significant topic in China at this period. In this presentation, I shall look at the evidence for the identity and origins of those engaged in activities that would today be called 'astronomical' in English, and ask how far it is possible to identify a self-conscious community of 'astronomers' under the Qin and Han.

SCHOLARS, THE STATE AND THE CIRCULATION OF MATHEMATICAL KNOWLEDGE IN EARLY QING CHINA (1644-1735)

Catherine Jami

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During the Ming dynasty (1368-1644), mathematics was by and large regarded as a technical rather than scholarly field. The imperial state showed no particular interest in developing and controlling it. However, some mathematical works were included in the *Calendar books of the Chongzhen reign* (*Chongzhen lishu*), mainly composed by Jesuit missionaries and completed in 1635. The conflicts aroused by the Manchu Qing dynasty's decision to implement the calendar reform proposed in these books caused Kangxi (r. 1662-1722), the second Manchu emperor to rule over China, to take an interest in the mathematical sciences. He took steps to promote their study and codify them. However, until the 1700s, he effectively held a personal monopoly on mathematics and other sciences that he studied with the Jesuits who were in his service.

On the other hand, during the second half of the seventeenth century a number of Chinese literati took up the study of mathematics and astronomy, and advocated its relevance to Confucian learning. Scholars like Mei Wending (1633-1721) studied Western learning as far it was available in late Ming works in Chinese, but were sometimes quite critical of it. A number of them were Ming loyalists, so that their skills were not always available to the new dynasty.

The present paper discusses these two separate communities of mathematical learning, and shows how they came together. As part of his policy of reconciliation of Chinese elites to the Manchu rule, Kangxi successfully recruited a number of literati to his service for the compilation of a compendium on mathematics, astronomy and harmonics completed in 1723. In this process, a consensus was reached as to what formed valid knowledge in these fields, and mathematics itself was granted legitimacy as a field of scholarship.

THE EMERGENCE OF LITERATI MATHEMATICIANS AND THE NEW CULTURE OF MATHEMATICS IN LATE EIGHTEENTH-CENTURY KOREA

Jongtae Lim

Seoul National University, Korea

The second half of the 18^{th} century in Korea witnessed the emergence of a new breed of Confucian literati: the literati mathematicians. Sharing specialized interests in mathematics, astronomy, cartography, and instrument-making, they constituted a vibrant intellectual network, in which ideas, texts, and artifacts were freely exchanged. This signaled a remarkable change in the intellectual culture of the Confucian society, in which professional mathematics had largely been considered a job for the lower "middle men" class, and thus not a proper intellectual pursuit for Confucian literati. Which socio-intellectual factors encouraged those literati to specialize in mathematical investigation? How did the "Confucian-mathematicians" justify mathematical practice as a legitimate endeavor for Confucian literati? This paper focuses on three factors, which were both intellectual stimulations of, and the socio-cultural justification for, the literati's mathematical enterprises. First, the growing popularity of the *Yijing* numerology among the Confucian community provided a fertile ground for the literati's investigation of numbers, an endeavor that very often took the form of mathematical enquiries of the universe. The second, and a more important factor in shaping literati's research agenda and their self-conception as mathematical practitioners, was the new mathematical learning introduced from China. The works of the China Jesuits and the Qing literati mathematicians provided the Koreans with both the material to be studied and the model to be emulated. The third factor was the government projects of the astronomical reform and the cartographic survey, which were prioritized by the thrones during the late eighteenth century. The literati mathematicians, who were the driving forces of the projects, emphasized the usefulness of mathematical arts in reforming statecraft and consolidating royal power. In sum, those three factors–*Yijing* scholarship, Sino-Western mathematics, and statecraft reform in the court–shaped a hybrid culture of mathematics, in which mathematical sciences took the central position in the politico-intellectual endeavors of the Confucian literati.

« MEDICAL NETWORKS AND CIRCULATION OF KNOWLEDGE IN THE MARGINS OF THE QING EMPIRE (1644-1911)»

Florence Bretelle-Establet

REHSEIS, (CNRS), France

Over the last two decades, a number of contributions have opened a window on the social and cultural landscape of medicine and healing strategies in late imperial China. Scholars notably analyzed the role played by the State and by private agencies in medical assistance, the social and cultural evolutions in the community of physicians and in medical writings, the competition between the main medical currents of thoughts, and the religious strategies for fighting against disease. It is however mainly at the important economical, political, and cultural center of the Lower Yangzi region (or, Jiangnan), that scholars have looked when examining the social and cultural history of late imperial medicine. In this contribution, I propose to look at another region of the empire, the Far South, which included the provinces of Yunnan, Guangxi and Guangdong, and see what it meant to be a physician in the remote and rural areas of the empire, what these physicians knew, and how knowledge circulated throughout the empire when nor licensing law neither formal medical instruction had codified the practice of medicine.

WHO WERE THE FIRST GENERATION OF 'STATISTICIANS' IN EARLY 20TH CENTURY CHINA?

Andrea Bréard

Université des Sciences et Technologies de Lille, France

The introduction of statistical institutions and theories in late Imperial China took place in the context of administrative and educational reforms, which followed mainly Meiji Japan's political model after the Chinese defeat in the first Sino Japanese War. Constitutional and educational reform provided a territory to implant statistical institutions in the capital and the provinces and to introduce statistical education in the curriculum of newly created modern style schools. But who were this first generation of 'statisticians' that staffed the newly established network of statistical agencies in the Ministries and Provinces and the Maritime Customs' Statistical Department? What was their educational background? Which were their career patterns, and their political positions?

In this talk, I will reflect upon these issues as determined by the available archival sources and analyze more generally the social construction of the image of the statistical expert. The problem which regularly comes up in official court communications is the question of how to distribute the power over the production of numbers: does a specialist sent by the center to a province have the necessary knowledge to lead an investigation in a province with which he is not familiar? The first 'statisticians' thus became subject to controversies between centre and periphery, between virtuous and talented bureaucrat.

SCIENCE, NATIONALISM AND INTERNATIONALISM IN EARLY 20th CENTURY CHINA

Fa-ti Fan

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This paper investigates the intersection of global currents of science, nationalism, and internationalism in the early 20th century by examining an international scientific society in China in the 1920s and 30s. Founded in 1925, the Peking Society of Natural History served as a forum for Chinese and foreign naturalists in the Beijing area to meet, exchange ideas, present research results, and build scientific friendships. The main objective of the Society was "the promulgation of the study of and the spread of interest in the natural history of China." It held monthly meetings and published a serious research journal, the Bulletin of the Peking Society of Natural History. Members of the Society included American, European, and Chinese scholars - for example, Amadeus Grabau, a German-American geologist of international stature, Davidson Black, a Canadian paleoanthropologist, Gist Gee, an American expert on sponges, and Weng Wenhao, a distinguished Chinese geologist. The Society was one of the most active scientific institutions in China at the time and its members made significant contributions to the research on the natural history of China.

This paper analyzes the main goals, members, functions, and research activities of the Peking Society. It discusses how the Society envisioned scientific cosmopolitanism based on a belief in the epistemological authority of science and the moral authority of nature. It analyzes the role of science in national imagining and nation-state building. To elucidate these points, the paper makes comparisons to the international scientific congresses and other science societies in China in the same time period.

GIA TRUYEN AND A RAPPROCHEMENT WITHIN THE HEALING COMMUNITY IN VIETNAM

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Vietnamese *gia truyen* texts contain prescriptions and medical advice handed down within medical families. Most *gia truyen* were produced during the early twentieth century. They do not have a high reputation and their reputation is connected to the status of their authors. They were written by members of medical families rather than by members of the elite. By the 1920s a class divide had developed between members of medical families and the educated, westernized, younger generation of the Vietnamese elite. The anti-French movement prompted a rapprochement between the two groups and this produced a national health care system with both traditional and bio-medical components. However, this health care system, even institutes devoted to traditional medicine, was dominated by the elite who had attended French educational institutions. This paper will examine the cooperation between the two groups during the struggle for independence from France and the American War, remnants of class division among healers in Vietnam, and the continuing involvement of the medical families who produced *gia truyen* in health care in Vietnam.

NATIONAL ACADEMY OF PEIPING AND SCIENTISTS TRAINED IN FRANCE

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Abstract: In the past more than one hundred years, modern science was introduced to China from western developed countries. The National Academy of Peiping(NAP) was the most important scientific institution in north China before 1949. An outstanding and unique characteristic of NAP was that most scientists received their education in France. Contrast to Academia Sinica, NAP developed another experiment of scientific research system in modern China and showed a different research tradition. They used French as their premier foreign language and kept close relationship with academe of France. Leading by Li Shizeng and Li Shuhua, NAP played an extraordinary role in Chinese natural science and social science, education, and the communication of science and culture between France and China.

Key words: National Academy of Peiping; Sino-France Scientific Communication; Li Shizeng;

CONTINUITY/DISCONTINUITY AND CHANGING AGENTS OF JAPAN’S COLONIAL SCIENCES: TECHNO-SCIENCE TURN FROM THE FOLLOWERS OF THE WEST TO THE LEADER OF THE EAST

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There is a long pre-history: it was Jesuit science that came first to Japan in the 16th century, but unfortunately, it was premature that failed to take deep roots into the Eastern soil. Then came the Dutch agents, who manouvered with Japanese collaborators, and succeeded in building the firm intellectual foundation and techno-infrastructure of “Modernization” of Meiji Japan. Unfortunately, again, the Dutch was not “Super-Power”, and the Japanese leaders abandunded them without due respect to their former representative of the masters of sciences.

Later half of the 19th century, Japan established modern nation state, and her history in the modern world of imperial race has begun. Its narrative mostly emphasized introduction of modern western “fruits” of techno-instruments/equipment/institutions and its successful transplantation, from majour powers of the period, US-Britain, France and Germany. It was a successful jump and almost quantum leap in history of techno-science. It was as if “linguistic turn” and “technology turn”, also as if Admiral Togo turned his fleet in front of Russian navy, character of Japan’s science/technology and medicine has been changed at the certain point. This can be named as the “Colonial Turn” of Japan’s history of science. Institutionalization and instrumentalization, as well as professionalization of science took place almost at the same time in Japan, when Newtonian-Einstein physical shock wave hit Japan, where itself became Darwinian experimental (testing) field, and Japan is also a Baconian heaven, where scientists were supposed to be enjoying their freedom to twine any Lion’s tails and Tiger’s teeth, even the Dragon’s claw.

In order to have dealt with “Colonial Turn” of Japan’s history of techno-science, in this presentation, however, I do not like to praise triumphantism of Japan’s history. Instead, I would like to analyse its changing character of Japan’s history of techno-scientific history, and try to shed new lights on foreign/domestic agents for this change.

Iwould like to examine when and where, and in which discipline did it happen, and discuss the process of change and actual agents involved in the turn, whether it were continuous process (from long pre-history), or is there any discontinuity before and after the turn.

I would like also discuss its diffusion/expansion to non-Japanese Eastern regions, and if there are any of Japan’s colonial legacy left.

COMMUNITY BUILDING AND TRANSMISSION OF KNOWLEDGE: THE CASE OF QUANTUM PHYSICS IN JAPAN

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This paper aims to understand transmission of quantum mechanics from Europe to Japan in terms of community building and networking among physicists.

Various models have been suggested or implied in order to understand how Western science spreads to a non-Western culture and stabilizes its status as universal knowledge. Problems of previously proposed models are their tendency toward a West-centered perspective and their reliance on the truth value of scientific knowledge to explain its transmission. Those models often assume that a non-Western culture is either a vacuum that Western science simply fills in or an obstacle and alien conceptual framework that blocks communication and hinders understanding of Western science.

I propose to conceptualize transmission of scientific knowledge in terms of resonance of scientific practices. Replication of scientific practices can occur through creation of a scientific community and a network of scientists. In this process, various forms of communication among scientists and others play a central role in legitimizing and stabilizing new (or newly transmitted) science.

As exemplified by the past and recent Nobel prizes, theoretical physics has been deemed as one of the most successful scientific disciplines in Japan. It poses a question how this came to happen. One of the historical roots of Japanese theoretical physics is Japan’s successful introduction of quantum physics, which took place in the late 1920s. In Japan, there were several separate attempts to introduce quantum mechanics in the late 1920s. Yet, productive research activities in quantum physics only started when a community of atomic physicists was created after Nishina Yoshio’s return to Japan in 1928. A group of young physicists gathered in Tokyo to Nishina's group at Riken, including a future Noble laureate Tomonaga Sin-itiro. Then, physicists spread to other research institutes in Tokyo and elsewhere. Other groups emerged in Osaka, Kyoto, and Nagoya.

In hindsight, transmission of quantum mechanics to Japan seems only natural and its success only a matter of competence of Japanese physicists. Yet, it still demands an explanation why this particular field of research was readily accepted in Japan? We now know that the particular lines of research conducted by Japanese theoretical physicists since the 1930s were generally productive scientifically as well as relevant to various practical, in particular military, applications. Yet, these were not entirely certain in the 1930s. Then, how could Japanese physicists legitimize quantum physics among themselves and toward society at large?

This paper attempts to analyze this process of transmission and stabilization of quantum mechanics into Japan, discussing how these community building and networking activities established atomic physics as a legitimate discipline and universal scientific knowledge in the socio-cultural context of prewar Japan.

PRECIOUS FEW: EAST ASIAN NOBEL LAUREATES IN SCIENCE IN THE TWENTIETH CENTURY

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During the twentieth century, twelve East Asian scientists won Nobel Prizes for their distinguished accomplishment in physics (8), chemistry (3), and physiology or medicine (1). They were precious national treasures and a source of great pride, but the number was too small to satisfy East Asians. Six of these winners were Japanese scientists, and all had graduated from Japanese universities. The other six were Chinese Americans; all, except one, had been born in China and all had been trained in the United States. These simple numbers reveal many interesting characteristics of East Asian science community in the twentieth century. This presentation analyzes: 1) who these East Asian Nobel Laureates were; 2) the differences between Japanese and Chinese Nobel Laureates; and 3) how they influenced the development of science in Japan and China.

IDENTIFYING "LOCAL AREA DOCTORS": TKM (TRADITIONAL KOREAN MEDICINE) PRACTITIONERS AND DISEASE UNDER THE USAMGIK, 1945-1948

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In May 1946, the USAMGIK (United States Military Government in Korea) noted its first reports of a cholera outbreak, a development which threatened the joint occupations of Korea and Japan. Spread by contaminated food and water sources, cholera was particularly problematic at a time when large migrations were taking place on the Korean peninsula: groups of refugees and Japanese military personnel were traveling south from as far north as Manchuria, with the repatriation of ethnic Koreans from Japan also in progress.

This paper surveys the contingency measures adopted by the U.S. military, a scheme which identified four categories of (Korean) physicians: the Western-trained doctor, the "herb doctor" (Chinese medicine), and the "limited area doctor" for both of these previous categories. "Limited area herb doctors" represented a group which had long been marginalized under Japanese colonialism (190-1945) with its medical modernization project, and here again these practitioners were placed in an ambivalent position, recognized for their potential contribution to disease prevention, yet granted permission to practice only within a particular area. This strategy carried with it strong echoes of colonial practice, which had asked TKM practitioners to register their presence during the build-up and execution of the war with China (1937-1945) and the United States.

By focusing on these TKM practitioners, this paper seeks to re-examine their role as a community in transition, acting as mediators between local residents and the occupying power. Moreover, the formation of academic programs in Korean medicine would later become the dominant strategy in the post-Korean War period, as this would bring professional recognition. Lauded for their preservation of "tradition," these practitioners would be simultaneously celebrated and marginalized with the creation of a South Korean state in 1948, a state which sought to lay claim to Korean tradition, while also prioritizing biomedicine in the hopes of projecting a "modern" image.

CONSTRUCTING THE COMMUNITY OF RADIATION MEDICINE IN POST-WAR JAPAN: COMMUNICATION BETWEEN JAPANESE AND AMERICAN SCIENTISTS

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The American atomic bombing at the closing of the Pacific War placed Japan in a unique position; it became the first country that possessed a large group of *hibakusha*, sufferers from the elusive ailment of 'radiation sickness' (*hôshanôshô*). Recent scholarship has described how this unique constellation of Japan provided a ground on which both American and Japanese researchers studied the biological and medical effect of radiation exposure from the immediate post-war period. They have analysed how a community of scientists were forming around the study, based on the communication between American and Japanese scientists who were affiliated with the Japanese National Institute of Health and American-based Atomic Bomb Casualty Commission. In this presentation, I will examine the aftermath of the Bikini incident (also known as the Lucky Dragon incident), in which the American hydrogen bomb test on Bikini Atoll in the Marshall Islands on 1 March 1954 made 23 fishermen on the boat, Lucky Dragon No. 5 (*daigo fukuryûmaru*), into yet another visible group of Japanese sufferers of radiation sickness. I will consider how the Bikini incident as well as the post-Occupation era in Japan offered a new context that contributed to the changing nature of communications across the Pacific on the study of radiation sickness.

LEAPING FROM THEORY TO PRACTICE: MATHEMATICS IN CHINA IN THE LATE 1950s

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The Great Leap Forward period brought an abrupt change to the development of Chinese mathematics, especially to the work of its most prominent researchers in the Institute of Mathematics of the Chinese Academy of Sciences. After 1958, mathematicians formerly engaged in abstract investigations of number theory, algebra, analysis and topology had to find new, applied problems to work on. In some cases, this disrupted fruitful careers and hindered previous progress, but this ideologically conditioned shock also pushed many mathematicians to enter new fields, design innovative methods and create contributions highly valued by their peers abroad.

The political and ideological imperatives of the Great Leap Forward ended an ongoing debate about the correct ways to link theoretical mathematical work with production practice. This complex problem now had to be solved immediately and concrete results were required. In the suspicious atmosphere following the anti-rightists campaign of 1957, doubts and moderation were interpreted as ideological wavering, which created a strong pressure on mathematicians to deliver on 'linking theory with practice' in the shortest possible time. This zeal reached its peak in September 1958, when a target was set to 'produce concrete results in linking theory with practice, to be presented as a gift to the Party on the National Day' in just twenty days.

A survey of activities of several Chinese mathematicians (Hua Loo-keng, Wang Yuan, Wan Zhexian, Loo Chi-keng, partly based on first-hand interviews) shows some of the adjustment mechanisms adopted in this period. Actors' views of their activities in the period also reveal the perceived positive aspects and opportunities created by the rush to 'link theory with practice', balancing the more obvious complaints about the chaotic and coercive nature of this movement.

Symposium S57
Meanings of "Science" in Twentieth and Twenty-First Century East

REFERENCE TO SCIENCE IN THE LIFE-STORIES OF SENIOR CHINESE MEDICINE PRACTITIONERS IN THE PRC

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The lecture will present cases when senior practitioners of Chinese medicine in the PRC narrate the story about how they became representatives of the state-orchestrated TCM, a term which is loaded with meanings related to scientific and national development. At a second look however, the reference to scientific TCM comes up only at certain points of these narrations when a biographical crisis is explained as a manifestation of collective cultural crisis.

Two main reference frameworks are 1) their representations of competence to the outside world, and 2) claims for status among insiders. Generally, the scientific community is still divided between proponents of the natural sciences and the humanities. Inventions in the modern laboratory continue to provide powerful tools for political development strategies but they also raise concerns about the vulnerability of cultural identity as preserved in the hands of cultured scholars. In China, the divide between *like* and *wenke* became a threat for the standing of Chinese medicine practitioners in China as a result of the re-structuring of the academic world and modern images of the intellectuals. This is the modern dimension of the problem that my informants tackle when they try and give a complete story of their life in spite of the ruptures. In addition, the physicians refer to a second reference framework of context-sensitive practice when they claim their social and professional position by recalling relations to their patients, to localities and to events that occurred in the periphery of national history.

LINKING CHINESE CRAFTS TO GLOBAL CONTEXTS – THE RESEARCH OBJECTIVE OF ZHU QIQIAN

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In the 1920s, the eminent politician and antiquary Zhu Qiqian (1872-1964) searched for the underlying causes of China’s military weakness, as did many intellectuals of his time. One explanation he found for Western dominance in the field of technology was a level of awareness in the West for craft traditions that was lacking in China. For this reason, he launched several research projects on the history of Chinese crafts, its terminology, actors and its immutable principles.

This contribution focuses on the conceptual framework of Zhu’s research initiative, exposing the 1920’s approaches to demonstrate the relevance of Chinese traditional crafts for a global history of technology. It explores Zhu’s struggle to find a balance between preservation and innovation. He categorized Chinese traditions and adopted Western methods of historical analysis, developing an idiosyncratic research style. His efforts aimed at understanding fundamental concepts of Chinese crafts and examined their relevance for cross-cultural historical developments.

My study demonstrates that although various research projects remained unfinished, Zhu’s effort to reveal the influence of Chinese technologies on other cultures became seminal for later researchers. Zhu’s studies still resonate substantially in modern Chinese historiographic approaches to fields of technological knowledge.

DRESS PATTERN BOOKS AND THE DIFFUSION OF WESTERN TAILORING TECHNIQUES IN MAOIST CHINA

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This paper is dealing with technology rather than “science” in the strictest sense. It explores how the technology of western tailoring, introduced into China in the early 19th century and practiced by specially trained “Hongbang” tailors, came to be a common skill by the time of the Cultural Revolution (1966-1976).

After a short introductory outline of the history of western tailoring technology in China, the paper will trace the process of spreading tailoring skills in Maoist China among the *laobaixing*. It will mainly concentrate on one means of distributing tailoring knowledge, namely dress pattern books. These teaching materials were published in irregular intervalls by different provincial clothing companies (*fuzhuang xiemao gongsi*).

In dress pattern books, the expertise of renowned tailors was processed in a way to become intelligible for and applicable by unskilled laypersons. This form of spreading specialized knowledge lead to a simplification of dress patterns as well as techniques and thus had a substantial impact on the development of dress styles. The methods of imparting knowledge through these books are going to be explored.

The paper will conclude by showing how the diffusion of western dress making skills was closely linked to the distribution of sewing machines. Only when sewing machines became available to a broader public could western techniques of measuring, cutting cloth and sewing the pieces together become common practice.

BECAUSE SCIENCE SAYS SO: TOWARD A GENEALOGY OF SCIENTIFIC VALIDITY IN MODERN CHINA

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Claims to scientific validity have emerged as one of the most powerful rhetorical devices in modern Chinese discourses. Together with the often simultaneous rallying cry to help prevent imminent national emergencies, nothing mobilizes popular support more easily, and silences opposition more effectively, in China today than appeals to scientific expertise. After the repeated collapses of ideological certainty, starting with the demise of the orthodox Confucian doctrine at the turn of the twentieth century and culminating in the breakdown of state Marxism a century later, science serves as the last source of uncontested authority in academic, political and popular debate.

This paper is part of a larger project aimed at reconstructing the genealogy of scientific validity and valorization in China. Drawing on earlier efforts examining the translation of modern science into Chinese since the mid-nineteenth century, I will focus on views of science expounded in the writings of authors commonly seen as reactionary opponents to the rapid adoption of scientific theories and practices. Supplementing existing studies on Chinese scientism in the Republican period, I will argue that the tacit embrace of key tenets of scientistic thinking by its conservative critics played an indispensable role in shaping the inflated meanings science has come to command in twentieth and twenty-first century China.

MEANINGS OF ‘BECOMING SCIENTIFIC’ IN REPUBLICAN AND EARLY COMMUNIST CHINA

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In this paper, I explore two aspects of Chinese understandings of what it meant to make Chinese culture more scientific, and attempt to link the two.

The first meaning was centered on empiricism. Scientific knowledge, as presented by missionary translators, was directly accessible to the senses and needed no abstract theoretical systems to explain. In practice, what this meant was that such abstractions such as the theories of yin and yang and the Five Agents were regarded as superstitious and unscientific, while western abstractions such as the theory of the ether, were not. In this pre-Popperian idealization of science, which emphasized reading the ‘book of nature’ through observation and experiment, but not necessarily hypothesis-testing, the acquisition of cultural knowledge was an impediment to seeing the world ‘scientifically’. This was the basic premise of many May Fourth generation intellectuals, and part of the justification for the abandonment of literary Chinese in favor of the written vernacular.

The second interpretation was even more radical in its approach to culture: scientific knowledge should be immediately accessible, even to lay people. This meant, for example, that the organization of Chinese library catalogs and dictionaries by character radicals was less scientific than the numerical 4-corner system developed by Wang Yunwu in the 1920s, because you did not need to memorize radicals or even know how to write Chinese to be able to search for characters in this ‘scientific’ classification system. It meant that the Buddhism of the complex sutras was less ‘scientific’ than Zen Buddhism, in which enlightenment does not require lengthy immersion in the sutra literature. This view also informed the Maoism of the Great Leap Forward and Cultural Revolution periods, which lauded the proto-science and primitive dialectics of the common people over the learned knowledge of the educated. In this view, folk remedies were more ‘scientific’ than classical prescriptions, and backyard steel furnaces were as ‘scientific’ as industrial plants.

Although these extreme interpretations seem absurd today, this paper will attempt to demonstrate their historical continuities and internal logic.

SENTIMENTAL EDUCATION IN SCIENTIFIC TERMS

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The field of literature and popular culture from late Qing through the post-May fourth periods (1890s-1940s) was dominated by discourses of sentiment. The idea of sentiment, love, emotions (*qing*) was not new: The “cult of emotions” already had played a crucial role as transformatoric power in 16^{th} through 17^{th} centuries.

It is well known that attempts to reshape temporal and spatial landscapes in the 1920ies and 1930ies based on imported vocabularies whose notion of “modernity” was strongly connected to the categories “secularism” and “religion”. These categories for their part had been evolved under the programme of the rising Protestant Christianity. These categories also fostered new perspectives on soul and mind. Soul and mind in the views of educators and reformers become the most important areas within the body landscape: This should be internalized by every citizen of the new nation.

The newly institutionalized psychological knowledge branch was eager to promise the making of new men. Chinese reformers officialy proclaimed the concept of “psychological construction” .

This paper looks at the discoursive connexions between the claims of scientific remaking of body landscapes in the light of the new (Western) medicine and the remaking of Chinese sentiments, emotions and feeling within the given time and place.

Symposium S58
Iron Curtains and Immaterial Instruments – The Circulation of Software and Computer Science in Cold War Europe

THE FEEDBACK OF FEAR: AMERICAN AND SOVIET (MIS)PERCEPTIONS OF THE OTHER SIDE'S CYBERNETICS AGENDA

Slava Gerovitch

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As ideas and techniques circulated across political borders during the Cold War, they were often profoundly reinterpreted. Norbert Wiener's Cybernetics (1948) caused a stir among American intellectuals, but Wiener's public defense of liberalism and pacifism tinged cybernetics in the red communist color in the eyes of government officials and drastically limited the basis for its support. The Soviet side, however, perceived American cybernetics as a serious threat, both technical and ideological.

Soviet cybernetics enthusiasts expanded Wiener's definition of cybernetics to include a broad range of computer applications, overturned previous ideological critique, and legitimized cybernetics in the eyes of Soviet authorities. Soviet cyberneticians began to promote a wide-ranging reform in Soviet science and the economy under the banner of cybernetics. In particular, they called for the creation of national automated economic management system on the basis of a countrywide network of computer centers.

When the Soviet cybernetics movement gained strength, the Americans began to show concern. The CIA interpreted Soviet cyberneticians' radical proposals as the indication of an actual decisive turn in Soviet policy, and the Kennedy administration set up a panel to investigate the alleged Soviet lead in cybernetics. In the meantime, the Soviet government paid lip service to cybernetic rhetoric but stalled any practical efforts at a cybernetic reform.

This paper draws on Soviet-era documents and recently declassified CIA reports to suggest a complex picture of Cold War interactions among cybernetics enthusiasts, computer scientists, politicians, and the intelligence community on both sides of the Iron Curtain. Scientists and engineers cleverly manipulated government officials' fears of the emerging "cybernetics gap" to promote their own agendas.

COMPUTING IN RUSSIA BEFORE AND AFTER 1991

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If the USSR missed the computer revolution — at least from the points of view of cultural receptivity and individual connectivity — then in contemporary Russia everybody has joined the internet revolution. From students to grandmothers, from stores to NGOs, ubiquitous computer culture thrives. Even government ministries and President Medvedev himself have superbly informative webpages. This short paper will examine continue and change in computer culture in Russia before and after 1991.

WHEN THE IRON CURTAIN LEAKED: TRACKING EASTERN EUROPEAN AND SOVIET INFLUENCES UPON BELGIAN COMPUTING HISTORY

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In this paper, we explore the working hypothesis of a shadow Eastern European and Soviet influence upon the development of computing in post-war Belgium. This hypothesis is inspired by material collected on post-war Belgian computing history suggesting the circulation of people and the import of writings out of the COMECON region. We here explore some of the traces left out by these circulation and imports, and their roles and impacts upon Belgian computing.

The main part of the paper will be devoted to the exploitation of primary information collected about Belgian computing history towards arguing for an Eastern European and Soviet shadow – and yet possibly significant – influence upon computing at the Université Catholique de Louvain. We will firstly comment on the roles played, in the wake of the 1956 Budapest coup, by the arrival of Hungarian scientists at the Université, with special emphasis on Peter Lipnik. At Louvain, Lipnik acted as computing expert for the local physics group and, seemingly, introduced habits of high standards in physics computing practices, which we relate to his habits of caring for accuracy issues in computing. A second case evoked will be that of Jean Meinguet, director of the Centre de Calcul of the Université. Meinguet's expertise in numerical analysis methods acquired through the ETH, Zürich, and his many readings in German and Russian, which he promoted around him, contributed to the emergence, locally, of numerical analysis research. This also contributed to Meinguet's career as a numerical analyst. These case studies suggest the hypothesis that one – possibly main - cross-fertilisation effect from Eastern European and Soviet influences upon post-war Western European computing was the learning of habits of high standards and caring for accuracy in computing.

In the conclusion, as an attempt to categorise the possible origins of the above phenomenon, we will discuss, along a line developed by Jankovic, on how exposure to equipment of limited comparatively 'backward' technical capacity – as it was the case in the COMECON region by comparison to Anglo-Saxon milieus – implicitly trained in taking special care for issues of accuracy while at performing computations. This will lead us to some analytical comments on how the COMECON region being in a 'catching-up' process in matters of computing technology contributed lead to, and to configure concerns for accuracy in computing practices.

Selected references

Hormigon, M., S. Kara-Murza (1997), "La influencia de las contribuciones cientificas en los aspectos ideologicos de la economia politica," *Archives Internationales d'Histoire des Sciences*, 47, 347-388.

Jankovic, V. (2004), "Science Migrations: Mesoscale Weather Prediction from Belgrade to Washington, 1970-2000," *Social Studies of Science,* 34(1), 45-75.

Lipnik, P. (1997), "Architecture de Mgr. G. Lemaître en arithmétique," *Revue des Questions Scientifiques*, 168(2), 161-178.

JACEK KARPIŃSKI – A POLISH BILL GATES ?

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Jacek Karpiński was born in 1927 in Turin. During the Second World War he fought against occupying forces as a member of underground activity group. He studied at Technical Universities in Łódź and Wrocław. He graduated in 1951. From 1951 to 1954 he worked as senior constructor in ZWUE T-12 (Żerań Factory in Warsaw).

Karpiński was not only an engineer but first of all an exceptionally talented inventor. In the 50's he construed: a shortwave radio transmitter (used by government to communicate with polish embassies), a machine for a weather forecasting and in 1959 AKAT-1 – the first transistor machine build for solving differential equations.

In 1960 Karpiński won the international competition organized by UNESCO for technical talented youths. As a reward he was studying on Harvard and Massachusetts Institute of Technology (1961-62). After his return to Poland Karpińki worked in Polish Academy of Science (in the Department of Artificial Intelligence). He constructed *the percepton* - a machine which recognized an environment with the use of a camera (it was probably the first such construction in the world). But Karpiński is best known as the inventor of two computers: KAR-65 and K-202.

KAR-65 was built in the Institute of Experimental Physics of Warsaw University. It was the main part of scanner for analyses of pictures of elementary particles' collisions. KAR-65 carried out 100000 operations per second (it was twice as fast and thirty times as cheep as contemporary polish computers ODRA). KAR-65 worked until 80's.

In out paper we will focus on the best construction of Karpiński – the computer called K-202. It was the first microcomputer in Poland (produced in 1970-1973). K-202 carried out 1.000.000 operations per second and because of modular construction was able to address 8 MB of memory. (The first personal computer XT IMB in 1980 addressed only 16 kB of memory and speed comparable with K-2-202.) K-202 was the revelation of Poznań Intenationa Fairs in 1971. In spite of his only 30 computers was produced (in cooperation with British company). The government decided to stop the production and to compensation for British partners. The reason for this decision is still unknown. We will compare K-2-202 with computers in Poland and in Europe to justify the claim that it was very good, ingenious construction.

In 1981 Karpiński emigrated to Switzerland. In 1989 he returned to Poland and now he lives in Wrocław.

VLADIMÍR VAND AND SCIENTIFIC COMPUTING

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Vladimír Vand (1911-1968) started his career with the study of variable stars and spectroscopy at the Charles University in Prague. He was a head of the Variable Star Section of the Czech Astronomical Society after young Zdenìk Kopal, later famous astronomer and numerical mathematician. During that time, they published the Variable Star Atlas together.

In 1935 Vladimír Vand began work at the Škoda Company. Here he had befriended Antonín Svoboda, later famous inventor of computer. In the Research Department at Škoda, Vand and Svoboda jointly devoted themselves to the accoustical localization of airplanes, which at the time flew at low speeds, and to developing prognoses of their future positions. They designed an original position locator for use by anti-aircraft artillery, which was based on the concept of the analog solution of differential equations describing dynamics of the airplane.

Shortly after German occupation of Czechoslovakia Vand and Svoboda left country to France. By this time, France and Great Britain had entered into war with Germany. Vand very dangerously travelled to Port Sunlight near Liverpool where he worked in the research department of the Lever Brothers Comp., and he contributed essentially to the theory of viscosity of solutions. In particular, he worked on colloid suspensions and he constructed several viscosimeters. He also started to investigate molecular structure of organic compounds by means of a new roentgen tube.

Later he invented a mechanical calculating machine for X-ray analysis of crystal structures, and cooperated with Francis Crick on the structure of helix DNA molecules by means of Fourier transform. Three models of Vand's calculating machine were constructed: First of them worked in the Cavendish Laboratory, where Lawrence Bragg expressed special satisfaction with Vand's ideas. Second machine was constructed at the Cardiff University and last one served to Vand as experimental machine in his laboratory. A description of his invention appeared in *Nature* **163** (1949), 169 - 170.

In 1954 Vand received the title of Doctor of Science at Glasgow University and in 1961 he became Professor of Crystallography at Pennsylvania State university. He investigated meteoric craters (e.g. the Ries Kessel crater in Germany) and show why tektites have such complicated shape. He published about 160 scientific papers (about 20 in *Nature*). The Web of Science contains thousands of citations of his work. He continued to be a pioneer of numerical methods and computational technologies to the end of his life in 1968.

The special Committee of the International Astronomical Union in honour of Vladimír Vand named the minor planet 129 595 by name "Vand" in 2008. Vladimír Vand was one of outstanding personalities of world science.

SEEING LIKE A STATE? THE "FUNCTIONAL PROGRAMMING SYSTEMS" IN THE CENTRAL PLANNING ECONOMY OF EAST GERMANY

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John C. Scott's late 1990s title "Seeing like a state: how certain schemes to improve the human condition have failed" is a classic analysis of central planning efforts, following the thesis that central planning is basically doomed for failure due to the overwhelming complexity the state is trying to control and the distance of the planner from local implementation. Scott's consideration exemplary reflect the basic problem of finding a balance between the adaption to local need and the abstraction necessary to make a technology ubiquitous applicable that also absorbed contemporaries.

The problem was faced in a nutshell by the software-engineers that created so called "Functional Programming Systems" (Ger. "*Sachgebietsorientierte Programmiersysteme*") – a business software that is often said to have been "East Germany's SAP", long before SAP's solutions came into existence. Software engineers were caught between the urges of the state to create a technology that truly reflected the socialist planning process, a hierarchy of providing information to one's superiors and the (never fully realized) idea of interconnecting the whole economy by a web of data processing centers, while at the same time keeping in mind the requirements of their users. The latter was especially challenging as the software was not only distributed locally in East Germany but also within CMEA, as it formed a part of the GDR's participation in the so called "Unified System of Computing". In a third dimension the software engineers themselves were subjects of a planned technology policy, claiming later that the power elites had never fully realized the potential of the new technology and given away their work far below it's actual value.

Unlike the Unified System that can be said to be a "creative adoption" of the architecture of IBM's /360 series the business software was something groundbreaking new and far from being a "failed technology" - despite the various challenges it had to face. The paper analyzes how business software as a technology came into being in East Germany and how the interrelations between state and technical elites unfolded.

REASONS FOR THE FAILURE OF SOVIET ESTONIAN COMPUTER PROJECT JUKU

Laur Kanger

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The paper will explore the birth, development and eventual failure of Soviet Estonian PC project Juku, which mainly took place in the second half of the 1980s. Insights from actor-network theory, technological systems of innovation theory and multi-level perspective will be employed to account symmetrically for the influence of both, material and social factors. The structuring impact of existing power relations and wider social processes will also be considered to illustrate the "limits of improvisation" of the concerned agents, and turn attention to the "asymmetry of mutual influence".

On the basis of documentary analysis and semi-structured interviews with involved actors, it will be shown how the configuration of various blocking factors – eg the lack of interaction among the supplier-user chain, the difficulties with obtaining the necessary components, the inability to popularize the computer among potential users, the general state of Soviet computer construction etc – coincided in such a way that Juku was rendered obsolete fairly quickly.

SCIENCE AND POLITICS INTERTWIENED: SLOVAK COMPUTING IN THE INTERNATIONAL CONTEXT

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Computer science in Czechoslovakia started to develop soon after the World War II. The Institute of Mathematical Machines in Prague and the Institute of Technical Cybernetics, Slovak Academy of Sciences (ITC) in Bratislava were the pioneering institutions. Initially, the political climate was not supportive of such activities (cybernetics was labeled "bourgeois pseudoscience"). In the sixties, there was a period of political and financial support coinciding with attempts to reform society known as the Prague Spring. It ended when the Soviet military forces occupied Czechoslovakia in 1968. The repressive measures that followed were reflected in a period of restrictions in science. Later, however, the importance of science and, in particular, its application to industrial processes called "electronification and automation" was recognized by the Party. Scientific institutions, including the two main hubs of computer science in Slovakia, ITC and the Slovak Technical University grew in size. ITC peaked with 600 staff members in the 1980s.

In 1974 Slovak industry started to produce computer systems based on developmental work done in ITC. The RPP-16 computers were used in major power plants in Slovakia, including the nuclear power plant and several large industrial companies. The industrial boom was short lived. It came to halt when a political decision of the governments of the COMECON countries was taken to produce functional equivalents of successful Western technology. It resulted in abolishing the production and further development of RPP-16 (even through it was well suited to real-time applications).

The original research in hardware slowed down, too but was less prone to political influence. Following the announcement of the Japanese fifth generation project , the ITC turned its attention to computers of higher generations and, as of 1978, to Artificial Intelligence, Robotics and computer architectures for AI.

The management of ITC put in practice several ideas that proceeded their subsequent general introduction. One of these was an organization of the Base Laboratory where, during its 5 years existence, about 230 visiting scientists from 12 countries worked on long-term contracts.

Despite all the effort and many clever and often novel ideas the gap between the Western products and the production abilities of COMECON countries was widening as the end of the Cold war was approaching.

The paper will explore the most remarkable undertakings of the ITC based on archive materials available from the Institute of Informatics SAS (the formal successor of ITC) and structured and semi-structured interviews with former ITC employees.

TURNING PROGRAMMING LANGUAGE INTO WORKING TECHNOLOGY: COMPILER CONSTRUCTION AT THE AMSTERDAM MATHEMATICAL CENTRE, 1960

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In the Dutch and German cultures of programming in the 1950s a tendency towards abstraction was predominant. One may suggest that the relative absence of computers was significant, but even where automatic computers were available, academic teachers would urge their students to stay away from the machine and sit and think first. Rather than the availability of hardware, we suggest, it has been the tradition of scientific computing in theoretical engineering and science that made this approach prevail. It was this approach which had an easy appeal to fellow mathematically oriented computer scientists across Europe, on both sides of the iron curtain, and which could in a natural way make use of the existing paths connecting mathematicians across the continent.

Leaving open for the moment, the question whether there was such a thing as a central European culture of computing, we study the Dutch case in detail. Given the preference for the abstract, it hardly needs explanation that designing a programming language like ALGOL 60 was a beautiful thing to work on. On the other hand, even a programming tool, which by metaphor is called a language, is meant to be working technique. To “work” it needs to be implemented, that is, a compiler needs to be written to make this language usable on a specific machine. Edsger Dijkstra (1930-2002) and Jaap Zonneveld (1924-) of the Mathematical Centre in Amsterdam gained fame by writing the first ever compiler for ALGOL. Their cooperation beautifully illustrates the double face of the European approach to programming. While Zonneveld needed the compiler to actually use ALGOL for his computations, Dijkstra’s zeal was the proof that such a thing could be designed. Zonneveld used it. Dijkstra went across Europe, from Brighton to Novosibirsk, to offer his thoughts on this approach.

WESTERN EFFORT, INTERNATIONAL ALGOL 60: COMPILER CONSTRUCTION IN CZECHOSLOVAKIA IN EARLY 1960s

Helena Durnová

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SAPO, the first computer in Czechoslovakia, put into operation in September 1957, was a five-address computer. These five addresses made the structure of the computer more accessible to the first programmers in Czechoslovakia. Such is the claim of the first Czechoslovak programmers, who began designing programmes before they had even seen a working computer.

From the start, mathematicians were working around computers (then called mathematical machines) together with engineers and physicists: in the late 1940s, the first courses on mathematical machines were held under the auspices of Václav Hruška (1888-1954), professor of mathematics at the Czech Technical University in Prague, and in 1950, the small, but rapidly growing community of people interested in computers found a working space in the Academy’s Central Mathematical Institute directed by the topologician Eduard Čech (1893-1960).

Considering this setting, it is not surprising that close connections were maintained between the (since 1958 non-academic) Research Institute for Mathematical Machines (VUMS) and the Faculty for Mathematics and Physics of Charles University (Prague), directed by František Nožička (1918-2004). Doctoral candidates from VUMS defended their theses in Nožička’s department. Following the institutional transformation of the (academic) Institute for Mathematical Machines, this department also provided a refuge for the members with academic ambition, a.o. Jiří Raichl (1927-1990) and Olga Pokorná.

The western, namely German and American, effort to design a universal algorithmic language for programming computing machines fell on fertile ground in Czechoslovakia. The work on the ALGOL 60 compiler started soon after the publication of the *Report on the algorithmic language ALGOL 60.* The first compiler was constructed for the EPOS computer by Imlauf, Sedlák, Kindler, and Raichl. Theoretical work on compiler construction by Jiří Raichl, Jan Sedlák, and Evžen Kindler dates from early 1960s. ALGOL 60 compilers for other computers used in Czechoslovakia soon abounded: FEL ALGOL and TESLA ALGOL are two examples of ALGOL dialects for the MINSK 22 and TESLA computers respectively.

The frequently quoted disadvantage of ALGOL 60 in comparison with FORTRAN, the missing handling of input-output in ALGOL 60 report was considered a necessity, even an advantage, by the compiler writers. It remains to be shown why the intellectual quality of ALGOL 60 and later of ALGOL 68 was valued so much by most computer scientists on the Eastern side of the Iron Curtain.

Symposium S59
Instruments for Modifying and Enhancing Oneself and their Social Impact: The Case of Amphetamines and Some of their Derivatives

BLACK BILE TREATMENT BY RÂZÎ (865 – 925)

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The treatment of black bile disorders was very difficult for medieval physicians because of unexpected dangers for body during the care. We have examined various medical treatises of Rhazes concerning black bile. We are interested particularly to diet and care to food and drinks products (Aromatized wine, Honey, *Oxymel*, and varieties of Si*kandjibîn*). Beside the basic drugs, these complementary handlings help the physician to adapt the treatment for each patient with his particular temperament.

WHEN 'MODIFYING THE SELF' IS A COMMAND: AMPHETAMINES AND THE ALLIED MILITARY IN THE SECOND WORLD WAR

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The Allied forces in the Second World War dispensed amphetamine to its men for use in combat, much as the Germans supplied methamphetamine. By examining the testing programs behind the decision of the British and American militaries to supply amphetamine, I argue that the main type of 'enhancement' determining the adoption of the drug was its effects on mood and 'morale'. I further explore the relation of this official non-medical use of the drug to military medical thinking at the time, offering some speculations on the typical pattern of combat usage. I conclude with reflections on the limits of the concept of 'self-modification' as a concept for understanding modern 'technologies of the self', arguing that it is necessary in some cases to revert to a more traditional notion of coercion (albeit more or less diffused).

Nicolas Rasmussen, On speed, the many lives of amphetamines, NYU press, New York, 2008.

BIRTH, GROWTH AND DECLINE OF A BIO-POWER : SOME REMARKS ON THE CARRER OF THE FIRST SYNTHETIC PSYCHOTROPIC DRUG, AMPHETAMINE

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The use of molecular instruments to shape the state of mind of individuals suffering from various so-called psychiatric diseases is nowadays of growing importance. Indeed, it has become of common practice to treat psychiatric conditions with synthetic psychotropic drugs. The same instruments are also used to obtain enhancement of some human abilities.

Two recently published books trace back the history of these pratices to the discovery and use of amphetamine (N. Rasmussen, *On speed, the many lives of amphetamine*, NYC, NYU Press, 2008 and P. Nouvel, *Histoire des amphétamines*, Paris, PUF, 2009), in the 1930's. Amphetamine were used to treat a large variety of conditions ranging from Parkinson disease to see-seakness, including mild psychiatric conditions (such as depression) and a kind of disorder that was to become known under the name of ADHD (attention deficit hyperactivity disorder). At the same time, amphetamine began to be used as "enhancement drugs".

The two books describes the carrer of amphetamine. However, they both have different emphasis. Moreover, they suggest a slighlty but significantly different notion of what the term "bio-power" can mean, based on historical analysis.

In this paper, one will present the notion of bio-power according to each of the two authors. Issues that are uderlined by both will be discussed.

Pascal Nouvel, *Histoire des amphétamines*, Paris, PUF, 2009.

A CONCEPTUAL HISTORY OF THE NOTION OF BIO-POWER

Dominique Lecourt

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The social and political impact of technical instruments that can affect human behavior has been tentatively conceptualized by a suggestive term coined by Michel Foucault : *bio-power*. This neologism was introduced to depict a new kind of relationship between technique and life, which, Foucault claims, appears in Europe in the course of the XVIIIth century.

Georges Canguilhem, the master of Michel Foucault, is wellknown for its analysis of normativity in living organisms. However, a carrefull attention to the developpment of his work shows that it is grounded on a meticulous and thorough refelexion on the relationship between life and technique which, in turn, is based on carreful reading of Descartes, of course, but also of Ernst Kapp, Ramon Turro, Eugène Dupréel, as well as some others.

The relationship between technique and life appears to be the core issue that shape the notion of bio-power. In this paper, a genealogy of the concept will be presented and discussed.

Dominique Lecourt, Humain, post-humain, Paris, PUF, 2003.

'MAKE ME SMARTER': AMPHETAMINES AND THE QUEST FOR COGNITIVE ENHANCEMENT

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Amphetamine consumption among students and academics aiming at enhancing their productivity has received a growing attention in these last years. This phenomenon, however, is not new. The first report on amphetamine use for non medical purposes among university students appeared in 1937, i.e. as soon as amphetamine became available in tablet form in the United States. In the same years, the psychostimulant effect of amphetamine in healthy individuals and in hospitalized patients were reported by medical studies in the United States and in Europe. Likewise, the first medical studies on the effects of amphetamine on children hospitalized in psychiatric institutions reported a significant improvement in children's learning capacity, mood and behaviour.

During the following decades, the consumption of amphetamine among students commanded little medical attention: amphetamines were considered safe medications and their psychostimulant effect did not seem markedly superior to that of caffeine. Subsequently, however, amphetamines have been increasingly redefined as being addictive, powerful and potentially dangerous medications. They became available only through prescription and nearly exclusively for the treatment of Attention Deficit Hyperactivity Disorder. Non-medical consumption for intellectual enhancement has become illicit and, to some extent, a morally questionable sort of cheating. The developments in neurosciences and pharmacology and the debate on 'medical enhancement' are, however, reshaping the issue. The extention of off-label prescription of psychostimulants and other cognitive enhancers to patients with neuropsychiatric disorders and conditions impairing their mental abilities, the introduction of new drugs, and the availability of drugs through online pharmacies blur the boundaries between medical and non medical use and make restrictions to cognitive enhancers use obsolete.

This paper retraces the history of the medical discussion on the psychostimulant effects of amphetamines and discusses the scientific and social dynamics underpinning the emergence of the concept of cognitive self-improvement.

Symposium S60
Colonizing Drugs – Constructing the Other in the Mirror of (Precarious) Substances

WILL THE REAL COLONIZER PLEASE STAND UP? EARLY MODERN CONTROVERSIES ON THE EFFECTS OF TOBACCO ON THE WESTERN BODY

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Hailed variously as philosopher's stone and cure-all for all kinds of maladies (including the Great Plague) and passionately condemned as deadly poison and barbaric custom, the reputation of tobacco in the Western world has, from its arrival in the late 16th century up to today, been the subject of bitter controversy. The pharmacological promises of the beginning were soon disappearing into irrelevance in comparison to its recreational significance.In England, where it had spread rapidly after the magic date of 1565, the King himself felt obliged to start the first nation-wide anti-smoking campaign in order to save his subjects from the destructive powers of this „noted weed" (Shakespeare, sonnet 76). But neither his contemporaries, nor, in the next generation, Milton or Dryden, or their later successors in the realm of literature and culture (Charles Dickens, Virginia Woolf, Wordsworth, Mark Twain, to name just a few) would listen to the warning.

Based on late sixteenth- and early seventeenth-century writing the paper will pursue how tobacco is placed within an emerging discourse of power, that has freed individuals and nations from the constraints of a God-given order of things, and led them to appropriate new worlds with all the resources that these seemed to offer. After tobacco had been brought to Europe from South America, *aficionados* rapidly created their own culture around the plant, 'translating' and adapting its original use to the European mindset. Tobacco was thus part of a process of colonization, that used and appropriated resources from other cultures, creating characteristic patterns of colonization.

But the advent of smoking also marks a reverse moment, which is supported by the same discourse of power and its concomitant revolution in the use of the Western body: the abject qualities, the toxic substance of tobacco here serve as colonizing agents of the body itself and turn tobacco into a telling instance of control over whatever is Other to the Self.

RELIGION – PHARMACY – TRANSFER OF PHARMACEUTICAL KNOWLEDGE AND DRUGS MEN OF GOD AS MEDIATORS BETWEEN THE CULTURES (16th TO 18th C.)

Sabine Anagnostou

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In the context of the European expansion in early modern times a close connection between mission and pharmacy developed. While the theological reasons for this relation can be traced back to the origin of Christendom, in the context of the colonial situation, the beginning globalization and the worldwide mission in Early modern times it became a significant factor for the exchange of medical-pharmaceutical knowledge between different cultures, the transfer of medicinal drugs and the change of different materiae medicae. Motivated by the Christian principle of charity, missionaries, especially Jesuits – either apothecaries and or men with certain pharmaceutical knowledge –, explored the foreign regions of the missions for medicinal drugs to provide the population with affordable remedies as the local medical supply often was poor. At the same time Jesuit apothecaries ran pharmacies in the centres of urbanization and added genuine plants to their stocks that also were provided with traditional European products. While the missionaries transferred the European materia medica and scientific concepts overseas and laid the base for the development of an institutionalized pharmacy there, they explored their surroundings for in Europe unknown, often ethnomedical drugs that they later integrated into the European materia medica and also introduced in other mission countries. The missionaries learned from the traditional indigenous expertise, from their own personal experience and studied the contemporary European scientific literature like pharmacopoeias and herbals or famous works about exotics. Pharmaceutical-botanical manuals like the *Materia médica misionera* (18th c.) by the Jesuit Pedro Montenegro (1663–1728) in Paraguay as well as recipe books and inventories of pharmacies in the mission countries give testimony for the pharmaceutical practices in the mission countries. By their medical-pharmaceutical activities the missionaries functioned as mediators between Europe and the colonies. It was the Society of Jesus, the most successful worldwide acting order during the colonial period, who established a global network for medical supply and the exchange of medicinal drugs. The centres of this complex pharmaceutical network were the pharmacies of the order in the mission countries of the Spanish and Portuguese Empire and in Europe. Their activities led into a worldwide exchange of drugs besides the commercial drug trade. This international drug transfer between the continents enriched many different materiae medicae and also introduced foreign medicinal drugs in Europe. Finally, the traditional healing plants of different ethnic groups described and used by the missionaries would definitely be worth to be investigated further to evaluate their potential for modern phytotherapeutics.

DRUGS FROM THE MOUNTAINS: COCA AS AN EXOTIC TONIC (CA. 1850-1900)

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In 1858, the Italian physician Paolo Mantegazza started to publish his findings on the effects of Coca leaves on the European mind and body. Throughout the next decade, he continued to hail the drug as a cure-all for stomach ailments, neurological and mental problems (hysteria, depression) and agreed to prior judgements that Coca was a precious tonic to prevent physical exhaustion. In addition to the two categories of nutrients that Liebig had distinguished (plastic and respiratory nutrients), he postulated that there was a third category, namely nerve nutrients, including, amongst others, Coca, coffee, mate, and alcohol. His main argument for opening up this new category was that these substances all had considerable effects even in a small dose. In this respect Coca as focussed by Mantegazza is can be taken as an example of "precarious substances", hence, substances whose effects are highly desirable and potentially beneficial, yet also potentially dangerous and difficult to predict.

One year later, the main alcaloid of coca was isolated by an assistent of Friedrich Wöhler, but only in the 1880s did cocaine begin to play a dominating role in comparison to the Coca leaves. When focussing on the late 1850s and early 1860s one can individuate a pan-European discussion on the effects of Coca leaves and on the difficulties of stabilizing their effects in clinical experience and physiological experiments. These debates coincide with a growing interest of Europeans in the Latin American States and their economical resources. Hopes, ethnic stereotypes and deeply rooted patterns of Europeans thus intersect in Coca's history in 19th century Europe. Coca's fate in 19th century before the stabilization of Cocaine as a local anaesthetic and its simultaneous spreading as a psychoactive drugs thus throws a light on the following development of 20th century drug culture in the industrialized states.

THE *TOXIC TOTAL SITUATION*: PRESERVATIVES AND THE CRITICAL CONSUMER AROUND 1960 IN WEST GERMANY

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In the late Fifties and early Sixties the regulation of food additives represented a remarkable turning point in German consumer politics, establishing a debate about decision making and policy advice, altering the discourse of purity and contamination, and inaugurating a new political actor, the organized critical consumer. The amendment of the Food Law in December 1958 functioned as a negotiation process between representatives of science, industry and the state, which was institutionalized in the Senate Commissions of the German Research Foundation. While these Commissions for preservatives, foreign matter and colorants worked behind closed doors, a public discourse about the "toxic condition" of modern life and the negative role of the pharmaceutical and chemical industry gained strength. The catchphrase of a "toxic total situation" (toxische Gesamsituation), coined by Fritz Eichholtz, director of the Pharmacological Institute at the University of Heidelberg and member of the commission for food preservation, thereby instructed a far-reaching debate on the boundaries of risk assessment and the uncontrollability of chemical substances.

The recurrent theme of this speech will be the controversy about the admission of hexamethylenetetramine (hexa), which took part at a crucial moment around 1960. Hexa was used as a preservative in the fish industry. But its anti microbial effectiveness was caused by the decomposition of hexa to formaldehyde. Despite the commission's verdict against hexa, the lobbying activities of the industry granted it a reprieve. In the media, the case of hexa was seen as a touchstone for the capacity of negotiated decision making and the ability of rational scientists to resist the demands of industry. Finally, in 1963 it was the new political actor of the organized critical consumer, heir and successor to the housewife federations as well as to "purists" advocating life reform, who, supported by the media, enforced the prohibition of hexa as a preservative. The contradiction of negotiated risk management and fundamentally precarious substances was the condition for the formation of a new way of politics in the early 1960s.

STANDARDIZING SLEEPING-SICKNESS THERAPY AS A PRECARIOUS GERMAN-BRITISH-BELGIUM-SPANISH COOPERATION IN THE INTERWAR PERIOD

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Sleeping sickness is a severe parasitic disease that infects both humans and cattle. During the interwar period the world was relieved when Bayer, a German pharmaceutical company, released the message that it had found a drug effective against this disease, Bayer "205". What was now needed was a standard treatment with the new drug. German researchers went to Africa in order to conduct clinical research, aimed at finding a reliable and efficient therapeutic standard. The medical scientist went into colonized countries, colonized by other European powers, because Germany lost its colonies through the Versailles treaty.

Friedrich Karl Kleine, a parasitologist and later director of the Prussian Institute for Infectious Diseases, went on a research expedition between 1921 and 1923, funded by Bayer pharmaceutical company, and co-financed by the Imperial Colonial Office and the German Research Funding Organisation, DFG. The patients he experimented on lived in British, Belgian and Spanish colonies in Africa. The therapy with Bayer "205" was successful, insofar as an acceptable dosage was found. But establishing standards, by definition, requires constant verification and revision, as part of an ongoing process. It was therefore not an unusual proposal when in 1928, Johannes Zschucke, a German physician with colonial experience, travelled to Fernando Poo – an island at the Westafrican cost, Spanish colony, for a subsequent prolonged study on sleeping sickness and its therapy. He tested the efficacy of Bayer 205 against the arsenic substance Tryparsamid.

This example from the German post-colonial era will show the precarious situation of the German researchers in the foreign colonies, they were seen as colonial masters but weren't, they were guest who needed the permission of the colonial power and cooperation of the indigenous people to perform clinical trials. The situation for the indigenous war precarious as well, they weren't asked for the human trials they were forced to join. For the high estimated drug Bayer "205" the situation became precarious in the clinical trials performed by Zschucke.

TEST SYSTEMS AND MUTAGENS: THE REGULATION OF SCIENTIFIC, CONSUMPTIVE AND DANGEROUS OBJECTS

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Mutagens are simultaneously both required and avoided substances. They are "substances of transformation," but also "genetic poisons." Their transformative qualities destined mutagens to become unavoidable instruments within genetics and molecular biology. Since the 1960s, however, mutagens have defined a trans-disciplinary problem of risk policy. Substances such as radioactive particles from fall-out and the nuclear industries, pharmaceuticals, chemical supplements in the foodstuffs industry or pesticides (like DDT) were silent, efficient and ubiquitous. The precarious status between efficiency and (dangerous) autonomy formed the key characteristics of mutagens that nurtured the ambivalent career of mutants.

The ubiquitous threat of mutagens coincided with the emerging era of mass consumption in the early 1960s. Less well known, however, is the process by which, in the same period, the environment became an object of 'science-politics,' while Western governments only launched their environmental programs in the early 1970s. Governmental policy widened its focus from closed circuit of production and consumption towards a general ideal of "environmental hygiene" and "biopolitics of life as a whole"? Scientists were involved on a rather high level. Their function in that process corresponds quite well with that what Sheila Jasanoff has described as "regulatory science" for the 1970s.

However, part of this story is the establishment of the instruments that should provide scientists with crucial information about the harmful potential of substances. These instruments were called experimental "test systems" that should work as standardized detectors of the mutagenic and carcinogenic harms in question. In the 1960s, efforts were made in several countries to find out what the best systems were. The discussions were about the right animal model to use, procedures of extrapolation on human physiology, and the still about the very nature of biological processes involved.

Concerning "instruments" the question is how these test systems were negotiated since several interests were at stage at the same time. The talk should give an insight in theses debates in Germany that resulted in the organization of the "risk episteme" of mutations and that differed in some respects to similar efforts made in the USA. It also intends to show how these discussions connected instruments, problems and concepts of molecular biology with social affairs.

Symposium S63
Entanglements of Instruments and Media in Investigating Organic Worlds

DEFINING LIFE IN THE EIGHTEENTH CENTURY: INSTRUMENTAL REASONING, EXCITABLE MATTER AND LIVING SUBJECTS

Joan Steigerwald

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This paper will examine the debates over irritability in the mid-eighteenth century. Albrecht von Haller is attributed with making irritability central to animal function in the 1750s by defining it as the capacity of muscle fibers to respond to stimulus and contract. But many physiologists resisted the introduction of a new capacity of irritability that did not fit into extant conceptual frameworks. Haller's definition of irritability and the place he gave it in the animal economy was particularly contested by the "nerve patrons" as it denied sensibility and the nervous system the governing role in all animal function. Indeed, irritability had an equivocal status amidst the competing physiological systems of the eighteenth century. The dispute over irritability also became entangled with other areas of natural philosophy and medicine from chemistry and pharmacology to electricity.

Haller's definition of irritability was instrumental, based on the perceived responses to stimulus in living animals. The many trials provoked by the dispute brought to attention new phenomena of organic vitality and the problems arising in the experimental investigation of organisms. Despite Haller's repeated attempts to provide definitive instrumental demonstrations, to inscribe his conception of irritability into the organic material, the phenomena manifested in experiments on living animals and organic materials remained variable and unstable. The debates surrounding irritability not only made it into a significant matter of concern, but also enlivened it as a phenomenon, making it more complex than Haller's initial definition suggested. In the process, the instrumental reasoning introduced to define the organic properties of irritability and sensibility by Haller was shown to involve fundamental indeterminacies; both the instruments and the judgments made with their assistance were opened up to critical interrogation. In asking questions of organic parts, instrumental investigations gave life to organic matter; but life also answered back, posing questions of instrumental reasoning. Reading and indeed writing the signs of organic vitality involved entanglements of instruments, organic material and living subjects whose meanings were ambiguous.

THE VERY NERVOUS APPARATUS ENTANGLEMENTS OF MEDIA, MIND AND MATTER

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Electrification, the integration of human societies into networks of communication and power, did not stop at the outside borders of the human body but resulted in the construction of an electro-technological framework for neurophysiology. From the telegraph to the computer, communications media dominated brain theory as conceptual tools while also serving as investigative instruments, and Marshall McLuhan's famous statement that man set outside a model of the nervous system with the arrival of electrical communication technology echoed a conviction fairly common within the scientific community since the 19th-century. As an effect of the mobilization of technology for sensing, reading, recording, transmission, inscription, and stimulation, the brain was quite literally turned into a nervous apparatus. The very productivity of this articulating chain hinged on the interchangeability of the positions within the system, where nervous preparations served as sensitive detectors of electrical currents, and were studied as media communicating such currents to recording instruments. While Hans Berger tuned his recording media to the electrical musings of the brain, the neurosurgeon Otfrid Foerster, pioneering intra-operative electric stimulation, was praised as "guiding his patients like a musician his cello." Next to the spaces where electric shock became the convenient mass treatment for social disintegration, Wilder Penfield used the stimulating electrode to probe mind and memory. More recently and with the arrival of functional imaging, the realism of computer graphics was being employed to reveal the artificiality of the human soul. Before hasting to such a conclusion, one may reconsider another of McLuhan's famous statements, e.g. that only the rupture in the transition to a new media system opens the space for investigating the articulation of the very process of mediation.

RESPONSE-ABLE EXPERIMENTATION WITH TOXIC ALGAE

Astrid Schrader

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"And say the animal responded?" is the title of a lecture and a question Jacques Derrida puts before the entire tradition of Western philosophy, which, according to him, has always said the same: that the animal cannot speak and therefore it cannot respond. Response must be distinguished here from a reaction. Nobody doubts that an animal can react to environmental stimuli, instinctively or programmatically according to its 'genetic code'. A genuine response, however, it is said, requires the *logos*, reason and speech, which are proper only to 'the human'. According to such a view, only humans have culture, history and memory that can evolve independently from genetic determinations.

As Bruno Latour has pointed out, such a fundamental distinction between humanity and animality manifests itself in scientific inquiries as *a priori* separation of the epistemological question of 'how we know' from the ontological status of the 'medium' to be probed. Following Latour I ask, what if microorganisms have a history that cannot be reduced to either the history of their discovery or their 'natural' evolution in time? Can we imagine a 'history' of microorganisms dissociated from the possession of the *logos* that manifests itself in the variability of relations between 'organism' and 'environment' or 'medium' and 'instrument'? In other words, what kind of experimental (con)figurations would enable microorganisms to respond to scientific questions?

In tracking discrepant experimental enactments of a toxic microorganism – the fish-killing dinoflagellate *Pfiesteria piscicida* – that seek to provide evidence for their toxicity, I explore various ways of how the entanglement of 'apparatuses' and 'media' are resolved experimentally. Complicating a Latourian analysis, the toxic microorganisms under investigation are neither plant nor animal, but can act as both depending on environmental and experimental conditions. Their 'identities' and reproductive strategies are contingent on a 'history' of intra-actions with other kinds of organisms. I argue that experimental attention to the response-ability of the 'object of study', the enactment and maintenance of its ability to respond has consequences for the responsiveness of the scientific practice to the larger question at hand. Would it be possible to link responsibility in science to response-able experimentation?

GENERATING "ANXIETY LIKE PHENOTYPES" IN THE ELEVATED PLUS MAZE: A MEASURE OF MOUSE ANXIETY OR A MODEL OF HUMAN ANXIETY?

Nicole Nelson

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In the laboratory, mice are often used as models for humans, entering into experimental configurations in ways that humans cannot. But, they are also organisms with their own natural histories and (sometimes unpredictable) behaviors. How do behavior genetics researchers, who deal with live, "behaving" animals, rather than animal tissue, reconcile the mouse as model with the mouse as natural object? In this paper, I will explore how naturalistic and anthropomorphized visions of the mouse are blended together in the study of anxiety. Using ethnographic data from a behavior genetics laboratory, I will look in detail at how researchers measure anxiety in mice using one widely used behavioral test, the elevated plus maze.

The elevated plus maze consists of two long platforms arranged in a "plus" shape, and lifted off of the floor. One arm is protected on all sides by walls, and the other arm is open, with only a platform and no walls surrounding it. The mouse's level of anxiety is measured by comparing how much time it spends in the protective closed arm versus the exposed open arm. The validity of this test for anxiety is narrated in two different ways: as a test that takes advantage of the natural instincts of the mouse, and as a test that has been confirmed by using human anti-anxiety drugs. The ethological explanation argues that this is a valid test because mice naturally avoid open, exposed places, such as the unprotected arm of the maze. The pharmacological explanation argues that this is a valid test because when human anti-anxiety drugs are given to the mice, they will spend more time in the open arms.

These explanations are not incompatible or mutually exclusive; rather they show two different senses in which the mouse is being used as a model. The pharmacological model of validation suggests that the mouse is useful because it shows patterns of behavioral response to drugs that are consistent with human responses, but it does not require that researchers understand what the mouse is experiencing. The ethological explanation portrays the mouse as an entity capable of experiencing something "anxiety like" that is similar to human anxiety, not just as a biological detector for drug effects. Balancing each of these explanations means that scientists can flexibly argue that their research is more or less applied: intimately connected to the mouse as model for humans, or exploring the nature of the mouse itself with more tenuous connects to the human world.

THE USE OF COMPUTER SIMULATION IN STUDYING BIOLOGICAL EVOLUTION: PURE POSSIBLE PROCESSES, SELECTIVE REGIMES AND OPEN-ENDED EVOLUTION

Huneman Philippe

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This talk will investigate the relations between biological evolution and computer modeling of evolving entities through natural selection. It argues that what is proper to algorithmic evolution is that the selective dynamics of one modeled entity - for ex. genes, or species - is happening in the simulation with no immediate entangling with other levels of a hierarchy, unlike in biological evolution, where all the levels of the biological hierarchies are present together and their selective dynamics are entangled. This amounts computer simulation to propose "pure possible processes" of evolution, i.e. processes for which we know what kind and level of selection is at work.

Computer modeling therefore suggests processes as candidate explanations for the patterns of evolution we see out there. For this reason, computer science is likely to suggest new kinds of evolutionary processes whose outcomes would be discontinuous patterns of evolution. On this ground we can finally undertake the classification of simulations in terms of the possible patterns of evolution they could yield, especially their potential for open-ended evolution. Hence the last section of the paper will revise in this light typologies of evolution in AL proposed by Bedau and Packard, Channon and others, that tried to classify the kinds of increasing complexity AL could reach.

RECALCITRANT INSTRUMENTS, OBJECTS AND INVESTIGATORS IN THE NON-INVENTION OF A NON-INVASIVE PRENATAL GENETIC DIAGNOSIS TECHNIQUE

Aryn Martin

York University, Canada

This paper tells the story of "NIFTY," a multi-laboratory, multi-million dollar, decade-long clinical trial whose aim it was to isolate fetal cells from pregnant women's blood for prenatal genetic testing. Despite initial optimism about the simplicity of the task at hand, an abundance of both material resources and good will, and constant efforts to discipline the humans, machines and cells involved in the network, the outcome was a judged by the participants to have been a failure in its aim of demonstrating the feasibility of such a technique. When interviewed, participants agreed that the results were disappointing, but there were as many justifications for the failure as there were interviewees. Explanatory resources ranged from funding rubrics ("it should never have been called a clinical trial"), to problems of trust, to differences in tacit knowledge, skill and patience ("some researchers just have better hands"), to problems of consensus ("we lacked a common protocol"), to instrumental sensitivity, to recalcitrance of the phenomenon ("it's like looking for a very small needle in a very large haystack"). Hence, the failure was distributed across the delicate socio-technical apparatus of the collaboration. While investigators treat the huge study as a somewhat embarrassing footnote in their careers, it presents a number of puzzles for S&TS analysis. Inspired by Hans Jorg Rheinberger's ideas, this paper explores the effect of this trial on the status of the fetal cell as an epistemic thing, and the unexpected success of this collaboration as a "generator of surprises," both material and social.

EXCITABLE MEDIA: INTRA-CELLULAR SIGNAL TRANSDUCTION AND INTRA-ACTIVE MODELS OF CELLULAR LIFE

Natasha Myers

York University, Canada

This paper experiments with expanding the frame of ethnographic analysis to include—among all the other instruments, objects, and media in the experimental scene—the affects and gestures scientists perform while crafting models of molecular and cellular activity. My ethnographic research among structural biologists who build models of molecular structures has evidenced a range of affects integral to both the labour of model making, and to the articulation of structural knowledge as scientists work through hypotheses and communicate with others. These affects include a range of gestural excitations that mimetically transduce the forms and movements of molecules, and which animate how researchers speak and write about the objects that they lovingly and painstakingly model. The question that propels this paper is: What model of cellular life emerges when researchers' affective entanglements with their objects, instruments, and media are infolded into the analysis? How are scientists' feelings, aesthetics, and desires generated in the experimental milieu, and how do these affects inflect how scientists imagine and represent cellular processes?

Here I build on Karen Barad's (1996, 2007) theory of "intra-action" which calls attention to the impossibility of disentangling experimenters from their objects and instruments, such that the phenomena that are produced in a given experimental setup are expressions of an entire configuration of elements. Barad's theory operates to decentre both the scientist as the directive force organizing the experiment, and the object as the primary determinant of the phenomenon registered by the "apparatus of observation." I expand this analysis to include researchers' articulate bodies and imaginations as kinds of media that can intra-act with and so transform other elements in the experimental configuration. For me, the entire scene of experimentation acts as a kind of *excitable media* through which much more than data referring to the experimental objects are propagated. That is, as an excitable media, the experimental scene can generate affective entanglements between the experimenter and their objects. These intra-actively generated affects—including sensations and sensibilities—can in turn transform both how scientists represent and imagine the objects they study.

This paper extends this analysis to visualization techniques that are used to model the molecular and cellular structures involved in the *transduction* of signals within and between cells in organisms. Such structures include, for example: the plasmodesmata found in plant bodies that tether adjacent cells to generate a continuous tissue that can conduct signals through the cytoplasm of all cells in a plant; and the chains of protein molecules involved electrochemical pathways of excitation and activation that transduce signals from the environment into cells. In this paper I explore the range of images, models, and narratives of signal transduction and cellular excitation currently propagating among researchers. My aim is to observe how these emerging models of cells are themselves transductions of the excitations and affects generated in the excitable media of experimentation.

Symposium S64
Working with Pages and Texts

WORKING WITH TEXTS AND SPACES TO EXTRACT SQUARE ROOTS IN MEDIEVAL SANSKRIT MATHEMATICS

Keller, Agathe

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This presentation will analyse several rules to extract square roots as stated in the *Āryabhatīya* (Vth century) commented by Bhāskara (Vth century) and Sūryadeva Yajvan (XIIth century) and in the *Patiganita* (ca Xth century) commented upon by an anonymous commentator. The study will focus on how the text of the algorithm is worked upon by these different authors. It will also analyze the relation these algorithms have with the working space on which it should be carried out.

FROM QUARRY TO PAPER: CUVIER'S RECONSTRUCTION OF MONTMARTRE TERTIARY MAMMALS

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CH2ST EA Modernités et Révolutions Université Paris 1 Panthéon Sorbonne, France

In 1798, Cuvier announced the discovery of an unknown animal in the gypsum quarries of Montmartre. This first announcement was the starting point of a long enquiry which led him to set up the paleontology of the vertebrates. Cuvier published the results of his research work in his famous *Research of fossil bones* of 1812.

In this paper, I will explore how Cuvier reconstructed these extinct species by mobilizing intellectual, material and social resources. I will focus the analysis on Cuvier's working practices like dissecting, scratching, cleaning, pasting, assembling, drawing, corresponding, classifying. Yet, these practices, typical of the museum culture of collectors and taxonomers, were associated with an innovative methodology borrowed from comparative anatomy and an interest in antiquarian research.

The paper aimed to show how Cuvier managed to reconcile these very instable and mixed approaches in his textual reconstructions by using logical, visual and rhetorical means.

LABORATORY WRITING

Hans-Jörg Rheinberger

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This paper is concerned with forms of writing that characterize the laboratory, a research place where scientific knowledge is made to emerge and can be grasped in its emergence. Laboratory notebooks and other forms of research inscriptions have received increasing attention in recent years. With few exceptions, however, the epistemic function of such notes in the overall order of knowledge production has been widely neglected.

This paper tries to compensate for this neglect. It highlights some facets of the productive function of particular forms of laboratory writing in the process of knowledge acquisition. In other words, it considers laboratory writing in its epistemic positivity.

The first part describes some characteristics of individual, primary laboratory 'write-ups.' As an example, a short case study on the research notes of the German geneticist Carl Correns follows. The paper closes with a few remarks on collective forms of laboratory writing.

THE SIGNIFICANCE OF PARATEXT IN BUFFON'S *HISTOIRE NATURELLE*

Stéphane Schmitt

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Buffon and his collaborators' *Natural History* was one of the most important editorial enterprise in the 18th century, since the first edition, published from 1749 to 1789, was composed of 36 quarto volumes. It was very successful and had many editions, in French and other languages, and it was far more widespread than, for example, Diderot and d'Alembert's *Encyclopédie*.

This work was studied by historians from a diversity of standpoints, especially conceptual and stylistic ones. But whereas scholars have emphasized its importance in the history of ideas (on anthropology, embryology, evolution, etc.), they have generally neglected the material aspects, such as the very rich illustration

Here we would like to give some elements on the paratext, i.e., according to Jean Genette's definition, the different things that accompany the text himself, like titles, title pages, prefaces, index, etc. We argue that these elements often have a significance and that historians have to take them into account when studying scientific books.

A MATHEMATICIAN WRITES WITHIN A GIVEN GENRE: BOOKS OF MATHEMATICAL RECREATIONS BY DÉNES KÕNIG

Mitsuko MIZUNO

REHSEIS, France

Dénes KÕNIG published *Theorie der endlichen und unendlichen Graphen (Theory of finite and infinite graphs)* in 1936, in which he put various problems orderly, and discussed them as an integral part of a theory he shaped, that is, graph theory. This book written in German was translated into English, and became well-known in all over the world.

Before working on this treatise, he had also published 3 other books in Hungarian, which were not translated into any other languages.

His first 2 books are *Mathematikai mulatságok (Mathematical recreations)*, published successively in 1902 and 1905, when he was still a student. In addition, in 1918, he published a treatise, *Az analysis situs elemei (The elements of analysis situs),* where he treated many topological problems, but nothing related to mathematical recreations. In 1920, he published a textbook of mathematics, *Mathematika: Mûegyetemi elõadás építész- és vegyészhallgatók számára (mathematics: polytechnic lecture for architect and chemist students)*.

I will direct my attention mainly to problems related to mathematical recreations, therefore mainly to the books in 1902 and 1905. How did KÕNIG treat problems related to mathematical recreations in these books?

I will compare the books in 1902 and 1905. The 1905 book contains many problems which will be treated again, but in a different way in the 1936 book, while none of the problems from the 1902 book are treated in the 1936 book.

Depending on these examinations, I will consider the role played by KÕNIG's earlier works on mathematical recreations in KÕNIG's later works on graph theory. In particular, I shall try to distinguish the two kinds of mathematical recreations that are treated in the 1902 and the 1905 books.

FOCUSING ON ACTUAL MANUSCRIPTS TO DISCUSS WHAT THE GENUINE TEXT OF EUCLID WAS – REEXAMINATION OF TRADITIONS OF EUCLID'S *ELEMENTS*

Ken Saito

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Since the publication of Heiberg's critical edition published in 1880's, all studies of Euclid's Elements have been developed on the assumption that it offers the best available tradition of this work.

Knorr's study (1996) of a particular manuscript preserved in Bologna–transcribed by Heiberg and attached to his edition as an appendix, which had not attracted the attention of scholars–has revealed that the mainstream Greek tradition has suffered considerable later alterations and additions at least in Book XII, where the Bologna manuscript and Arabo-Latin tradition offer simpler readings against other Greek manuscripts.

An extensive description of the discrepancies among the Greek manuscripts and those of the Arabo-latin tradition can be found in Vitrac's French translation of Book XII (2001), where Vitrac modifies some of Knorr's hasty conclusions.

It seems, thus, gratuitous to suppose that Greek tradition of the Elements is free from later intervenations in other parts of the work where such obvious evidence is available.

I will discuss possible approaches to the identification of later intervention in the extant texts and translations of the Elements.

EDITING TEXTS AND DIAGRAMS: MEDIEVAL ISLAMIC DISCUSSIONS OF ARCHIMEDEAN SOLIDS

Gregg De Young

The American University in Cairo, EGYPT

When confronted with a paucity of evidence, the editor of pre-modern mathematical texts faces difficulties, both in terms of establishing the verbal text and in terms of presenting its accompanying diagrams. The basic principles of textual editing have been well established for many years. The editing of mathematical diagrams, however, is still in its infancy. In the past, editors have often been ready to reconstruct textual diagrams to fit their modern notions of what diagrams should look like, with little regard to how the actual diagrams were constructed or how they functioned within the text.

The main focus of this paper is the difficulties of editing diagrams in mathematical manuscripts. It discusses how the modern editor can remain faithful to the character of the original text and its diagrams while at the same time respecting the needs of the modern reader. These questions become more acute when the manuscript diagrams have been damaged or when the author / copyist follows diagram conventions that differ from those commonly used in mathematical treatises today. The manuscript editor knows that he must preserve and accurately represent the actual textual readings when editing the verbal elements of the text. I argue that he should also accurately preserve the essential features of the original diagrams when editing a manuscript. At the same time, he must provide adequate access to the text and its diagrams by non-specialist readers. To exemplify these basic issues, I introduce some examples of specific problems in editing text and diagrams that were encountered during recent study of several medieval Arabic and Persian discussions of the Archimedean solids.

LA REFLEXION DU PASSÉ INDUSTRIEL DES PAYS DE BOHEME AUX ARCHIVES DU MUSÉE NATIONAL TECHNIQUE DE PRAGUE

Milada Sekyrková

Le Musée National Technique de Prague

Les Archives de l´histoire du commerce, de l´industrie et des travaux techniques sont créées en 1931 à Prague, dans le cadre du Musée technique du Royaume de Bohême. Grâce au soutien d´historiens tchécoslovaques célèbres tels que prof. Josef Šusta (1879 – 1945) ou prof. Bedøich Mendl (1892 – 1940), ces archives se sont progressivement transformées en un important lieu de travail spécialisé dans le domaine de l´histoire industrielle et économique contemporaine, ainsi que, par la suite, en un centre méthodologique pour les archives d´entreprises.

Dans les années 40 et 50 du siècle dernier, ces archives ont entamé ce qu´on pourrait appeler une collection de manuscrits et de souvenirs, bien connue aujourd´hui sous le nom de Collection de Klepl (d´après le chef des Archives de l´époque et initiateur de cette collection, le dr. Jan Klepl, (1907 – 1965). À l´heure actuelle, cette collection compte plus de 2 000 ouvrages manuscrits d´envergure plus ou moins importante (de quelques pages à plusieurs centaines de pages) qui retracent l´évolution des artisanats, du commerce et de l´industrie sur le territoire des pays tchèques, de la Tchécoslovaquie et ce, pour la plupart d´entre eux, du début du 19ème siècle à la période d´après-guerre. À l´origine, cette collection devait être un questionnaire artistique destiné aux employés de l´industrie lourde et aux artisans dont le travail souffrait de plus en plus suite au développement de la production industrielle. Avec le temps, d´autres manuscrits, des chroniques familiales, des mémoires d´entrepreneurs venant des différentes parties des pays tchèques, la correspondance de sociétés allemandes en déclin et des études non publiées, traitant de l´histoire de l´industrie et de la technique dans notre pays, sont venus s´ajouter. De nos jours, il s´agit d´un ensemble de sources uniques nous permettant d´aller à la découverte de notre passé industriel.

Travailler avec ce genre de sources est très difficile. D´un côté, elles vous offrent l´avantage de la concentration et de l´homogénéité d´une grande partie de leurs ouvrages. De l´autre, il convient d´être très prudent et critique quant à la crédibilité des témoignages recueillis et des faits mentionnés dans ces sources qui sont, de facto, narratives.

Une partie de cette collection est actuellement en train d´être numérisée. Grâce à cette opération, nous allons pouvoir mettre en place des registres détaillés et documenter le contenu de tous les ouvrages sous forme de base de données.

Symposium S65
Diverse Cultural Practicies in 20th Century Nuclear Physics

THE GREEK-AMERICAN CONNECTION: THE FIRST NUCLEAR REACTOR IN GREECE

Maria Rentetzi

National Technical University of Athens, Greece

“We cannot proceed on our own, without the guidance and assistance of the United States, on what is for us new and unknown territory.” This was the response that the physicist and General Secretary of the Greek Atomic Energy Commission Theodore Kouyoumzelis gave to an *Economikos Tachidromos* journalist in September 1955 on the dependence of Greek atomic physics research on the technical assistance that was to be subsequently provided by the U.S. Two months earlier, a bilateral agreement for the development of nuclear energy for peaceful uses in Greece had already been signed. The agreement was part of President Dwight Eisenhower’s “Atoms for Peace” program and included the installation of a nuclear reactor, the supply of uranium for its operation, technical support for research, but also advanced training for Greek scientists in U.S. research laboratories.

I argue that the establishment of the first nuclear research laboratory in Greece and the supply of radioisotopes and nuclear laboratory technology to the country were part of the same the Trojan horses of 1950’s United States foreign policy in Europe. The import of Eisenhower’s project ‘Atoms for Peace’ to Greece put on display interesting negotiations among four at least parties: the Greek Royal Family and especially Queen Frederika, the Prime Minister Konstantinos Karamanlis and his modernizing politics, a small group of scientists who envisioned themselves as participating in equal terms with their international colleagues in the network of nuclear scientists, and the United States which through generous support aimed to strict surveillance of a geographically key region.

THE MEXICAN-AMERICAN CONNECTION: THE FIRST MEXICAN ACCELERATOR

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In this paper I analyze how the acquisition in 1952 of a Van de Graaff generator for the Universidad Nacional Autónoma de México (UNAM) is related to: the International policy of the United States toward Latin America, a mexican nationalistic discourse on atomic physics and the relations established mainly between William Buechner and Robert Van de Graaf from the Massachusetts Institute of Technology (MIT) with Manuel Sandoval Vallarta and Nabor Carrillo from the UNAM. Nuclear experimental physics was introduced in Mexico as a new practice due to the donation (from the Mexican Government to the University) of a 2 MeV Van de Graaff generator constructed by the the High Voltage Engeneering Corporation (HVEC). Students and researchers from the University were sent to MIT and the HVEC to acquire the skills for using the accelerator. The nuclear research program of Buechner at MIT was extended and adapated to the mexican research program. As he wrote to Nabor Carrillo in 1952 “I am most anxious to help in carrying out the research program at the University”.

THE NORWEGIAN- AMERICAN CONNECTION: ATOM SMASHERS BEFORE AND AFTER WWII

Roland Wittje

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This paper traces the significance of Norwegian immigration and return immigration in the development of nuclear research technology on both sides of the Atlantic. The scientific community of a small country like Norway had to be outward looking. Germany acted as the main point of reference up to WWII. But the turn towards the other side of the Atlantic was heralded already in the Interwar Period. Whereas Germany remained the centre of theoretical physics up to 1933, the USA led the way to increasingly industrialized experimentation. This became nowhere more obvious than in the development of atom smashers. Whereas most of the discoveries in nuclear physics in the 1930s were made in Europe, accelerator development happened in the USA. Rolf Wideroe, a Norwegian electrical engineering student in

Germany developed several accelerator principles and motivated Ernest Orlando Lawrence to build the cyclotron. Lawrence himself was of Norwegian ancestry, and so was his boyhood friend Merle Tuve, competing with Lawrence on accelerator building and experimentation. The Norwegian Odd Dahl, who became a legendary accelerator builder and was involved in most nuclear machines in Norway before and after World War II, joined Tuve's team at the Carnegie Institution of Washington. From 1933 to 1938, Johan Holtsmark and his team at the Norges Tekniske Høgskole in Trondheim built the first running particle accelerator in the Nordic countries. Their success depended decisively on their contacts to Dahl and the American group. Dahl accredited the Trondheim team a work spirit similar to "any peppy place in USA". Also Gunnar Randers, the driving force behind Norway's postwar nuclear program, was busy referring to his British and American experiences, which he wanted to implement for the modernization of Norway and its scientific community.

TURKEY'S PARTICIPATION TO THE 'ATOMS FOR PEACE' PROGRAM: EXPECTATIONS AND CONSEQUENCES

Kaan Ata

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As from first years of the Cold War, studies on atomic energy and atom bomb arouse great interest throughout the world. 'Atoms for Peace' program launched by the United States was an invitation to governments concerned in nuclear energy research and production. The aim of this program was the share of the knowledge acquired from nuclear energy studies at international level. Dwight D. Eisenhower, the president of the United States, in the speech he delivered on December 8, 1953, urged the peaceful uses of atomic energy and declared that the program's goal was to promote the effective use of fission material in peacetime, to support international scientific research, to reduce the destructive power of atomic energy in the world and to show that the United States aims to use this energy not only to produce weapons but for the good of humanity. Eisenhower also proposed the establishment of an international atomic energy agency and assured to provide technical support for the construction of a nuclear research reactor and the necessary amount of enriched uranium.

On May 8, 1955, the Turkish government concluded an agreement with the United States and became the first country to join the program. Accordingly, a nuclear research station would be built in Turkey. The institutionalization of nuclear physics in Turkey began during these years: Nearly forty Turkish scientists were dispatched to the United States to be trained and work in the advanced research centers for a duration changing between six months and several years.

What were Turkish government's expectations in joining this program? What did Turkey gain as a part of the agreement? What was United States' attitude to Turkey after its participation to the program? How this program affected physics studies in Turkey? If Turkish government didn't have attended the program in 1955, would the present-day nuclear physics studies be different in Turkey? Although nuclear energy stations were built in many countries, why did Turkey follow a different strategy? By what means the nuclear energy was presented to Turkish public and how it was received? While reviewing Turkey's encounter with nuclear energy in post WWII, this paper aims to discuss the above mentioned questions.

NABOR CARRILLO AND THE FIRST VAN DE GRAAFF PARTICLE ACCELERATOR IN MEXICO

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Nabor Carrillo was a Mexican engineer who devoted his life to soil mechanics and to promoting nuclear energy and nuclear physics. He managed to acquire the first Van de Graaff particle accelerator in Mexico, which became the first Latin American country to own an instrument of this kind. The accelerator was installed in the Physics Institute of the National Autonomous University of Mexico in the middle of XX century.

Symposium S66
Framing the Outer World in the Biological and Human Sciences: A Comparative Historical Perspective

CIRCUMSTANCES IN CONTEXT: THE EXAMPLE OF JOHN STUART MILL'S ETHOLOGY

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In the Fifth Chapter of Book VI of his *System of Logic* (1843), John Stuart Mill offered a blueprint for a new "moral" science he christened "Ethology", that is the "science of the laws of the formation of Character". The characteristic feature of Ethology was that it ascribed a major influence to "circumstances" whilst downplaying the causal role of innate or physiological elements in the process of character formation. Furtheremore, Mill held this science to be crucial to any project of social reform, for it was supposed to provide reformers with a reliable and robust knowledge of how characters traits are formed and, therefore, of how they can be modified or transformed according to the needs of both individuals and society and so as to ensure "the greatest happiness of the greatest number", as the Utilitarian motto Mill subscribed to had it.

But what in 1843 boded well for Mill's scientifically-minded projects of progressive reforms did not yield results thereafter: Mill wrote nothing substantial on Ethology in the years following the publication of the *System of Logic*. Given the centrality of Ethology in Mill's plans to improve social arrangements through a better knowledge of human nature, the failure to establish the "Science of the Formation of Character" on safe grounds undoubtedly represented a major threat to his hopes for social progress.

It is this "ethological fiasco" that I would like to analyze in my paper. I suggest three complementary reasons for this failure: (1) the sheer number of "circumstances" relevant to Ethology which prevented the working out of a manageable theory from which to deduce explanations for character formation; (2) the lack of precise ethological empirical generalizations against which to test ethological deductions; (3) the absence of a composition law governing the combination of ethological causes. Throughout my presentation, I will try to shed some light on the concept of "circumstances" Mill relied on and try to unearth its intellectual and historical origins.

WEISMANN'S BARRIER ? : THE ROLES OF SOMA AND ENVIRONMENT IN LATE NINETEENTH CENTURY EVOLUTION

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The term 'inheritance of acquired characters' was used as an umbrella term for much of the 19th century, and into the early 20th century. The term has been used to encompasses a number of theoretical mechanisms that included, among other things, the 'effects of external conditions' and the internally driven mechanism of use and disuse. Far from being an idea that was rejected by 'Darwinism', there was considerable debate on all sides about the implications of any potentially heritable effect of the environment for our understanding of inheritance and evolutionary mechanisms. These are debates that were framed by the late nineteenth century interpretation of Darwin's work on heredity - Pangenesis. The response of the early Neo-Darwinians, for example Galton, Poulton and Wallace, to Darwinian Pangenesis has influenced the reception of the 'inheritance of acquired characters', the understanding of Weismann's barrier and the representation of Darwinism to the present day.

« *MILIEU*, *UMWELT* AND *LEBENSRAUM*. FRIEDRICH RATZEL AND THE BEGINNINGS OF AN ENVIRONMENTAL SCIENCE »

Wolf Feuerhahn

CNRS, Centre Alexandre Koyré, Paris

Ratzel's Geography illustrates that the first scientific conceptualizations of the environment came from a science which was at the junction of human and biological sciences. His use of the concepts of milieu, Umwelt and Lebensraum has to be understood within the scope of both his Bio- and Anthropogeography. We will show what is at stake in his hesitations between these three concepts.

THE INTERNAL AND THE EXTERNAL IN EVOLUTIONARY THEORY AT THE TURN OF THE TWENTIETH CENTURY

Sander Gliboff

Indiana University

Ernst Haeckel (1834-1919), had been Darwin's leading interpreter on the Continent since the 1860s and had consistently invoked environmental factors and the inheritance of environmental effects as the most important causes of variation, adaptation, and change. In his vigorous defenses of his own system against rival Darwinians or anti-Darwinians, he always associated internal causes—whether in the germplasm, the mechanics of embryonic growth, or elsewhere in the organism—with teleology and predestination, but external, environmental, causes with creativity and progress.

By the turn of the twentieth century, the challenges to Haeckel's system—from genetics, experimentalism, and new evolutionary theories—were multiplying, and Haeckel failed to answer them all. This paper will explore the ways in which a younger generation of evolutionists rose to these challenges and tried in contrasting ways to keep Haeckel's ideological concerns alive and to salvage as much as possible of his system of external causes. The focus will be on Richard Semon (1859-1918), Ludwig Plate (1862-1937), and Paul Kammerer (1880-1926). These three evolutionists, often dismissed in the existing literature as "Lamarckians," are treated here as modernizers of Haeckel's Darwinism.

'TO DO WORK IN THE WORLD': INSTRUMENTALISM IN PRAGMATIST PSYCHOLOGY AND PHILOSOPHY

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Georges Canguilhem's (1904-1995) harsh criticism of scientific psychology is still famous. According to him, by trying to state so-called psychological "facts", modern psychology denies the difference of "value" between a man and an instrument. It thus provides the theoretical justification for the mechanical use of men, who are expected to adapt themselves passively to their social and technical environment (such as the fabric, the school, etc.). I would like to show in this paper that the "pragmatist", "instrumentalist" or "functional" psychology, as developed in the United States by William James (1842-1910), John Dewey (1859-1952) and Georges Herbert Mead (1863-1931), is non only free from such an attack, but also agrees with Canguilhem's own conception of what the "knowledge of life" should be. In that perspective, pragmatist psychology will be examined through three points: the notion of environment, the concept of reflex, the meaning and value of knowledge.

1) James and his followers did for the study of the mind the anti-deterministic reversal in the understanding of the relationship between an organism and its environment, that Canguilhem describes and approves of in "Le vivant et son milieu" ["The Living and Its Environment"]. Far from being passively moulded by the outer world, the mind has for function to help the human organism to shape its environment according to its needs and interests.

2) Secondly, they have taken over and extended to mental functions the anti-mecanistic conception of reflex action which has always been opposed to the cartesian interpretation of the body, as Canguilhem masterly shows in *La formation du concept de réflexe au XVIIe et XVIIIe siècles* [*The formation of the concept of reflex during the XVIIth and XVIIIth centuries*]. It is because the reflex is a teleological behaviour that the mind is purposive and has a practical function.

3) Finally, pragmatism and instrumentalism, based on this psychology of the reaction to the environment, conceive knowledge in the continuity of the "normative activity of life", to use Canguilhem's vitalist motto in *La connaissance de la vie* [*The Knowledge of Life*]. For them, true ideas are instruments of vital value, which are made to improve our lives by enlightening our course of action in the world.

Throughout this paper, I will contrast pragmatism with behaviourism, the latter being in fact the constant target of Canguilhem's attacks. Some guesses will be made as to know why Canguilhem did not really take pragmatism into account in his critical survey of modern psychology.

THE CONCEPT OF UMWELT INANTHROPOLOGICAL PHYSIOLOGY: VON UEXKÜLL, PORTMANN, BUYTENDIJK

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"Philosophical anthropology" is the name of a trend of thought that flourished around the middle of the 20th century (between 1920 and 1960) on the European continent, especially in Germany, Switzerland and the Netherlands. It comes as a humanistic reaction against positivistic naturalism in science, especially the new experimental sciences of human and animal behaviour. It strives to build a bridge between *Naturwissenschaften* and *Geisteswissenschaften*, that is, between the science of nature and the science of the human mind. The basic concern is to launch a philosophical way of practicing science. It aims at understanding how the human race "builds its nest" in the world (Gehlen, posth., 1986). The philosophical inspiration lies both in existentialism (Karl Jaspers) and phenomenology (Edmund Husserl). Most of the literature is in German. *Ethology* and *physiological anthropology* belong in that trend of thought.

After world war 2, continental biologists who had emigrated to England reckoned that the study of animal behaviour had developed along such divergent paths in the anglophone world from that in the german world, that researchers did not understand each other any more. They had published in different journals, writing different languages, using different technical vocabulary, and different methods of research and measurement. On the Anglo-american side, the research had mainly be the task of psychologists, the typical animal was the laboratory mouse (or rat), the main focus was learning, the explanatory scheme was Pavlov's conditioning. That was the *behaviorist* school. On the German side, the research had been conducted mainly by zoologists. Animals - even humble animals such as insects - had been studied outdoor within their natural environment, learning was not the focus of interest; German researchers were interested in innate behaviour, instinctive (often complex) animal reproductive (or other) strategies. That was *ethology*. In 1950 there was in Cambridge, England, a meeeting during which researchers of the two traditions met and discussed with each other. Paul Schiller, a psychologist from Hungary, offered to translate the German literature in English. He died before the work was completed, his wife completed it (Coll., *Instinctive Behaviour*, 1957). That is when the two schools merged, and when, in animal research, the Darwinian scheme of explanation (*trial and error*) definitely replaced the behaviorist scheme (*conditioning*).

It is the story of this intellectual trend that would like to explore in my paper, by focusing on the ways the concept of *Umwelt* was used within this tradition of thought, most notably by Von Uexküll, Portmann and Buytendijk.

THE CONCEPT OF BIODIVERSITY: BETWEEN SCIENCE AND SOCIETY

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When E. O. Wilson, in his autobiography, explains how he was led to use the word "biodiversity" in a book title, and how very soon the word gained public acceptance and worldwide success, it appears clearly that the concept is not originally a biological one. It is typically a hybrid concept, involving both value-commitments and scientific contents. One face of biodiversity is a happy one: it has to do with the splendour and munificence of the creation, in the biblical tradition, and with a representation of a motherly nature providing inexhaustible wealth in a rich tradition of art and culture. The other face of biodiversity is an anxious one, worried by the risks that threaten the natural world due to human activity, and which are increasingly reported in the second part of the twentieth century.

Thus the concern about drawing up an inventory of the natural world has different meanings and quite opposite connotations, depending on the underlying representations of nature and of the relationship between man and nature. For instance, biodiversity protection policies can favor "integral protection" which tends to prohibit human activities or sheer human presence in protected areas, or foster some kind of "sustainable protection" including human interactions with nature, depending on the representation of nature which more or less explicitely underpins the policy.

Biodiversity is also linked to economic interests in different ways: for instance, today, economists and ecologists try to make assessments of the economic services provided by biodiversity. And you can go to justice about taxonomic questions concerning endangered animal or vegetal populations, when ecological concerns conflict with economic interests on populations whose taxonomic status is uncertain. Biodiversity has become a symbolic issue which concentrates a lot of conflicts and fears in a world anxious of its future.

The paper proposes a modest archeology of this concept, with two main goals:

1 explain the biological meaning of the concept of biodiversity, and to trace the historical pathways which lead to the concept
2 present the cultural context which explains the success of this concept and its wide dissemination.

FINDING THE BOUNDARY: EVOLUTIONARY DEVELOPMENTAL BIOLOGY

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It is trivially true that organisms interact with their environments, however, as Richard Lewontin has argued, many metaphors and models of evolution by natural selection have not always adequately represented this fact. In the late 1970s and early 1980s two accounts were developed which attempted to incorporate the organism's interaction with its environment into the structure of evolutionary theory. The first, "niche construction," was developed by Richard Lewontin. This account focused on the interactions between the organism and the environment, and presented a very different picture of evolution by natural selection. The second, the "extended phenotype," was developed shortly afterwards by Richard Dawkins. Unlike niche construction, this account did not offer a different understanding of evolution by natural selection *per se*, but rather offered a radical understanding of the "vehicle" of natural selection. The extended phenotype account redrew the boundary between the inner and outer, thus subsuming many of the interactions between organism and environment into the extended phenotype. The extended phenotype then became a "vehicle" of natural selection.

The recent arrival of evolutionary developmental biology has brought development back into evolutionary theory. A sub-discipline, "eco-devo," focuses on the role of the environment in development and evolution. More traditional approaches in evolutionary developmental biology have tended to retain the inner/outer boundary as the skin of the organism. However eco-devo may wish to eschew this boundary.

In this paper I want to do two things. The first is to outline the two very different approaches to thinking about the relationship between the "inner" and "outer" developed by Richard Lewontin and Richard Dawkins. The second is to examine what lessons can be gleaned from these approaches for the new discipline of evolutionary developmental biology, and it's even newer sub-discipline, eco-devo.

Symposium S67
Uses of Cultural Manifolds in Research

CULTURAL MANIFOLDS AND THE NEED FOR GENERALISTS

Sivin, Nathan

U.S.A.

Cultural manifolds comprise not only the various dimensions of a complex historical phenomenon, but also the interactions that make all of these aspects into a single whole. A cultural manifold includes how people's work is paid for, their relation to structures of authority, what bonds connect colleagues, how they communicate with each other and with outsiders, what concepts and assumptions they rely on, and how they use technical resources. It rejects the notions that social factors determine thought, and that ideas determine social change. The point is to comprehend interactions within a manifold as thinkers respond to, and at the same time influence, institutions and prevalent values.

The highly specialized studies that are usual in many disciplines of the humanities often are never integrated with others, remaining incoherent. An isolated insight in, say, economic history, may be fruitless because it lacks all connection to understanding of thought or even of social organization. The mythology of modern academic scholarship assumes that generalists will spontaneously appear to tie together the results of extremely narrow research, but this often fails to happen. Generalists who can write for educated, non-academic readers are badly needed, and often reach positions of intellectual leadership. Practically speaking, instruction in the use of cultural manifolds is an effective tool for developing the skills of young scholars who want to be generalists and show talent in that direction. This paper will offer examples of the value of cultural manifolds in integrative historical studies.

THE MANIPULATION OF FIRE IN CHINESE ALCHEMY

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This paper focuses on the role of fire times (*huo hou*) played in the making of elixirs in Chinese alchemy. It starts with a review on *Token for the Agreement of the Three in Accordance with the Book of Changes* (*Zhouyi cantongqi*), and proceeds to more alchemical treatises.

The review on *Zhouyi cantongqi* shows that *Cantongqi* constructed an idea of controlling the fire in accord with the growth and decay of *Yin* and *Yang* one day, one month and one year through the trigrams and hexagrams.

The research on other alchemical texts indicates that the idea of *Cantongqi* was followed but with various modified forms. These forms include increasing and decreasing the weight of fuel in one year subtracted *Mao* month and *You* month, or in 9 continuous months in which the weight of fuel increases in the former 15 days of every month and decreases in the latter 15 days of every month.

Some are more flexible in dealing with fire times. They argue that the weight of fuel shall not be decided, for the containers have different sizes and the weights of materials are different. They propose to improvise the fire times according to the condition of Yin and Yang at the moment.

Some are more practical, disregarding the idea of *Cantongqi* and controlling fire at their disposal with no consideration of *Yin* and *Yang*.

ANIMALS AS CULTURAL MANIFOLD

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Animals in Chinese tradition played a role in many contexts and for diverse professions: in agriculture as a source of food, clothing and power, in *materia medica* to provide a great variety of ingredients, in local gazetteers to enhance local identities, in poetry and art to function as metaphors. Many of these professions left written proof of their expertise and of their specific views on the animal as object and as subject. The generalist scholar of traditional China tried to combine knowledge of these different fields with a proficiency in the philological and historical aspects connected with the animal kingdom as such, and its fathomless variety in species and variants. In Chinese encyclopaedias and specialized treatises cross-sections of these practical and scholarly knowledge corpora were made available by and for specifically these scholars. This paper highlights the centre and focus of these separate fields, distinguishes their areas of intersection, and investigates how they fed into and influenced each other's knowledge spheres. The paper demonstrates how animals as an object of knowledge constituted a cultural manifold connecting different planes of erudite and practical activities.

WHAT INHIBITED THE DEVELOPMENT OF THE PLANETARY THEORY IN SONG CHINA?

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In the Northern Song (960 -1127), the planetary motions received much attention from astronomers. In the frequent reforms of the astronomical system during the period, the planetary events were induced to verify and evaluate different systems proposed, a practice apparently aimed at bringing the accuracy of the system to a higher level. Even Emperor Taizong (r. 976 -997) himself is said as checking the planetary positions calculations submitted by the Imperial Astronomical Bureau. Shen Kua (1031 -1095) when in charge of the Astronomical Bureau proposed a very ambitious project to improve the prediction of the planetary motions. He even envisioned some mathematical methods that could solve the most difficult problem of predicting the position of Mars, *zhui shu* and *tuo shu*, as he called them. But all these promising threads did not weave into an advance in the planetary theory? What inhibited this possible development? In this paper we investigate many factors that might have contributed to this underdevelopment, as a case of the application of the concept cultural manifold. Technically, the criteria used for testing the accuracy of the planetary theory were problematic, which emphasized the number of "fitting" cases between calculation and observation, while avoiding prediction at the crucial moments of the planetary motion. Politically, in portent astrology, planetary events did not present omens as conspicuous as solar and lunar eclipses. An error in the prediction of a planetary event would not raise an alarm as failure in solar prediction did. So there was not much political motivation for improving the planetary theory. Bureaucratically, incumbents in the Astronomical Bureau were actually very unwilling to bring change to their routine work. When Shen Kua proposed to improve the planetary theory, he needed continuous observation of the planets for at least three years. He did not get support on this from his colleagues. On the contrary, he was interrupted with fierce quarrels between talented astronomers and incompetent placeholders. Financially the Song state had limited resources on astronomy. Much money was spent on the instrument rather than on the use of the instruments. This paper concludes that all these factors combined to inhibit the development of planetary theory in the Northern Song.

CONTROL VS. AUTONOMY: FABRICATIONS IN SONG ASTRONOMY

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During the North Song Dynasty, there were many innovations in astronomy. With the sponsorship of the state, a lot of achievements were accomplished in astronomical activities such as calendar-making, observation, innovation of instruments and so on. But, as the same time there was a series of fabrications in astronomy in the period. How and why did the the fabrications happen? The paper attempts to use concept of Cultural Manifolds to analyze their causes and draws the following conclusions. There were fabrications of astronomy in both group activities and individual activity. It was the two main factors that caused fabrications of astronomy. First, from the view of the state control and management, astronomy was associated with a belief about the responsibilities of empire; there were a conflict of value between politics and technology, a lack of rules of supervising in astrology, and the hereditary system in

personnel matters. All these caused the fabrications of astronomy . Second, from the view of the technical officials' motive, abusing power for personal gains, doing works perfunctorily, too eager to be successful that one saw only the immediate advantages and so on, these also caused the fabrications of astronomy. Generally speaking, when political management interfered with technology excessively, the technical officials did the work with improper motive, there were fabrications of astronomy. On the contrary, when the state supervised astronomical activities properly, with definite object the technical officials did the works on their own initiatives, it would cause the development and innovation of astronomy.

***Keywords:**: the North Song Dynasty, Astronomy, Fabrication*

THE NEEDHAM QUESTION AND BEYOND – MODERN SCIENCE IN THE CONTEXT OF CHINESE CULTURE AND SOCIETY

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Compared with the huge system of universities and research institutes and the large number of researchers in contemporary China, the quantity of original scientific work accomplished is embarrassingly small. What is responsible for this situation? There have been many discussions about it, both in Chinese mass media and in the field of science policy. Here the authors would like to discuss the question from a historical and comparative perspective and consider it as an extension of the Needham Grand Question. It was a similar situation that compelled Joseph Needham to explore the relations between science and civilization in ancient China.

Drawing from studies on the history, philosophy and sociology of science, the authors argue that, there are four elements that is essential for the birth and development of modern science, namely: (1) an impersonal notion of truth; (2) an acceptance of methods for the discovery and justification of truth; (3) a deep personal respect towards people who commit themselves to the searching and defending of such truth; and (4) the institutionalization of scientific research which guarantees the searching unaffected by social powers or opinions.

Based on the above observation, the authors then attempt to answer the extended Needham question -- why modern science did not emerge in China and why it has not taken root in the Chinese society. According to authors' examination, an impersonal notion of truth was not firmly established in traditional Chinese systems of thought. Partly because of this weakness, the methods for and attitudes towards the searching of truth have not been widely appreciated in Chinese culture, and the institutionalization of modern science still has a long way to go in contemporary China. This analysis shows that the Needham question does involve many aspects of Chinese culture and society.

Symposium S69
The Social History of Military Technology

SEPARATING THE MEN FROM THE POLLOI: THE REJECTION OF MISSILE TECHNOLOGY BY THE CLASSICAL GREEKS

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It is generally accepted by modern scholarship that Classical Greek battle was focused upon the clash of two opposing phalanxes of hoplite heavy infantry, with cavalry and missile troops occupying only skirmishing or supporting roles. This situation has been viewed as a conscious decision by the various Classical Greek city-states to reject the use of missile technology, with a number of reasons being advanced to support this: 1) Missile weaponry was ineffective considering the defensive strength of the hoplite; 2) Missile weaponry was viewed as both cowardly and effeminate; 3) Missile weaponry was opposed to an unwritten code of conduct which the Greek city-states adhered to when at war with each other. None of these reasons rests upon solid evidential foundations, with the exact opposite being demonstrated in some surviving sources; indeed, it is probable that all three reasons presented above have their origins in modern, rather than ancient, scholarship. However, the fact remains: missile technology was rejected by the vast majority of Classical Greek city-states as a primary means of protecting themselves and waging war against their neighbours, and this fact now requires a new explanation. By focusing upon the military and political difficulties of commanding missile troops I will demonstrate that missile technology was not rejected because it was ineffective, cowardly or 'against the rules', but because the risks and tactical considerations involved with its use were such that the majority of commanders were either unable or unwilling to do so.

REPUBLICAN ROMAN REJECTION OF SIEGE TECHNOLOGY

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The fourth century saw a revolution in ancient military technology in Greece: the invention of the catapult, followed by the development of torsion catapults, the introduction of mobile siege towers and advances in designs of ram tortoises. For the most part siege technology become more sophisticated and increasingly widely used, but this was not always the case. The Roman republic, especially between the late third century and the end of the second century BC, stands as something of an aberration. The weapons they used were far less sophisticated than those which the Greeks, Macedonians and Carthaginians had been using a that time and in the previous century.

There were a number of reasons which led to the Roman decision to avoid being dependent on technology, which I will discuss. I will show that the Romans of this period were neither ignorant of these advanced weapons nor unable to construct them and that the trend away from them was a conscious decision on the part of Roman generals, intended to play on the strengths of their army. Their discipline and the nature of their leadership allowed the generals to effectively use their manpower in such a way as to make advanced technology unnecessary.

SEVEN REASONS FOR THE REJECTION OF KNOWN MILITARY TECHNOLOGIES IN THE CLASSICAL WORLD

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A number of military technologies were invented and developed in the ancient world, e.g. the catapult, mine fields, siege towers, and a variety of tactics. This paper offers seven general reasons which individually or in combination explain, at a highly abstract level, why the adoption of such technologies was selective, not universal, across the ancient world. Three are technological, 'internal' reasons for non-adoption. Four are socio-political, 'external' reasons for rejection of a particular technology. The examples will be drawn from classical Greece and Rome, but the method is intended to be applicable to other domains (i.e. civil technologies), other periods, and other places.

CHILDREN OF MERCURY, CHILDREN OF MARS: CIVIL AND MILITARY TECHNOLOGY IN GERMAN VERNACULAR ILLUSTRATIONS, 1400-1525

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This heavily-illustrated paper argues that civil and military devices appear with surprising frequency in vernacular illustrations from pre-Reformation Germany. It explores how these illustrations treat both categories of devices – weapons and machines, for example – with a rather matter-of-fact quality, rather than rendering them as symbols and emblems. This trend correlates with the argument that an increasing acceptance of technology as part of the human condition was one of the changes in attitudes that marked the end of the Middle Ages. Most of the sources were works produced in the former Hapsburg Empire in the 1400s for audiences that seem to have been mainly courtiers – retainers of princely figures. The questions raised by the nature of this audience-readership is treated as well. This paper is meant to suggest links between military history, history of technology and art history.

NATIVE AMERICAN ADOPTION OF FIREARMS 1609 – 1640

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At the time settlement of North American began circa 1600, Native Americans had most tools and weapons the Europeans did, but in different forms. The one item they did not have was the gun. By 1609, arriving Europeans had four possible ignition systems to ignite their gunpowder weaponry, the matchlock, the wheellock, snaphance and the flintlock. By circa 1634-1638, one ignition system became the preferred method and Native Americans from the Carolinas to Canada began acquiring guns on a large scale. Organizing archaeological and documentary data in an evolutionary fashion has some explanatory utility for examining how and why the shift to flintlock ignition and the resulting Native American "taking up the gun" occurred. Gun-related artifacts from a variety of seventeenth century archaeological sites show the shift occurred. More precisely dated contemporary documents and their image laden terminology shows how quickly Native American adoption occurred once the flintlock became available among the settlers.

THE EMBODIED SOLDIER AND THE IMPACT OF TECHNOLOGY: MODERN IMAGES OF HEALTH & DISEASE–DISMEMBERMENT AND REPAIR

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The soldier and the military have often been referenced in bodily terms within ideological constructions of the nation state. While the ideal of the healthy warrior is asserted strongly with the advancing nationalism the role of technology in damaging and repairing bodies injured in war becomes especially apparent in the 20th century. In this paper I want to examine images and experiences of disfigurement, injury, the maimed and the prosthetic from the 16th century to the present with a view toward better understanding the body politics linking changes in weaponry, tactics, medicine, and nationalism with culture.

SPIRIT OF THE AGE: INVENTORS, SCIENTIFIC INSTRUMENTS, AND THE MILITARY AT THE ROYAL ARTILLERY INSTITUTION, WOOLWICH

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As the center of England's ordnance infrastructure, we should not be surprised to find the Royal Artillery Institution (RAI) playing a significant role in English military developments in artillery. As England was also at the forefront of the development of science as a professionalized undertaking, and the relationship of scientific testing and gunning have typically been seen to epitomize military developments since the 16th century, we would expect the RAI to have therefore been on the cutting edge of scientific artillery developments, especially in instrumentation. A current cataloging project of the Royal Artillery Historical Trust holdings at the Rotunda Museum and Firepower!, both in Woolwich, however, has brought to light some other interesting relationships between the military, science, and inventors developing instruments for use with artillery and ordnance. In this paper I propose to compare two periods in the RAI history and the material objects of artillery now in the museum. The mid-18th century and the late 19th century were considerably different times in the world of science, and these periods are well represented by objects in the museum's collection. The stories these objects convey tell us a great deal about the social world of technology within the Royal Artillery and shed light on the larger relationship between scientific endeavor and technological practice in the military context over the space of a century and a half from c1730-1890.

THE *CONVENTIONNEL*, THE WORKERS AND THE WAR. AN EARLY WELFARE STATE OR A WORKFORCE MILITARIZATION?

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In February 1794, as the Navy's need for weapons was growing, the French *Convention Nationale* sent four of its members to different iron-making areas of France, giving them all necessary authority to "expedite, by all possible means, the production of cast-iron guns for the service of the Navy". One of these four, Gilbert Romme (1750-1795) was sent to the South-West of France, to the Dordogne *département* and its surroundings.

Among the numerous measures he took there, one in particular caught the attention of his biographer and other scholars of the French Revolutionary period: a decree of Fructidor, an II (Sept. 1794) spelling out the rights to compensation of workers who had been maimed or killed in the course of their work in weapon-making factories. This decree, along with other similarly-minded decisions, has been widely presented as one of the first attempts at establishing a welfare State in France.

Our argument will be that, while Romme certainly had the general well-being of laborers in mind, the analogy that is to be made is not with today's social safety net systems, but with the various schemes for compensating army invalids (or war widows) that were in place or were being legislated at the time. In this light, Romme's effort can be viewed as part of a larger trend towards a wartime assimilation of the weapon-making workers to the military forces.

WEAPONS AND ETHNOLOGY IN 19th CENTURY BRITAIN: LT.-GEN. PITT-RIVERS AND HIS MUSEUM

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With the expansion of the British Empire and the development of theories of evolution, there was an increasing interest in ethnology in Great Britain during the second half of the 19th century. A leading figure in this movement was Lt.-Gen. A. Lane-Fox Pitt-Rivers. While testing rifles for the Army in 1851, Pitt-Rivers became interested in the history of firearms and began collecting them. He soon expanded his collection to include an entire range of primitive weapons as well as other ethnological objects. This collection, originally displayed in his home, eventually served as the foundation of the Pitt-Rivers Museum at Oxford University. This paper will show that in organizing his collection for display, Pitt-Rivers became influenced by theories of evolution, particularly those of Darwin and Spencer, and came to believe that the development of weapons could be seen as being governed by evolutionary principles, in that improvement in

weapons were the result of a "succession of very slight modifications." In order to demonstrate this discovery, Pitt-Rivers organized and displayed his collection based primarily on form or typology, and only secondarily according to the geographical and cultural origins of the objects. This paper will argue that the relationship between the study of weapons and the study of ethnology led to some new insights into technological development. By focusing on the role of evolution in the development of weapons, Pitt-Rivers tried to demonstrate that technological development did not take place in a series of great jumps but instead, new inventions were dependent upon what had been previously developed. In Pitt-Rivers' use of the term typology, it did not mean the study of fixed types; rather it meant that older forms could prefigure the emergence of later more complex forms. Finally, the paper will argue that the relationship between weapons and ethnology also led to changes in the conception of the museum. Before the work of Pitt-Rivers, ethnological museums tended to focus attention on the unique and the valuable and display those objects according to geography and culture. Pitt-Rivers provided an alternative conception – one in which ordinary artifacts would be collected and displayed based on typology, a term he introduced into ethnology. But the most important impact of Pitt-Rivers' work was that it emphasized the role of the museum as a laboratory. In order to understand the evolutionary development of artifacts, such as weapons, it would not be enough to study a single artifact. Instead one needed to be able to study all of the artifacts that represented a certain typology and this could be best done in a museum. Of particular importance was the theory that improvements in technology were dependent upon what had been previously developed. This meant that the museum could provide a source of information for the study of technological development and could function as an engineering laboratory.

JAMES H. BURTON, JOHN W. MALLET, AND THE FOUNDATIONS OF A NEW SOUTH: SYSTEM, UNIFORMITY, AND CONTROL AT THE CONFEDERATE ORDNANCE DEPARTMENT

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This paper will examine the production of ammunition and weapons by the Confederate States Ordnance Department and the social and economic transformation it brought to southern society. By the war's end the Confederate Government could barely feed and clothe its troops. The Ordnance Department, however, under the command of Brigadier General Josiah Gorgas and his able subordinates, Lieutenant Colonels John W. Mallet and James H. Burton, met many of the South's requirements to wage a long and destructive war. The keys to this success were the ideas brought by Mallet and Burton. Mallet had been educated in chemistry at the University of Gottingen and Burton had been Chief Engineer of the Royal Arms Manufactory at Enfield, England. This paper will show how their unique backgrounds brought new ideas about technological transfer, the application of modern management techniques, standardization, control processes, and bureaucratic structures to the South. Moreover, it will analyze how these ideas promoted an acceptance of technology that helped create the "New South" after the war.

NAVY, TAXES, AND PEOPLE
THE ITALIAN ROYAL NAVY'S 1874 SHIPBUILDING PROGRAM AND ITS CONSEQUENCES

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In December 1873 the minister of the Navy convinced the Italian Parliament to pass from a wooden to a iron made fleet. The plan got success, provided Italy of a heavy industry but, having enforced duties on imports on industrial products largely from Britain and France, France answered by imposing import duties on Italian products. These duties reduced their market and ruined the southern Italian economy. The lack of market caused a lack of work, whose immediate effect was emigration.

"HUNK O'TIN" THE AMERICAN *AMBULANCIER* AND HIS MODEL T IN FRANCE, 1915-1919

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At a small museum north of Paris resides a singular tribute to American volunteerism: a WWI Ford ambulance called *Hunk O'Tin*. A veteran of both civilian and military service, it bears the markings of the American Field Service (AFS) on the olive drab livery of the United States Army Ambulance Service (USAAS). *Hunk O'Tin* is perhaps the sole survivor of an ambulance service built around a remarkable man-machine duo: the American college-man and the indefatigable Ford Model T ambulance.

Underlying the romanticized life and times of the American *ambulancier* in France lay a well organized service that relied on college volunteers to man its ambulances. Ambulance sections exhibited a friendly collegial rivalry, and many had strong ties to particular schools. Within sections, American drivers demonstrated a selfless devotion to duty that endeared them to the French Army and public.

With American entry into the war, the U.S. Army's "militarization" of the service had the net effect of increasing support to the French Army, as the federal government, not being a charity, could enlist volunteers and procure equipment on a staggering scale. Despite criticism that the service ethic of the AFS would be destroyed, the all-volunteer USAAS demonstrated even greater school affiliation while maintaining the standards of service that the French had come to expect from American civilian volunteers.

Sifting fact from fiction, it becomes apparent that these volunteer *ambulancier*, having no pre-war experience with casualty evacuation, perfected a system that became the model for U.S. Army ambulance service in WWII.

VISUALIZING TANKS: WAR ARTISTS CONFRONT A NEW TECHNOLOGY ON THE WESTERN FRONT

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In the half century before the First World War, military technology changed far more quickly than military organization and doctrine, setting the stage for the stalemate on the Western Front. Even more than still-changing military technology, stalemate derived from the enormous productive capacity that made it possible to equip, maintain, and restore huge armies. As befitted a scientific-industrial age, efforts to break the deadlock called on technology. A range of mechanical innovations based on the internal combustion engine—trucks, tanks, and aircraft—did not prove decisive but their promise inflamed imaginations, and not only of soldiers.

Artists, too, were enthralled by the new technologies of industrial warfare. Some relied on familiar tropes to depict the new technical realities, while others sought to devise a new visual vocabulary. To a remarkable degree, the work of both traditional and avant-garde approaches proceeded under government sponsorship. The willingness of wartime governments to support such efforts was unprecedented and the consequences for society as well as the arts far-reaching. Official programs in many countries assigned eminent artists to record both combat and war industry for present and future generations. This is, of course, a very large subject. In this paper I propose to deal with only a limited aspect, how war artists depicted one new technology, that of armored fighting vehicles. This graphic evidence provides the primary source for this paper, which is based primarily on the Smithsonian's collection of the official American war art from 1917–1918, supplemented by a look at the work of British and French war artists. The drawings and paintings of war artists attest to the excitement generated by the new technology and also its frightfulness, but they also reveal some significant national differences in ways that are otherwise difficult to pinpoint.

IMPACT: PACKAGING THE U.S. ARMY AIR FORCE FIRE-RAISING PRACTICE DURING THE SECOND WORLD WAR

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In April 1943, the American Secretary of War hired away the Associate Editor of the *Smithsonian* magazine, Edward K. Thompson, to head up what became a three-year project, the publication of the magazine, *Impact*. (Thompson would subsequently become senior editor for the widely read publication, *Life*.) Distributed to bomber crews and combat pilots, *Impact's* stated purpose was twofold: "So that Air Force units and the Army as a whole might be informed of current developments," and to "disseminate intelligence and operational data." In this paper I demonstrate that *Impact's* message and meaning were anticipated to do much more. Included was the intentional manipulation of an air-war history that decoupled America's participation in fire raising from that implemented by the Royal Air Force. American politicians and Army Air Force officers feared that the indiscriminate carnage caused by the night-time incendiary bombing campaigns of the British would undermine any attempt to establish an American Air Force independent of the U.S. Army in the post-war years. *Impact* was designed in part to control the images and history of the application of this bombing technology during the conflict. *Impact* is an excellent example of wartime propaganda that transcends its official purpose by influencing audiences in very important ways, particularly as it pertained to the specific technology of incendiary bombing.

THE NORDEN-VICTOR CONNECTION: MAKING BOMBSIGHTS AND SELLING ADDING MACHINES IN WORLD WAR TWO

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On 10 February 1947, A.C. Buehler, the president of the Victor Adding Machine Company presented Norden Bombsight number-4120 to the Smithsonian Institute. This sight was the actual bombsight in service on board the *Enola Gay* when it dropped the first atomic bomb on Hiroshima. Through this public presentation, Buehler forever linked his company Victor Adding Machine, to the Norden Bombsight, the Enola Gay, and to history. Buehler's ultimate goal, however, was the sale of adding machines, and while significant, the presentation to the Smithsonian was essentially the final step in a long running advertising campaign designed to sell adding machines. Buehler's campaign had unabashedly exploited Victor's association with the famous Norden Bombsight. During the War, Victor was the Army's main civilian contractor for the production of these high-tech instruments. The relationship between Victor and the Norden Bombsight presents an almost comical irony when considered in its entirety. This work is an investigation into the dysfunctional yet necessary relationship that existed between Victor Adding Machine Company, the Army, the Navy Bureau of Ordinance (BuOrd), and Carl L. Norden Inc. Wartime shortages demanded that pre-war arrangements between the Army and BuOrd be reconsidered and it was agreed, much to the chagrin of Carl L. Norden Inc. executives, that the Army be allowed to select contractors to build Norden sights to meet Air Force supply demands. Battling through a bureaucratic quagmire exacerbated by uncooperative participants, Victor eventually began producing sights by spring of 1943. Within a year, however, Victor sights were scrutinized for their inaccuracies, and ultimately Victor sights were cancelled ending the Army's short sojourn into bombsight production. Victor sights had failed to meet the precision standards set by the original Norden devices, and here lies the ultimate irony: The producer of the most inaccurate Norden sights, built the sight that dropped a weapon so destructive that accuracy was irrelevant, and then marketed precision adding machines through this association.

THE DEVELOPMENT OF AIR DEFENSE SYSTEMS IN FRANCE: FROM TRANSATLANTIC NETWORKS TO SYSTEMS ENGINEERING (1955–1975)

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The combined dynamics of the Cold War and of R&D in electronics prompted the development of computerized radar networks, in the West as well as in the Soviet block. In France, the first initiative came from the air force, which gave contracts to IBM France and other companies to build such a system: STRIDA, designed essentially by French teams with little knowledge of similar US achievements. The navy chose a different social and technical configuration in 1960. The computers were Univacs imported from the US, the software was developed in Paris in close cooperation with the US Navy NTDS center at San Diego, and the industrial subcontractors were French companies. This change had an important political meaning: French Defense recognized the superiority of US technology and gave up developing military computers for a decade, to concentrate on applications, programming and licensed production. The main economic spin-offs of these efforts were the creation of consulting companies specialized in systems engineering. At the same time, the emergence of national nuclear deterrence capabilities enabled De Gaulle, then president of the Republic, to withdraw the French armed forces from NATO's military structure. There was only one unavoidable exception: France's new operational air defense systems remained closely integrated in NATO electronic networks. At the end user level, the implementation of these systems on ships was a cultural revolution: As ships became somehow mere terminals in a control-command network, it meant the end of the age-old principle of the captain and commander, 'sole master on board after God'. The main sources I used are the records of the French Air Force, Navy and Ordnance, and of the Centre National d'Etude des Télécommunications (CNET); interviews with former IBM, Bull and military engineers and officers added information and insight.

GREEK MILITARY AVIATION IN THE ELECTRONIC ERA: TECHNICAL PROTOCOLS, COMPETITION, AND INTERNATIONAL TRENDS

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The research is focused mainly in the adoption of electronics in the aviation technology and the different approaches of the software and hardware localization in the formation of the Greek aviation - military project.

It is focused on aspects of the history of the appropriation of aviation electronics and related technologies in Greece, as a result of the arguments of the military – industry - political – economical actors/complex. It is also interested in the competition between Europe and USA and the role of the politics in the final decision of each military project.

Main topics are the periods of the related aviation military projects, adoption problems in the Greek Air Force, synthetic Vs real training, economical approach, accidents and flight safety. The description of the formation of the Greek aviation military project (technological change) is focused on the perspective of how the use of the adopted technology linked – de-linked and re-linked the Greek air doctrine and the relationships of the militant participants with the other related – actors.

This case study offers an opportunity to try considering this history from a perspective of a national experience, that of Greece. Caught up in complicacies that make military-operational considerations a factor that could not be neglected, the Greek military aviation project has put the assumption about the globalization of technology into a strong test (Europe-USA).

Sources of the research are the archives of the Hellenic Parliament, Economic Chamber of Greece, military press, opinions of the actors of each project, including archives related to the doctrine of the Greek Air Force.

TOUCHING THE FACE OF GOD: RELIGION AND THE U.S. AIR FORCE

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The United States Air Force is a large organization based on technology and technological prowess—its emphasis on technology is so great that Carl Builder defined the U.S. Air Force as “worshipping at the altar of technology” (1989). What if this worship were more than just mere allusion, but was an artifact of a true Air Force religion?

I will argue that the U. S. Air Force is a religion, complete with sacred and profane objects; priests, prophets, and laity; soteriology and theodicy; cultural manifestations such as heroes; and more. Using seminal texts from Durkheim, Weber, and Gentile, I will build a generic military religion model and then show how the U.S. Air Force maps convincingly onto that model.

Using the Air Corps Tactical School as a historical example, I will briefly describe how the seeds of the Air Force religion were nurtured during the rapid growth of the nascent organization. As a result of its birth the modern U.S. Air Force is linked to a worship of technology and this emphasis on technology limits its problem-solving capability. I argue that only through careful balance of both technology-as-process and technology-as-thing will the U. S. Air Force come closest to achieving the high flight in which a human–not an artifact–may “reach out my hand, and touch the face of God” (Magee).

Symposium S70
'Spacing Earth History': Geological and Paleontological Sciences in Cultural Contexts from 17th to 20th Centuries

UNE "APPROCHE ORGANIQUE" DES MONTAGNES EN EUROPE MÉDIÉVALE – SAUVEGARDÉE PAR DES MINEURS ALLEMANDS EN HONGRIE ET DOCUMENTÉ PAR MARSIGLI

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L'officier italien, L. F. MARSIGLI (1658-1730) a préparé une présentation précise du Royaume de Hongrie pour les buts de la cour royale viennoise, vers la fin du 17ème siècle. Son cette "inventaire" est devenu, grâce aux données importantes et aux figures précises, une source d'information incontournable de telle période, en plus, déjà après la mort de l'auteur illustré, une version traduite en français de son manuscrit (écrit au fond en latin) fut édite – aux Pays-Bas, en cinq vastes volumes. Cette version imprimée a gardé les figures gravées ainsi que leures commentaires latines, mais – en présentant p.ex. la plus importante ville-mine médiévale du pays et ses parties différentes, comme une coupe – certains mots-de-maître ne sont y décrits, qu'en allemande (n'existant à l'époque aucune expression parallelle latine !).

Ce qu'on trouve ainsi aux figure originales présentantes précisement les lieux-de-travail des mineurs (c'est à dire les espaces / les corridors souterrains avec des roches) riches en métaux précieux, qui sont exactement sous l'exploitation… c'est qui m'a donné une certaine surprise, puis m'a soutenu l'hypothèse sur ce sujet. Comme ces pierres sont marquées soit comme ERTZ (ore), soit comme HERTZ (qui signifie la coeur !), cette similarité formelle forme la base de mon hypothèse aux arguments à présenter.

ORIGIN OF GEOLOGY IN THE NETHERLANDS (1780-1839)

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FIRST GEOLOGICAL INVESTIGATIONS OF AUSTRALIA'S COASTAL REGIONS BY FRENCH AND BRITISH EXPEDITIONS, 1788-1803: AN EXAMPLE OF SCIENTIFIC COOPERATION BETWEEN TWO NATIONS AT WAR

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In the fifteen years following the founding of the British colony of New South Wales and the establishment of the first European settlement at Sydney Cove in 1788, four expeditions of discovery, led respectively by the French captains the Comte de La Pérouse (1788), Bruny d'Entrecasteaux (1791-92), Nicolas Baudin (1801-03), and by the English navigator Matthew Flinders (1801-1803), mapped and carried out scientific investigations along large parts of Australia's coasts. The results of their work, together with data from colonial surveys, led to the publication of the first map of Australia. Despite the emergence of disciplines such as geology and botany as branches of science in their own right, the expeditions' scientists frequently worked across disciplinary boundaries. In addition to the investigations of the geologists Louis Depuch and Charles Bailly, geological observations were made, among others, by the botanists Jaques-Julien de Labillardière and Robert Brown, the zoologist François Péron, and some of the ships' officers and surgeons, including Baudin and Flinders.

While most of the scientists who accompanied these expeditions examined and recorded geological features as part of their general fieldwork, those sailing with Baudin, including Depuch, Bailly and Péron, investigated the country's geology in a more systematic fashion. They were the first to employ scientific methods and techniques in their work and to order strata and rocks according to then current schemes of classification.

Despite the fact that England and France were at war with each other during most of the fifteen year period, scientific cooperation continued on an amicable basis with the support of both governments. Any suspicions among the English about the purpose of the French voyages to the southern continent did little to impede the scientific work these expeditions.

LETTERS OF GERMAN NATURALISTS TO DOMOKOS TELEKI, THE FIRST PRESIDENT OF THE JENA MINERALOGICAL SOCIETY, IN THE END OF THE 18th CENTURY

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Count Domokos Teleki (1773-1798), a young Hungarian aristocrat studied in Vienna University (1789-1793), later he lived in his native district in Transylvania but returned several times to Vienna. He owned a valuable collection of minerals. On a journey in 1795 he visited the Saxonian principalities in Germany. Returning home he received many letters from Germany. As a result of this visit and correspondence he was elected for first president of the Jena Mineralogical Society founded in 1797, probably the first scientific society in mineralogy ever existed.

Ten letters of this correspondence addressed to Domokos Teleki were preserved in the archives of the Teleki Library in Marosvásárhely (Târgu Mureº, Romania). They are so far unpublished. Letters of Teleki and other Hungarian members sent to Jena are preserved mainly in the archives of the Jena University and have been mostly published.

Teleki received letters in the period 1796-1798 from the following persons:

- J. F. Freiherr zu Malkwitz, a high standing official and collector of minerals, Dresden,
- August J. G. K. Batsch (1761-1802), professor of botany and founder of the Society of Natural History (1793) in Jena,
- Johann Georg Lenz (1745-1832), professor of mineralogy and founder of the Mineralogical Society (1797) in Jena,
- prince Ernst of Saxony-Coburg (1784-1844), later ruler of the principality as Ernst I (1806-1844),
- prince Ferdinand of Saxony-Coburg (1785-1851), later incorporated into the Hungarian nobility (1827) after marrying the Hungarian duchess Maria-Antonia Koháry (1816).

The letters are dealing with donation and exchange of precious mineral samples, mainly various gold ores and precious opals of Hungarian origin. Another theme is the Jena Mineralogical Society, its organisation, members and activity in the year of the foundation. Persons like Werner, Klaproth, Goethe, Herder, the Hungarian secretary Bredeczky etc. are mentioned. In this respect the letters represent a valuable source of data concerning the contemporary specimens, collections and scientific studies of minerals.

The letters indicate that mineralogy was widely accepted in high social classes and among leading literary persons in Germany around the end of the 18th century.

MINING VERSUS ARCHAEOLOGY: NATIONAL STYLES IN EARLY 19th CENTURY STRATIGRAPHY

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One of the most common ideas in history of earth sciences is the discussion of mining as an essential tool towards the making of the new science of geology in the decades around 1800. This is due, not at least, to the emergence of the mining academies as a new type of professional education providing practical knowledge as well as scientific learning of minerals and rocks. The Freiberg and Schemnitz mining academies were the classic examples, representing the close interrelation between mining and earth sciences which has been influential particularly in the German speaking countries far into the 19th century: thus, still some of the leading mineralogists of the last quarter of the 19th century, like Paul Groth (1843-1927) and Victor Goldschmidt (1853-1933), started their careers at the Freiberg mining school.

A completely different view is given by a look on British geology. Among the famous British geologists of 19th century there are hardly any mining officials, which is also illustrated, for instance, by the members of the London "Geological Society", founded in 1807. Most of them were actually much better trained in archeology than in mining (and mineralogy). Thus, British geology of 19th century has been built within a context of a comprehensive science of antiquities, rather than within a tradition, comparable to the continental culture of mining.

The paper discusses these divergences with regard to the concepts of (national) scientific styles, and the "spatialisation", i.e. "spaces of knowledge". It focuses on the early works, and the geological practice of the Prussian geologist Leopold von Buch (1774-1853). He stood at the border of both `national styles': on the one hand he represented `German geology' like no other one of his contemporaneous colleagues, on the other hand, and this is often overlooked in modern discussions of his work, it was mainly Buch who was engaged in creating international standards for the new science of geology, in particular, for the new practice of writing earth history, i.e. for stratigraphy. Thus, the paper tries to re-open the question for the role of mining in the development of geological sciences, and also for the role of Von Buch in the history of earth sciences. It intends to show that the interrelation of mining and geology, in particular, with regard to the new history of the earth, i.e. to stratigraphy, was rather a characteristics of a particular (national) scientific style, or `space of knowledge', than a true constitutive part of the formation of a new science.

References:

B. Fritscher, "Einleitung", in: Leopold von Buch, Gesammelte Schriften, 4 vols. in 5 vols, with an introduction ed. by B. Fritscher [Berlin 1867-1885], (Historia Scientiarum) Hildesheim 2008.

N. Livingstone, Putting science in its place: Geographies of scientific knowledge, (Science culture) Chicago 2003.

M.J.S. Rudwick, Bursting the limits of time: the reconstruction of geohistory in the age of revolution, Chicago 2005.

H. Torrens, The practice of British geology, 1750 - 1850, (Variorum Collected Studies Series) Aldershot 2002.

LYELL'S PALAEONTOLOGICAL RESEARCH IN GRAN CANARIA

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Renowned as a geological traveller, Sir Charles Lyell (1797-1875) visited the Canary Islands during 1854 (18^{th} February to 8^{th} April). His stay on Gran Canaria Island lasted only twenty days (17^{th} February to 9^{th} March). During this time Lyell contacted Pedro Maffiotte Arocha (1816-1870), a Spanish engineer who was carrying out some works on Gran Canaria.

Following Lyell's visit to Gran Canaria, Maffiotte and he exchanged letters for twelve years, between 1854 and 1866. Maffiotte collected further samples from the localities that they had visited together and sent them to Lyell. The first delivery was mailed to Lyell on 23^{rd} March 1854 and consisted of two boxes of fossils from the track between Fuente Morales and Barranco Seco. These fossils formed a duplicate set, one part being sent to Lyell and subsequently donated to the British Museum (now Natural History Museum, London (NHM)), while the other eventually found its way to the "Villa Benítez" Museum (now *Museo Arqueológico*) in Tenerife.

Lyell spent several years studying the fossils that he received from Maffiotte, and exchanged letters with other researchers such as Leonard Horner, Charles Bunbury and George Hartung in an attempt to determinate the identities of the species present. Maffiotte was disappointed that Lyell did not publish a monograph on the geology of the Canary Islands, only making brief comments in the 6^{th} edition of *Elements of Geology* (1865).

Among the fossils acquired by Lyell were bryozoans from the locality of Santa Catalina. These specimens have recently been rediscovered in the NHM collections, accompanied by a letter from Lyell, and a letter and notes written by William Lonsdale to whom Lyell had initially sent the bryozoans for determination. Subsequently Lyell sent the bryozoans to George Busk, an authority on bryozoans, in whose collection they languished until presented to the NHM by Miss Busk in 1899.

Lyell's principal interest in the Canaries concerned their volcanic history. We will evaluate the extent to which these fossils helped his understanding.

GENEALOGICAL REASONING IN ALPINE TECTONICS. LINKING FAMILY HISTORY TO EARTH HISTORY

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Having singled out, described and classified the relative chronological order of rock strata according to the emerging standards of paleontology, geologists of the late 19th century sensed the necessity of exploring a second timeline of earth history. This timeline recorded the tectonic events – the postsedimentary dislocations or movements of the rock masses – which had led, together mainly with erosion, to the present profile of the earth's surface. As a rule, tectonic processes and structures were large-scale phenomena and operated on vast time scales. In the geologists' view, men had no means at hand to scale down the tectonic processes. There was no way to materially represent the forces the rock masses of the earth crust were subject to or, in turn, exerted themselves. Tectonicists struggled with this problem of generalization: They had difficult times in interpreting local evidence in view of a broader question or a more general framework. Consequently, the desk work of synthesizing and theoretical reasoning gained considerable weight. Now, what exactly did geologists do at their desk?

Albert Heim, the dominant figure of Swiss geology in the late 19th and early 20th century practiced the science of Alpine tectonics as a family business by conceiving his research in genealogical terms. He linked in other words, like many of his contemporaries did, the notion of "generation" to the idea of scientific progress. The mixing of family genealogies with intellectual genealogies found its expression in a special kind of desk work. Extending over four generations, Heim created a rather large body of documents: Handwritten notes of teachers and fathers were studied and edited. Own studies drew on the unpublished notes of the elders. Fathers and sons jointly mapped and published, and commemorative literature flourished.

Genealogical reasoning may be described as a standard pattern of historical reasoning. Arguably, Heim's genealogical rhetoric and work reflected a specific sense of making and communicating tectonic knowledge. In my proposed talk, I want to explore this idea in more detail.

STYLES IN GEOLOGY: EDUARD SUESS AND ERUDITION

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Eduard Suess is best remembered as the author of a grand global synthesis of geological knowledge, *Das Antlitz der Erde* (1885-1909), a massive work that is all too readily characterized as an example of the "contracting earth" theory that was soon to be eclipsed by continental drift theory and, ultimately, plate tectonic theory. Yet Suess, a leading geologist of his time and an outstanding figure in the *fin de siécle* Viennese scientific community, was in many ways a progressive figure. He did field work in a large state-funded geological survey, was actively involved in political life, eager for educational reform and, arguably, his most valuable contributions were in applied and urban geology, for his work in these areas led directly to the construction of a new and safe water supply for Vienna. Suess was very much a figure of the second scientific revolution but there is an important aspect of *The Face of the Earth* that seems out of step with his progressive, scientific practice: his emphasis on erudition as a source of geological knowledge. Although Suess's reliance on erudite knowledge, above all in his discussion of the geological phenomena associated with the "Temple of Serapis" at Pozzuoli, Italy, was unusual, it was not an alternative to, but rather an extension of geological fieldwork. His reliance on erudite knowledge belongs to an older era, but the way he used this knowledge shows that he was very far removed from the early nineteenth century world of gentlemanly geologists.

THE RIES PATRIOTS: THE INFLUENCE OF NATIONALISM AND LOCAL CONFINEMENT ON A SCIENCE DISTRUSTING INSTRUMENTS

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Between 1903 and 1960, the formation of the Ries Basin (Southern Germany) through a meteorite impact was proposed several times by outsiders of Ries research. Local experts however denied this interpretation fervently and successfully – holding to a volcanic origin of this geological structure – until in 1961 two American scientists, Eugene Shoemaker and Edward Chao, entered the scene with new and convincing data, obtained by using modern analytical instruments.

The ensuing "rearguard action", which can be demonstrated in detail through archive sources such as private letters and notebooks, highlighted general problems of geology in Germany – scientific and linguistic isolation during the 1930s and 1940s, a rigid, dogmatic methodology, self-imposed territorial restriction of geological research in connection with a stratigraphical and non-structural emphasis of geological research programmes – as well as a thorough distrust in analytical and instrumental sciences such as mineralogy.

Evidence that can only be seen through a microscope was as incomprehensible to many of the protagonists as the implications of chemical data or the mathematical models of physics. An Earth open to outer space and influenced by extraterrestrial agents was inconceivable for the old guard.

In the end, a change of general opinion came not by convincing the established authorities but because young scientists grew up quite naturally with the new ideas, while the old experts eventually retired and died.

GEOLOGY AS A SERVICE IN NATION BUILDING – THE JAPANESE EXAMPLE

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Right after the opening of the country following a long phase of political and cultural seclusion and the Meiji Restoration in 1868, the Japanese government started a concerted action for the development of industry, science and technology, law, military, and other critical sectors for the building of a Japanese nation. One of the most relevant initiatives in the area of science and technology was the general move towards the fostering of a geological survey structure which led to the foundation of the first state run scientific research institution of the country, the Geological Survey of Japan.

Several programmatic papers initiating this process came from the desk of the German geologist Edmund Naumann who served in Japan as a "hired foreigner" (*o-yatoi gaikokujin*) between 1875 and 1885. While the German original source papers are lost, our new translation and analysis of the *bungo* style old traditional Japanese texts prepared for the Japanese Prime Minister *Itô Hirobumi* and his cabinet reveal the line of reasoning, showing significant similarities to very recent debates in geosciences.

Both the regular use of geological methods as a means of scientific support for industrial and societal development, e.g. in the fields of mining and smelting, natural hazard reduction or environmental protection, and the implementation of a state financed research system for the sake of industrial as well as political stakeholders, were new to Japan.

THE SOVIET EXPERTS AND THE INTEGRATED SURVEY OF NATURAL RESOURCES IN CHINA (1950s)

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Key words: Soviet experts; Integrated Survey of Natural Resources

In the 1950s, the Commission for Integrated Survey of Natural Resources (CISNAR) was established in China by Chinese Academy of Sciences. Its main task was to survey natural conditions and resources and to propose the scheme of the development and layout of productivity.

Meanwhile, the Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance was subscribed in Feb.14th 1950. Then, the two countries, China and the Soviet Union, built alliances and started close cooperation and exchange in the fields of politics, economy, culture, science and technology. There were many exchange visits between the two countries at that time. Also, a large number of Soviet scientists came to China and cooperated with Chinese scholars.

With the suggestions and help of the Soviet experts£¬the Twelve-year Long-term Plan of Scientific and Technological Development was constituted by Chinese government in 1956. The Integrated Survey of Natural Resources was one of the projects of the Plan. From 1956 to 1960, the Soviet Union sent experts to participate in the Integrated Survey of Xingjian, Heilongjiang River Basin and tropical biological resources organized by CISNAR. They had a good number of scientific research tasks in the Integrated Survey. But the deterioration of Sino-Soviet relations in 1960 led to a halt in sending experts. Taking the Soviet experts in Chinese Integrated Survey of Natural Resources in 1950s as an example, this article analyses the role and the influences of this special group during the survey.

Symposium S71
Instrumentalizing Social Practice – Socializing Instrumental Practice

POLITICAL IDEAS AND INSTRUMENTAL IDEALS: THE DESIGN OF SCIENTIFIC INSTRUMENTS IN THE LATE 18th CENTURY

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When looking at 18th century scientific practice, several historians have stressed the importance of politeness. The necessity of using instruments in a specific social setting has also consequences with respect to the instrumental design. In taking the solar microscope as an example, I will discuss how the instrumental design had been developed throughout the 18th century in order to meet the social requirements of scientific practice. Yet, these could not only be related to social conceptions of knowledge production and dissemination but in some cases also to political ideas.

However, towards the end of the century, a new ideal of scientific practice was developed that became dominant in the nineteenth century. This practice was related with completely new instruments and can clearly be distinguished from the established one. Consequently, the instruments did no longer meet the criteria of classical enlightenment ideals. Even though several aspects played an important role in the development of this new style of experimentation, political ideas were one factor in this change.

CALORIMETRY AND THE SOCIAL QUESTION IN THE LATE NINETEENTH CENTURY

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From the middle of the nineteenth century onward, German physiologists of the biophysical reductionist school experimented on and interpreted physiological processes according to the assumption that the phenomena of life obey the laws of thermodynamics. Physiological processes could therefore be quantified and reduced to energy transformations. Although this assumption formed the basis of an extensive research programme, reductionist physiologists were unable to confirm it until the calorimetric studies of Max Rubner in the 1870s-1880s.

Approaching the animal body as a form of heat engine, Rubner used a highly sensitive calorimeter to measure the input in calories and output of heat, motion and bodily excretions in dogs. His results seemed to confirm that the energy conservation law was applicable to complex living organisms, results which were confirmed a few years later on human beings by Wilbur Olin Atwater, an American physiologist with German laboratory training.

In his experiments Rubner also explored the relationship between output forms in animals fed particular foodstuffs. The energetic hierarchy of foodstuffs that he developed on this basis suggested that dietary needs must be differentiated according to occupation and thus, implicitly, according to social group and class.

This paper will discuss the assumptions guiding the development of these animal and human calorimeters, the design of the experiments and physiological and social conclusions drawn from them. It will situate them not only within late nineteenth-century experimental physiology, but will also look to the social and cultural context of late nineteenth-century Germany and the role these factors played in the development of nutritional theory. Combining physiology, thermodynamics, engineering and economics, late nineteenth-century nutritional physiology constructed the living body as a working machine for an industrial society.

INSTRUMENTAL KNOWLEDGE: UNDERSTANDING HISTORIC SOCIO-TECHNOLOGICAL PRACTICE THROUGH ENGINEERING MODELS

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The role of models in the making of scientific knowledge has received increasing attention by historians over the past few decades. The nineteenth century saw a dramatic increase in the manufacture of such models due to new educational approaches and institutions. However, by the end of the 20th century these models had almost disappeared from museums and been replaced by new types of media. This paper explores the making and uses, underlying conceptions and social contexts of engineering models. It will be based on the impressive collection of engineering models kept at the National Museums Scotland, dating from the period 1850s to 1970s. These models in their days played a paramount role in the building of public technological knowledge in Scotland. They were not perceived as mere representations but as active mediators in the understanding of materials, techniques and processes. Models were instrumental in the transmission of contemporary engineering knowledge. Interaction with audiences in return enabled museum curators to build both collections and expertise. The exploration of these engineering models helps us to expand our own understanding of historic socio-technological practice.

ACCELERATING FOR PEACE SCIENCE, TECHNOLOGY AND THE AMERICAN DECADE OF NUCLEAR RESEARCH IN INDIA

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My paper looks at the establishment of a Nuclear Research Centre at the Indian Institute of Technology, Kanpur (IITk), with US American support during the Cold War. IITk was established based on the MIT as a model, by the Kanpur Indo-American Program (KIAP) - a nine-university consortium funded partially by the United States Agency for International Development (USAID). Three similar institutes were being established simultaneously in India with Soviet, British and West German help. Against this background, on October 16 1964, China conducted her first nuclear tests at Lop Nur. The Indian government responded with heavy criticism given also the history of an Indo-Chinese war situation barely two years before. US American foreign policy took due notice of the imbalance of power in the region and considered various options for enhancing Indian prestige. Help in nuclear matters was considered but decided against with concerns of proliferation. Physicists participating in KIAP in consultation with the Department of Atomic Energy (DAE) of India proposed the establishment of a nuclear research centre at the IITk in 1965. An acute awareness of the DAE's political and scientific agenda was combined with two concerns of the participating universities and funding agencies. Arguing for the MIT model of engineering education close to research and training in fundamental sciences, the physicists also combined the need for nuclear research at the IITk with competition. If the American IIT had to remain unique in comparison with the Soviet, British and West German, the nuclear research centre would provide just that opportunity. The Chinese nuclear tests, I argue, provided an opportunity for the DAE of India to seek support for an agenda that was shaped prior to the tests, and for KIAP, a chance to make an exemplar of an institution that would remain an uniquely American contribution to engineering education and the development of India.

SOUNDS FOR COMFORT OF COMPUTERS USERS IN THE 1950s

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In the era of "instrumentation", ca. 1930-1960, when the construction and use of instruments for science and engineering practices became almost a discipline in itself, even the instruments of calculation gained autonomy. Various cultures of schematizing and scheduling "instrumentalized" around 1950 to specific computing machinery and specific practices of using such automatic calculators.

In the following decades the integration of computers into the practice of research gave rise to a new kind of science, computational science. There, the impact of these instruments showed that computers were much more than instruments of calculation.

In this talk I will halt at the transition stage: the socialization of instrumentalized practices of computing. Leaving the calculations to an automatic computer, and trust the machine for the rationality of the result, was not automatic. The usual sonic or visual signal confirming the operation of instruments was absent in early computers. The loss of sensory tractibility of the instrument was compensated by auditory monitors. Speakers were installed in early computers to recomfort the user: restoring the sensory confirmation of it being an instrument. Particular Dutch and German practices of listening to computers in the 1950s will be related in some detail.

Gerard Alberts (1954) is head of the Program in the History of Computing at the Informatics Institute, University of Amsterdam. He is project leader of Software for Europe, in the ESF Eurocores program Inventing Europe. As a historian of mathematics Gerard Alberts has been writing on mathematical modelling and computational science. In history of computing he specializes in practices of computing and software. G.Alberts@uva.nl

ORBITING MARS, ORBITING A CAMERA: THE AMBIGUITIES OF BUILDING A SCIENTIFIC RESEARCH GROUP AROUND A SINGLE INSTRUMENT

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Since 2004, the *High Resolution Stereo Camera* (HRSC) is orbiting Mars aboard the *Mars Express* spacecraft. During most of the four approaches per day, it scans the surface of Mars and sends the data down to Earth. Inside the *German Aerospace Center*, a team of a dozen members is exclusively busy with the camera and the daily incoming stream of data. In a complex procedure, photogrammetrists build a "digital terrain model" of the surface of Mars, which is then used by geologists for the investigation of the properties of the boundary layer.

There is a strong sense of togetherness inside the group and a smooth cooperation between both professions in spite of ultimately different aims and methods. The common data format and visualization software enables the geologists to produce data products and visualizations by their own, and the location of the offices next door to each other makes it possible to have this done by the photogrammetrists for more sophisticated problems. These custom-made data products and visualizations are crucial for geological research, – at least do the geologists present their findings as direct results of the HRSC.

This strong internal coherence has, however, drawbacks for the external reception, a fact which is constantly complained about by members of the group. Although, in principle, all data are publicly available, almost no-one uses them outside the team. The idiosyncratic data format *Vicar* and the impossibility to fall back on the expert knowledge of the photogrammetrists in refining the data are at once social and technical reasons for this situation. In addition, the impression that the HRSC, the data and the team constitute a strong unit may be little encouraging for outsiders to compete with the group on its own playground. This situation is in no way peculiar to the HRSC-group. When *they* need data from other instruments, they face similar socio-technical boundaries.

GATHERING DATA, LOSING FOCUS: THE AERONAUTICAL RESEARCH INSTRUMENTATION OF SAMUEL PIERPONT LANGLEY

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Although the human desire to fly was ages old, it was only during the century before the Wright brothers made their historic first flights in a powered airplane in 1903 that much meaningful technical advancement took place. The research and practical experiment of Sir George Cayley in England laid an important foundation during the first half of the 19th century. Then, in the 25 years prior to the Wrights' success, an increasing number of professionally trained scientists and engineers began to join the community of experimenters studying the problem of human mechanical flight. Among those was the prominent American astrophysicist, Samuel Pierpont Langley.

Among the strengths Langley brought to his astronomical research were his skills as a keen observer, meticulous experimenter, and talented instrument maker, skills that he would bring to his aeronautical work as well. From the late 1860s to the mid 1890s, Langley developed numerous theoretical models to explain how a flying machine would work. To demonstrate the validity of his ideas, Langley built an extensive array of instruments to test different aspects of his theories. In many cases, his hypotheses regarding aerodynamics, power application, and control were flawed, even flat wrong. However, the instruments he built were often well-designed and well-fabricated, and gave him the data he sought to develop his ideas. This paper will examine Langley's aeronautical instrumentation and how his desire to gather precise data diverted him from seeing the larger flaws in his theories.

The Smithsonian Institution retains all of Langley's aeronautical research instruments and equipment. (He served as head of the Smithsonian from 1887 until his death in 1906.) That collection has remained largely unexamined and uncataloged until very recently. An ongoing study and preservation of these artifacts is currently taking place. This paper stems from that research.

"A FATAL HOUR FOR METALLOGRAPHY": THE COGNITIVE AND SOCIAL APPROPRIATION OF NEW INSTRUMENTS AND METHODS IN AACHEN'S FERROUS METALLURGY FROM 1900 TO 1914

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The construction of research laboratories equipped with the necessary instruments for empirical work was the point of departure for the fundamental research reform in ferrous metallurgy around 1900. Unlike international ferrous metallurgy, German metallurgy had fallen into a theory deficit, being still concerned with the continued systematisation of practical experience until the turn of the century. The Aachen ferrous metallurgist Fritz Wüst tried together with his colleagues to compensate for this deficit with the completely new orientation of research at the Aachen institute. Especially in England and France, a massive theoretization of ferrous metallurgy had begun already in the 1880's that made a fully new understanding of the foundations of iron and steel possible, mostly with the help of physical chemistry and thermodynamics. The altered understanding of the science inherent in this theoretization made experimental laboratory studies and the theoretical explanation of the phenomena observed ferrous metallurgy's foremost cognitive goals.

On the one hand, a necessary prerequisite for these efforts was the organization of metallographic laboratories, structure investigations being fundamental for the identification of different phases and their transition points. Pyrometric instruments were also an indispensable aid to the investigation of physical-chemical properties. However, the changes did not only take place at the cognitive level, for on the other hand, only the successful embedding of new methods and instruments in the social system of ferrous metallurgy as a discipline paved the way for the successful scientification of ferrous metallurgy. Furthermore, the appropriation of metallography led to radical structural changes in the disciplinary field. For example, the disposal over these new means of production was a new form of scientific power for ferrous metallurgy. The contribution retraces this dual metamorphosis in ferrous metallurgy with the example of the Aachen University.

Symposium S72
60 Years of Cybernetics and Information Theory – Ideas, Artefacts and Instruments

WHAT CYBERNETICS DID TO CHANGE THE MINDSETS OF ENGINEERS: NEW DESIGN PROCEDURES IN THE 50s AND 60s

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Wiener`s cybernetics approach developed new design theories and tools for engineers such as statistical design, input-output analysis, signal-flow diagrams, Laplace transformations etc. These new tools and theories led to an intensive discussion about different ways to rationalize the design process. The Research Laboratory of Electronics (RLE) at MIT played a significant role to assert cybernetics oriented design procedures in the 50s and 60s. Members of the RLE like John G. Truxal and Yuk Wing Lee, a scholar of Norbert Wiener, promoted the new design techniques in their engineering handbooks. This paper will focus on the change of design tools and theories caused by the reception of cybernetics, which promised a comprehensive way to gain control on complex technical but also social systems in the era of Cold War.

CROSSING BOUNDARIES OF CYBERNETICS AND INFORMATION/COMMUNICATION THEORY. THE IDEA OF FUZZY SETS AND ITS FIRST TECHNICAL APPLICATION

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Information theory and cybernetics, developed during the Second World War by Claude E. Shannon, Norbert Wiener, Andrei N. Kolmogorov, Ronald A. Fisher, and many others, became well known in the late 1940s and early 1950s.

Inspired by Wiener's *Cybernetics*, Shannon's *Mathematical Theory of Communication* and the new computer era that started during the wartime with the *Electronic Numerical Integrator and Computer* (ENIAC) and the *Electronic Discrete Variable Computer* (EDVAC), both designed by John P. Eckert and John W. Mauchly, the young emigrant Lotfi A. Zadeh continued his studies in electrical engineering after his emigration into the USA in the 1940s. When he started his doctoral studies at the Columbia University in 1946, he became acquainted with these new milestones in science and technology. Shannon and Wiener delivered lectures in New York about the new theories they had developed during the War. In 1950 Zadeh acted as a moderator at a debate on digital computers at Columbia University, held between Shannon, Edmund C. Berkeley, the author of the book *Giant Brains or Machines That Think* published in 1949, and Francis J. Murray, mathematician and consultant to IBM.

15 years later Zadeh, who was then a professor of electrical engineering at Berkeley, established the new mathematical theory of Fuzzy sets. Already in 1962 he described the basic necessity of a new scientific tool to handle very large and complex systems in the real world: ‘‘we need a radically different kind of mathematics, the mathematics of fuzzy or cloudy quantities which are not describable in terms of probability distributions.”

The potential of the new techniques of the theory of Fuzzy sets and systems urged Ebrahim H. Mamdani, a professor of electrical engineering in London, to attempt the implementation of a fuzzy system under laboratory conditions. He expressed the intention to his doctor student Sedrak Assilian, who designed a fuzzy algorithm to control a small steam engine within a few days. The concepts of so-called linguistic variables and Zadeh's max-min composition were suitable to establish fuzzy control rules because *input*, *output* and *state* of the steam engine system range over fuzzy sets. Thus, Assilian and Mamdani designed the first real fuzzy application when they controlled the system by a fuzzy rule base system.

The steam engine heralded the Fuzzy boom that started in the 1980s in Japan and later pervaded the Western hemisphere. Many fuzzy applications, such as domestic appliances, cameras and other devices appeared in the last two decades of the 20th century. Of greater significance, however, was the development of fuzzy process controllers and fuzzy expert systems that served as trailblazers for scientific and technological advancements of fuzzy sets and systems.

Very little is known about the connectivity between Cybernetics and Information and Communication theory and the theory of Fuzzy sets. My paper will review some historical links across the boundaries of these fields showing the influences of Cybernetics, and Information/Communication theory to the theory of Fuzzy sets.

BIONIC PROTOTYPES AS SCIENTIFIC MODELS: EXPERIMENTAL EPISTEMOLOGY AT THE BIOLOGICAL COMPUTER LABORATORY 1958-1974.

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Ten years after Norbert Wiener published his famous book on "Control and Communication in the Animal and the Machine", Austrian physicist Heinz von Foerster, another member of the illustrious Macy-Group, put the new scientific approach of Cybernetics into practice and established a truly interdisciplinary research facility at the University of Illinois in Urbana/Champaign. From 1958 on engineers, biologists and philosophers at the Biological Computer Laboratory (BCL) carried Wiener's analogy a bit further and tried to construct machines that would not only resemble biological systems but also operate according to the very same underlying „fundamental principles of nature".

Experimenting with these analogue computers and combining ideas from cybernetics and biological systems theory with latest results in experimental physiology, scientists at the BCL sought after "operational definitions" of biological phenomena (such as „perception"). In this respect electronic modelling as an epistemic strategy was intended to support the observation, explanation and demonstration of self-organizing systems at work. "My criterium for understanding", von Foerster once argued, "is being in principle capable of building a system which will do the things we profess to have understood".

In my talk I want to introduce machines of perception like the *NumaRete* (an artificial eye) or the *Dynamic Signal Analyzer* (an artificial ear) and discuss their status within the research program of an *experimental epistemology* at the BCL. As I am going to argue the reason models arose as a style of scientific thinking within BCL research are innately linked to the discourse of Cybernetics, Bionics and early System Theory, since the epistemic strategy of modelling incorporated the assumed universal Transfer of information between the realms of nature, logic and machine.

Between 1998 and 2005 **Jan Mueggenburg** studied media studies, philosophy and British cultural studies at the Ruhr-Universität Bochum (Germany) and the Edith Cowan University in Perth (Australia). He wrote his master thesis on "The History of the Computer as Medium and its Presentation in Museums of Technology". As a member of the Initiativkolleg "The Sciences in Historical Context" at the University of Vienna, Jan Mueggenburg is currently writing his doctoral dissertation on the Biological Computer Laboratory (1958-1974).

RICHARD WAGNER AND HIS BOOK ON FEED BACK SYSTEMS IN ECONOMY

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With his book Cybernetics (1948) Norbert Wiener established a new interdisciplinary approach. In accordance with the subtitle Control and Communication in the Animal and the Machine it focused on structural similarities of information processing in technical systems, biology, and society. However, in 1948 this approach was not totally new but there are a long pre-history in USA as well as in Europe. To that belongs also the book *Arbeitslosigkeit und Deflation im Wirtschaftskörper unter dem Gesichtspunkt biologischer Gesetzmäßigkeiten* (Unemployment and Deflation in Economy under the Aspect of Biological Laws) which had been issued 1932 by the publisher Emil Haim in Vienna. This book analyzed the economic crises at the end of 1920ies and mentioned as well proposals for solution. Conspicuously the author used biological metaphors and argued with feed back loops. However, the author's name is not on the cover but only the information "By a natural scientist".

1961 Richard Wagner, physiologist at the Munich University, confessed his authorship of this book. It is known that Wagner uses the concept of feed back loops 1925 for explanations of biological phenomena. With the book on unemployment and deflation clearly he exceeded the borders of his own discipline and generalized the idea of feed back loops into economy. Therefore Wagner can be considered as one of the pioneers of cybernetic ideas in Germany. The lecture will give an overview on Wagner's contributions in the pre-history of Cybernetics in Germany.

Symposium S73
Ideas of Technology Across Time and Space: Changing Concepts and Ideologies

THE ARTS AND ENGINEERING: THEIR MEANING AND CULTURAL PLACE IN LATE MEDIEVAL AND EARLY MODERN EUROPE

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This paper focuses on the ways in which the arts, mechanical arts, and engineering were perceived and understood and in a certain sense transformed in Late Medieval and Early Modern Europe from about 1400 until about 1600. In a discussion indebted to the physicist/philosopher Edgar Zilsel and the many scholars that have drawn on his work, it will explore how the values and meaning of the technical arts developed and changed over time, and the ways in which activities of craft and handwork came to be associated with learned cultures. The paper will pay close attention to "keywords" to use Raymond Williams' expression, as well as to the broader cultural context in which aspects of the "mechanical arts," in the form of empirical methodologies and instrumentation became intrinsic to the new sciences in the late sixteenth and seventeenth centuries.

A WEBERIAN MODEL ON TECHNOLOGICAL KNOWLEDGE – MEDIEVAL TRANSMISSION OF KNOWLEDGE ON PIGMENTS AND DYES FOR PAINTERS AND ILLUMINATORS

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A great variety of written technological sources may be described using a sociological model based on three parameters : i) a *Herrschaft* concerning the labour process (theological/ craft-guild /rational-legal/ capitalist), ii) the *form of technological knowledge* (traditional/ scientific description/ scientific rationalization), iii) the *kind of transmission mechanism* of the written record (manuscript/print culture/electronic data).

Considering Beckmann's *Anleitung zur Technologie* (1777) as a pivot time point, six manuscripts and three authors, in the time interval spanning from the beginning of the ninth century to the beginning of the twentieth century, are discussed. We first describe Beckmann's *Technologie* with an ideal type appropriately modified to account for the function of technology in Marx's and Taylor's works. The core of the article is the investigation of the transmission and innovation mechanisms of six medieval manuscripts (mss) on pigments and dyes (colours), the possible moving causes of their writing, the kind of readers and the type of knowledge carried by the mss themselves. The first three manuscripts belong to the *corpus* of *Mappae Claviculae* e.g.: the Lucca, the Sèlestat, and the Phillipps mss. The other three are treatises or organised essays, e.g.: *De Diversibus artis* by Theophilus , *The Craftmans's Handbook* by Cennini and the ms 6741 by Lebègue (1431).

This paper demonstrates how the difference between modern technological knowledge and pre-technological knowledge may be rationalised considering the three parameters of our model, e.g.: the rise of a universal, legal and rational form of *Herrschaft,* the scientific revolution and the diffusion of the printing process.

"MACHINE" AND "DECLINE": CONCEPTIONS OF *TECHNIK* IN THE CONSERVATIVE REVOLUTION OF THE WEIMAR REPUBLIC

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My paper explores the intellectual, material, and political connections between "philosophies of technology" formulated by members of the so-called Conservative Revolution in the Weimar Republic and the widely proclaimed crisis of liberalism in Europe between the late 1890s and the 1930s. I analyze specifically the ways in which the Conservatives used the term "technology" as a political and rhetorical tool to wage a massive attack against the entire bourgeois legacy – including the bourgeois citizen and the bourgeois state – of eighteenth- and nineteenth-century

Germany. I inquire at the same time into the technological systems that these philosophers used as illustrations and examples of what "technology" (*Technik*) meant for them. I rely on works such as Oswald Spengler's Man and Technics (*Der Mensch und die Technik*) from 1931 and Ernst Jünger's The Worker (*Der Arbeiter*) from 1932 to explain their understandings of the industrial mass culture that surrounded them as well as their understandings of the ostensibly coherent and monolithic term *Technik*. Spengler's and Jünger's texts illustrate how technological and intellectual cultures interacted with and profited from each other in a period in which the horrors of World War I provided the foundation for reactionary sentiments that challenged the very idea of the accomplishments and promises of modern technological and bourgeois culture.

THE TRANSNATIONAL SHAPING OF THEORY OF TECHNOLOGY IN IMPERIAL JAPAN, 1931-1945

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During the 1920s and 1930s, Japanese intellectuals simultaneously absorbed European and American notions of technology and adapted them to the Japanese context. Whereas early Japanese Marxists defined technology in a materialist sense as the "system of the means of labor," others analyzed the subjective and cultural aspects of technology, which they understood broadly as human practice, or the process of making things. In doing so, this latter group of thinkers not only expanded the term's meaning to encompass a broad range of phenomena; they also increasingly interpreted it in practical or existential terms, as signifying certain ways of acting, thinking, or being, or even as representing certain values, such as rationality, efficiency, creativity, or an ethic of responsibility.

The absorption of American and European notions of technology in Japan coincided with the increasing colonization of East Asia and total mobilization for war at home. The term, "technology" (*gijutsu*), became more prominent in public discourse and intellectuals formulated theories of technology they deemed suitable for building a productivist society in Japan and "constructing a New Order in East Asia" beyond capitalism or communism. My paper focuses on one prominent theorist of technology during the war, Aikawa Haruki, and his negotiation with contemporary German, American, and Soviet theories of technology. His theory sought to firmly root technology in "praxis" and subjectivity, thereby resolving social ills such as spiritual alienation and class conflict associated with the permeation of technology throughout modern life. By firmly positioning Japan within global conversations around technology and modernity, I seek to question studies of Japanese wartime ideology, which focus too narrowly on its irrationality, anti-modernity, and particularity.

THE ROLE OF CONTINENTAL CONCEPTS OF TECHNOLOGY IN AMERICAN SOCIAL THOUGHT, FROM TALCOTT PARSONS THROUGH HERBERT MARCUSE

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In a 2006 article in *Technology and Culture*, I argued that the German concept of *Technik* transformed the English-language concept of *technology* in the early 20th century largely through the work of Thorstein Veblen. This influence did not end with Veblen, however. From the 1920s on, a series of social theorists in the United States actively appropriated Continental ideas about *technique*. Sometimes these scholars translated the German or French term as *technique* or *technics*, for example Lewis Mumford in his 1934 classic, *Technics and Civilization*. But increasingly in the 1930s, Continental ideas about *technique* were transformed into an English-language discourse about *technology*. One can see this process clearly in the work of the sociologist Talcott Parsons, who earned a German doctorate in the late 1920s. The Continental discourse of *technique* also influenced American and British historians of science through the papers of Soviet historians presented at the 1931 International Congress of the History of Science and Technology. The debates provoked by these papers echoed throughout the 1930s, particularly in Robert K. Merton's 1938 work, *Science, Technology and Society in Seventeenth-Century England*. After WWII, American debates about *technology* were significantly shaped by Continental philosophers, in particular by the Frankfurt-school émigré Herbert Marcuse in the 1960s. Nevertheless, the older English-language meaning of *technology* as "science of the arts" survived in the definition of *technology* as "applied science." These combined meanings created a conceptual confusion that persists to this day.

Symposium S74
Technology in the Interaction with Society and the Environment

TECHNOLOGICAL RESPONSES TO CONCERN FOR THE FUTURE: FINNISH EXPERIENCE ON COPYING WITH LIMITS OF NATURAL RESOURCES

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Preindustrial Finland consumed so heavily on its timber resources that the standing stock turned to a noticeable decline by the turn of the 18^{th} and 19^{th} centuries. At the same period population continued to grow rapidly. Contemporaries paid attention to rising labour and transportation costs to acquire timber from ever more remote areas. The concern that in the future the acquisition of timber types of the greatest demand will cause increasing difficulties led to a debate on how to divert the unsustainable development trend.

The paper argues that when the problem was decided to solve by the more economic and rational use of timber, it meant considerable changes in space heating, grain growing and refining timber. However, prudence and new consumption patterns in timber utilization were not enough. Neither modifications of economic and agricultural policy were sufficient; technological change was regarded indispensable.

By means of building and estimating time series based on quantitative sources, the paper attempts to prove that technological solutions had the crucial role in turning the declining trend of the timber resources into an increase. Economic, social and environmental demands for technological change led to profound reforms that helped to avoid the predicted future.

DRIVING IS (NOT) FOR EVERYONE GENDER PERSPECTIVE ON MOTORING EXPERIENCES IN FINLAND, 1949-1980

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In postwar Finland the motorization of the transportation was an essential part in building a new and modern society. The amount of cars, as well as roads, increased considerably, especially during the 1960s. However, the share of female drivers was at the time still minor, only approximately fifth. In the public debate some contemporaries vocally explained for this gender imbalance by claiming that women cannot master technology.

This paper will analyse the interaction between technology and gender by focusing on the experiences of Finnish female drivers. How did they experience driving themselves? Did they see car as a technological device? Were they afraid of it, and how did they learn to handle the car? And most importantly, what did it mean for them to be able to drive?

As source materials of the paper, I will use mainly interviews, but also statistics, as well newspaper and magazine articles. Besides focusing on the case of Finnish motoring, the paper deals also in a more general level, how to study technology and gender.

AGAINST THE TIDE - TECHNOLOGY TRANSFER FROM THE PERIPHERY

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Technology transfer can be defined as a broad set of processes covering the flows of know-how, experience and equipment. It is usually described as something going from developed countries to developing countries or from the interior to the periphery or from "advanced" to "backward" areas [1]. In my paper, I will present some pre-industrial examples of reversal technology transfer – from the periphery to periphery or from periphery to the interior. In most of the cases, I present, the transfer is done through people in possession of certain knowledge or other means that leaves unremarkable traces, and only in one case, through literary means.

First I present two examples of technology transfer through migration. My first example is the transfer of Finnish slash-and-burn cultivation know-how to the forest region between Sweden and Norway and finally to North-America in the 17th century. My second example is the transfer of peatland cultivation practises across the Bothnian Gulf from Ostrobothnia to Västerbotten. These two cases can be considered as technology transfer from periphery to periphery, as all of the regions included were in the periphery on a European or global scale.

Finally, I present two examples of technology transfer from periphery to interior. My first example is the advanced Swedish saltpetre barn, which gained French interest in the 18th century. At that time the most advanced saltpetre barns within the Swedish empire could be found from peripheral Ostrobothnia. Indeed when Sweden lost Finland to Russia in 1809, peasants were advised to build saltpetre barns after the Finnish model in order to fill up the void after the loss of Ostrobothnian saltpetre. The final example is a transfer of technology in the form of a plant. In the 18th century the swede or yellow turnip (Brassica napobrassica) was introduced from Sweden to Great Britain. There it became an essential part of the advanced Norfolk-four-course cultivation method as it was more frost-resistant than the common turnip used in cropped fallow.

In my understanding a reversal approach like this, does not only bring an more diversified view on historical processes, but might also give some insights to the current discussion on technology transfer as a mean of development. My argument is that the suitability of a technology is more important than how advanced it is.

1. Headrick, Daniel R. (1988): The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940. New York & Oxford: Oxford University Press. p.. 9-10

RESOURCE CONSERVATION AND ELECTRIFICATION IN CALIFORNIA

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On the Pacific Coast of North America, engineers in the American state of California were among the pioneers in the development hydroelectricity. They developed hydropower principally on the rivers of the Sierra Nevada, and transmitted electricity hundreds of miles to valley and coastal towns and cities. Their efforts helped propel California to a position of leadership in technological and industrial development. The drive behind their efforts was, of course, economic and social development, the quest for progress that has so characterized western history during the past 200 years. However, resource conservation provided another equally important impetus behind California waterpower development.

Waterpower first became attractive in California because the most important steam power fuel, coal, was scarce in the region. Soon California entrepreneurs spoke conserving the energy contained the vast flow of water from Sierra Nevada streams by harnessing their power in great waterfall cities. When electricity became a viable energy technology, hydroelectric generation became an important part of the western conservation movement of the early twentieth century. By the 1940s, fully eighty percent of California's electricity came from waterpower, and during the energy crises of the late-twentieth century, waterpower was once again lauded as an essential environmentally friendly technology that conserved other nonrenewable resources.

Symposium S75
Playing with Technology

HEAVENLY GAMES OF FLIGHT ON THE PREHISTORY OF FLYING: BETWEEN AESTHETIC ILLUSION AND WONDERFUL TECHNOLOGY

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As the Middle Ages drew to a close, a discussion slowly emerged about the technological im/possibility of human flight. While the Renaissance bore witness to the first scattered attempts at realisation, artistic games with flying objects and antigravity choreographies had long been experiencing a heyday. It is extremely important to note that the great ambivalence of the desire to fly, with its moral scruples and technical doubt, is countered, on the other hand, by a great fascination and pleasure, bound up with the playful simulation of vertical dimensions. On festive occasions, lifelike simulations of aerial bodies were extremely popular, whether in the form of angels or antique gods, winged dragons or fantasy birds. Images of flying objects, as well as games involving airy apparitions were such a regular occurrence that it seems hardly possible that they would not have influenced the imaginations of those attempting to construct real flying machines. Conversely, the aesthetic games involving flying objects were so complex in their material, technical, logistic conditions, as well as their economic, political and aesthetic implications, that virtually every important issue in art, science and technology, as well as politics, economics and religion has been affected in one way or another by aerial aesthetics. Against this background, the planned contribution will not attempt to grasp the numerous histories of flying before flying as the triumphant progress of technological reason, but to draw insights from the horizon of the times, as aesthetic games of the wonderful, as ludic performances of 'wonders of technology'.

TOYS, EDUCATIONAL TOYS, AND SCIENTIFIC INSTRUMENTS

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About 1800, Thomas Beddoes, one of the 'Lunar men', the famous Birmingham society counting many visionary entrepreneurs and natural philosophers among their members, promoted the production of so-called rational toys. However, Beddoes's attempts to start the production of rational toys turned out futile, finding no eligible producer. His biographer, D.A. Stansfield notes: "Though the plan had good support in 'progressive' circles, Beddoes was not able to put it into practice. He tried again in 1800, having found a man capable of making the toys. Even then, outside Beddoes' own family, nothing came of it and the Rational Toys live only in Maria Edgeworth's 'Practical Education'." (1984, p. 225) Maria Edgeworth considered toys as outstanding educational tools indeed. In her eyes, the worlds of play and experiment were intensively linked. Playing with toys amounted to educating the senses. Children's toys should invite to play and discover. Beddoes and Edgeworth (as Pestalozzi in Germany) may rightfully be considered prophets. About 1900, their initiative would have resulted in an industry, producing educational toys and selling them via trade catalogues, some of them all over the globe.

At first sight, the nineteenth century seems to provide an over-all success story for educational toys. This paper wants to deal with that history in somewhat more detail, focusing especially on the transition from local manufacturing to (inter)nationally operating firms. In the first part of the century, the distinction between toys, philosophical toys and scientific instruments was not that sharp. Regarding scientific instruments, the standardization of equipment is considered an obvious merit. How should we assess the industrialized and more global manufacturing of educational tools, in comparison to their local production? We will focus especially on changing communication patterns between scientists and instrument makers. How did the manufacturers of educational instruments keep in touch with recent scientific findings? At what time did the opinions of pedagogues and scientists start to fall apart?

STORIES OF MODERN TECHNOLOGY IN THE CHILD'S WORLD DURING THE COLD WAR: THE CASE OF THE NETHERLANDS

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This paper analyses the ways in which dramatic technological innovations of the late 1940s until the early 1960s, especially nuclear power and automation (robotics), entered the world of children (age ca 8-13) through toys, books and comics. These innovations were widely depicted and described in the popular press and discussed by politicians, intellectuals, artists and the wider public, because they were believed to change the worlds of international relations, prosperity and work in dramatic though controversial ways. The question is how technologies that aroused such contradictory expectations in adults were presented to children. I chose the pre-puberty age, because this is the phase when - according to psychologists -children become aware of the wider world outside the family and parents are challenged to explain this world to them.

The theoretical premise, derived from the work of psychologists, philosophers and anthropologists (Bruner, Arendt, Lévi-Strauss e.a.) is that stories – fictional and discursive – are the main ways in which people explain their experiences to themselves and each other. Stories are used both to domesticate and explore 'the new', including new technology. We can test the hypothesis that children's stories were vehicles to make the brave new world of modern technology less threatening than it was for many adults by embedding them in a playful context. Another hypothesis is that they were used to awaken an interest in technology and to stimulate children to choose technological professions, in other words, that they were part of an attempt to solve to serve a man (woman?)power problem of western societies. The case of toys is slight different, because here children are allowed to weave their own stories around the objects of play (dolls, toy planes). The question here is what kinds of stories the toys enabled or stimulated the children to imagine.

The empirical basis is fourfold: a selection of children's books and comics, toys and advertisements for them and discussions among educationalists about bringing up children in the modern world. The study focuses upon the Netherlands, because I am working on a book about perceptions of and discussions about modern technology in the Netherlands in this period.

TECHNOLOGY, PLAY AND INNOVATION

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A first glance innovation and play are quite different fields: The most important aspects of playing are the freedom of play and the chance to create special worlds of games and playing. Thus playing offers good conditions to develop new ideas and to try something new. Innovations are planned and - by their origin - have the clear aim to shape inventions in order to become successful in the market. If this is impossible, an innovation fails. Thus innovations are taking place in a field of technological and economical conditions.

The aim of the paper is to search for mutual influences between technology, play and innovation. What is the role of play for innovation processes? And – vice versa – in which way do technical innovations influence games and play?

Innovations are an old and important field of the history of technology; new studies are interested in failed innovations and in the culture of innovation. Playing with technology is a quite new field; one can mention research in the field of sports and technology, on computer games and a few works on mutual influences of technology, science and play. It is a new focus in the field of 'playing with technology' to study influences between technology, play and innovation.

The author searches for links between acting in technology-based play and acting to promote innovations. For example: (i) Brand new technologies or scientific instruments were often imitated as small scale models and used as toys. Thus the toys might mediate knowledge on technology and advertise innovative products. To some degree they seam to be helpful to distribute an innovation, to make it successful. (ii) Play opens a field to test a new technology while the innovation process; this was the case before cars became suitable for transportation in-between the invention of cars and approximately 1910. (iii) Play might open a field to analyse strategies of innovation. But is this still playing, what is described here? The paper will deal with examples from technical toys and from the equipment of amusement parks at the turn to the 20th century.

Symposium S76
Politics, Technology and Infrastructure

BERTRAND GOLDSCHMIDT, PLUTONIUM AND TECHNOBIOGRAPHY

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‘Technobiography’ is a term of surprisingly recent vintage, despite its clear historical potential. It issues from the sociological study of Internet culture and experience, in part because it describes nicely a conceptual space where a media technology becomes a locale for the lives of users, and in part because for those who study the Internet, the term has a particular freshness to it that reflects their studies of contemporary technology. But, of course, an individual’s present or past relationship to airliners, or telegraphs, or copperware—or plutonium—could also be examined as technobiography. Any sort of technology might be studied, as well as any individual. We might observe that the development of a technology, and a particular life trajectory, are inseparable.

Such is the case with radiochemist Bertrand Goldschmidt and plutonium in France during the Cold War. Goldschmidt, the last personal assistant to Marie Curie, followed his instincts, and this led him to plutonium, from Chicago in 1942, to Montreal in 1945, to France after the World War II. As Goldschmidt advanced his career in the French atomic agency, he directed and encouraged the production of element 94, from milligrams to kilograms, by techniques, planning and diplomacy. Or: as plutonium production went from experimental, to pilot plant, to industrial, Goldschmidt’s star rose. This paper notes that the rise of the technology and the ascending career are inseparable and must be examined together, as technobiography.

THE BUILDING OF THE PARIS MÉTRO, FROM 1898 TO SECOND WORL WAR : AN OVERVIEW ON THE HISTORY OF TECHNOLOGY

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From the point of view of the history of techniques, the building of the Paris Métropolitain represents a particular case. Archive papers give an overview on the building methods, during all the XXth century. But even before the building in itself, different projects are drawn. Some are really amazing. Reading them open a door to a dreamt city, and a time in which progress and technique were the right answer to the big cities problems, like traffic jam.

Main sources are local ones. The City built its own network. These documents are mainly hitherto unpublished and offer a daily description on the biggest construction site in Paris, even bigger than Haussmann’s transformations. These archive are not only administrative ones, but also written and used by State engineers, who worked half a century on this underground railway.

How engineers and entrepreneurs built a Métro in Paris, without disturbing the city’ life? Which methods did they used? What was the reaction facing sudden obstacles?

Our study leaded us to a few conclusions, interesting for the history of technology. First, this construction site was not an innovative work. Builders worked with well-dominated techniques, more than with really innovative ones. They had to build for a whole century. The City’s image was involved. But, at the same time, these men had to adapt methods and schemes, facing the difficulties in the soil of the French capital.

SATELLITES INTO PLOWSHARES: POLITICS AND SPACE TECHNOLOGY 1946-1967

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During the Cold War both the United States and the Soviet Union developed satellites for civilian and military uses. During this "space-race," the politics of the Cold War had a profound impact on technological development. In the development of US space systems in the first twenty years of the Cold War several "military satellites systems" that were designed for communication, photo-reconnaissance, and navigation missions were open to the civilian market. At the heart of my argument, is the thesis that the politics of the Cold War led US Presidents to "open" specific military satellites programs such as COURIER (communication), TIROS (weather), and TRANSIT (navigation). For the Eisenhower, Kennedy, and Johnson these systems demonstrated the technological advancement of the United States, but also provided the global community with vital space-based systems that would improve international communication, weather forecasting, and intercontinental travel. The research for this paper uses recently declassified sources from extensive research at the Harry S. Truman Presidential Library, the Dwight D. Eisenhower Presidential Library, the John F. Kennedy Presidential Library, the Lyndon Baines Johnson Presidential Library, and the History Office of NASA.

A GLIMPSE BEHIND THE CURTAIN: POLISH PERSPECTIVES ON THE AMERICAN HOUSING INDUSTRY IN THE 1950s

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The American home building program started after the WWII, resulted with 10 million homes built in 10 years. Not surprisingly, this success attracted considerable attention from foreign engineers and politicians from all over the world. Even those from Soviet block shared that admiration for American housing program in spite officially lauded claims as to the superiority of communist ideology and technology. In late 1956, taking an advantage of the recent political thaw, a delegation of Polish engineers, led by vice minister Czeslaw Babinski, and celebrated engineer, Professor Waclaw Zenczykowski arrived to the US by invitation from the National Association of Home Builders.

During the four weeks long tour, they visited several construction sites and exhibitions learning from the American experience. Although they seemed to be impressed by what they had seen, the visit passed unnoticed in Poland, and eventually produced no results.

The paper brings out some facts related to that visit, and reveals surprisingly honest opinions expressed by Polish delegates; the opinions which were overstepping any limits of imaginary "freedom of speech" laid out by the political thaw of 1956. Also, this paper reflects upon the reasons why none of experiences learned in America during that trip was implemented in Communist Poland.

TIRES FOR GIANTS THE DEVELOPMENT OF THE PNEUMATIC TIRE AND ITS IMPORTANCE FOR ROAD TRANSPORTATION

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National Museum of Science and Technology

By tradition, there is a focus on the private car as the history of road transportation is written. It is the power of the motor, its speed, and its lay-out that is described. Those aforementioned characteristics are in the spotlight when the vehicles are exhibited.

When the theme for the first few decades of the 20th century was motor vehicles, this is a very natural consequence. In contradiction, there are other factors that should be discussed when the history of road transportation from the beginning of the 1920's to the present is told and explained. In this history, the pneumatic tire should play an important role, as one of the single most important components.

In the beginning of the 1900's, the air filled tire could only carry light vehicles; heavy trucks had to drive with massive tires. Vehicles with those tires could only drive on the most durable roads and at a low speed. Simultaneously, the vehicles vibrated due to the driving; consequently, the vehicles should be built very solidly with a rather high self-weight compared to the load to handle the vibrations. Lorries and busses should be light vehicles that drive on good roads in the cities.

Slowly, the tires were improved. Especially, the invention of the low pressure tire (the balloon tire) by the American firm, Firestone, introduced new possibilities for transportation. Where the best pneumatic tire in 1919 could only carry a load of 1.000 kg, the new balloon tire increased the load dramatically in its introduction in 1923. By 1934, the tires could handle an axle load of more than 10 tons.

The new tires reduced the vibrations in the vehicles; consequently, lighter constructions of the vehicles became sufficient. In the middle of the 1930's, a vehicle with only 13 tons of self-weight could handle more than 25 tons of payloads. The heaviest balloon tires could often last for a drive of more than 100.000 km. Before, the tires would only last for a much shorter distance. For example, around 1919, the typical duration of a tire's life was 10.000 km; consequently, haulage contractors could have expenses on tires that were more than 30% of their total expenses.

This paper will present the international situation and introduce some specific cases from Denmark.

This large improvement occurred in the beginning of the 1950's when "real" balloon tires became ordinary, while the tire arming, which was originally cotton, was replaced by nylon. This connection has not been described before. This is a problem with a large importance for society, while the technical construction of tires is an important factor in bringing the maximal gross weight able to be carried by a vehicle from around 12 tons in the 1950's to the present 60 tons.

Symposium S77
The Impact of Ideas and Ideologies on Science and Technical Innovations

ENGINEERS AND CONSERVATIVES IN THE CREATION OF STATE HYDROELECTRIC POWER IN CANADA

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In 1906 the Conservative government of the Canadian province of Ontario created what became the largest publicly-owned electric power utility in North America and in the non-Communist world – the Ontario Hydro Electric Power Commission (HEPC). This paper will examine the apparently paradoxical support this enterprise had from a conservative government and the participation of engineers on both sides of the debate regarding the benefits of state control of electrical power. The Conservative party member Sir Adam Beck was the driving force behind what he called "people's power" and he was supported by a number of engineers. There were other engineers, however, who attacked Beck and his plans. The American association of private electrical utilities – the NELA (National Electric Light Association) – was a particularly fierce opponent of the HEPC, which was considered a prime example of the evils of "socialist" control of electrical utilities and published a number of pamphlets attacking it. This paper will examine the role of engineers in the debate over public power and attempt to untangle the various ideological and technical strands in the debate.

THE TECHNOLOGY GAP IN CANADIAN MEDICARE

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One of the most powerful arguments against a government sponsored "single-payer" health insurance program is that it inhibits the effective and widespread use of the most advanced medical technology, such as magnetic resonance imaging (MRI) and positron emission technology (PET). This argument flows from the conviction that a "free" tax-supported insurance program encourages over-usage of the primary family physician, the "gatekeeper," to an extent that the vast sums of money spent at that level limit the introduction of highly expensive advanced technology. The United States twice rejected the single-payer system proposed by President Harry Truman between 1946 and 1950. Powerful interest groups predicted that the Truman plan would retard the development of advanced medical treatment and technology.

The Canadian single-payer system was introduced in 1957. Despite criticism from the medical establishment at its inception, both the professionals and the public seemed over time to accept that its benefits outweighed is limitations. In recent years, however, the criticisms have reappeared with considerable vigor, and the technology gap, particularly when compared with the availability of imaging devices in the United States, is once again at the forefront.

This paper will employ generally accepted standards of availability and usage of major diagnostic devices to determine whether the single-payer system does in fact limit the use of important technology. It will rely mainly on primary sources of information, prepared by independent groups and scholars, in order to avoid the political partisanship which has dominated the debate in recent years.

INSTITUTIONAL CULTURAL INFLUENCE ON THE APPLICATION OF SCIENCE TO WAR, 1914 TO 1945

David Zimmerman

University of Victoria

The increasing importance of scientific research to war in the 20th Century has been the subject of much academic debate. What were the factors that allowed science to be utilized effectively to both develop new weapon systems, but also to introduce scientific methodologies to improving military performance using such techniques as operational research (OR).

There is general consensus that the Allies made better use of their scientific resources than the Axis powers in the Second World War, but in the First World War it can be argued that German science had a more profound impact on the course of the war. What caused this transformation that allowed the United States and Great Britain to make much better use of science between 1939 and 1945? This paper will argue it was the direct result of the bridging of the great cultural gap between the armed forces and science that made this possible. Historians of science and technology in NAZI Germany have long argued that culture and ideology played an important role in shaping the way science and large scale technological programs were developed. I will argue that we must look for similar cultural forces in the United States and Great Britain. I will focus my attention on the scientific translators who bridged these cultural gulfs between science and the military in the western democracies.

EVIDENCES REGARDING THE INTRODUCTION OF METALLURGY AND THE UTILIZATION OF GUN POWDER IN EUROPE

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The main epochs of the civilizations history are linked to the history of Metallurgy, being largely confounded at the beginning. The birth of primitive Metallurgy (4500 b.Ch. – 1400) is encouraged by myths and unknown. Iron Metallurgy occurred between 1700 – 1500 b.Ch. in a region close to the Caucasus, Calybi, and to the Hittites. Starting from there, it spread out towards the West (Europe) and East (India, China).

The route of Metallurgy from East to West was established either through the Mediterranean (Greece) or through the Danube Valley, on the actual territory of Romania, Slovakia, Czech Republic, Austria, corresponding to the one of the celts. The prestigious Hammond Atlas – The Times Concise Atlas of World History - proves the priority, in the same time with the Near East, of the copper civilization on the Romanian territory: between 4500 – 3500 b.Ch. it encompassed Transylvania and Oltenia, the Balkans (early copper epoch), then in 3500 – 2500 b.Ch., the late copper epoch, and 2500 – 1500 b.Ch. the early bronze epoch, in Europe through Bohemia, Germany to England and Austria, Italy, France to Spain.

The first use of gun powder in mining took place in this part of Europe. A Latin manuscript from Bibliothèque Royale of Paris, recorded with the number 7239, states this fact. It is presented in "Histoire de l'artillerie I^{re} Partie. Du Feu grégéois des Feux de guerre et des origines de la poudre à canon", Paris, 1845, authored by M. Reinaud and M. Favé, in the 8th chapter, "Quelques conjectures sur la contrée ou s'est fait le premier emploi de la poudre à canon".The manuscript was brought from Constantinople to France by the ambassador Girardin. In his letter to M. de Louvois dated March the 10th 1687 he points to the last page, containing a map with the countries between the Black Sea shore and Hungary and from the Dardanele strait to Valachia. By examining this map, the period it was drawn could be established, based on the known dates: before the fall of Constantinople (1453) or the battle of Varna (1444) but after the defeat of the crusaders at Nicopolis (1386). As a conclusion, the manuscript dates from 1395 or 1396.

"Thus, the use of war fire-works was not propagated in Western Europe; it is very unlikely that in the East, more precisely in the lands between Hungary and the gorges of the Danube was learned to utilize the powder explosion". In the Latin manuscript can be found the description of the use of gun powder in mines. It is, thus, demonstrated that this application took place in the East, maybe with over hundred years and certainly with more than fifty years earlier than the epoch in which it was used in Italy.

Symposium S79
Special Topics

THE HISTORICAL DEVELOPMENT OF THE NOTIONS “NATURAL” AND “ARTIFICIAL” (FROM GALILEO TO NANOTECHNOLOGY)

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The concepts of the natural and the artificial are the product of ancient philosophy. In modern times, the problem of relationship between the natural and the artificial was pondered over in connection with the development of experimental natural science. Galileo’s main achievement in solving this problem was not so much in differentiating as in relating these two concepts and ascertaining their mutual convertibility. However, under the influence of engineering practice, the concept of a scientific experiment also changed gradually. Engineering thought influenced not only the experimental activity of scientists, but also scientific concepts themselves.

Thus, the engineer, like a research experimenter, deals with idealized notions of physical objects. The former, however, applies these notions and knowledge to creation of engineering objects (the artificial-natural-artificial approach), and the latter develops devices to conduct experiments in order to substantiate these notions (the natural-artificial-natural approach). It is this that reveals the likeness and mutual influence of experimental natural science and engineering practice.

In principle we understand a machine as mechanical devise and make a differentiation between organism (natural) and machine (artificial). But nanoscale devises as “molecular motors”, which transduce “chemical energy into mechanical energy”, can exist in the natural form but use “for bacterial locomotion”. In these cases the organisms are described as a specific complex machine.

WATER POLLUTION AND ITS TREATMENT IN NINETEENTH-CENTURY UNITED STATES

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This paper examines the three-stage evolution of water purification systems in the United States in the last half of the nineteenth century. The three stages that evolved were (1) the construction of pumping stations and underground pipes to bring water from rivers, streams, lakes, and other sources into the cities and underground sewer systems to carry waste matter from the cities into far out water sources where air and sunlight decomposed some of the waste matter; (2) the introduction of sand filtration and coagulants that removed undissolved solids and considerable bacteria; and (3) the addition of chlorine to drinking water sources killing bacteria and eliminating water-borne diseases.

Scientists who contributed to the development of the three water purification stages included Isaiah Smith Hyatt in New Jersey; George Fuller in Louisville, Kentucky; Rudolph Hering in New York City; and Abel Wolman in Maryland. Their pioneering efforts made possible the water treatment processes that function so effectively today.

MINING : IDEAS AND INSTRUMENTS IN GERMANY 1750 TO 1900

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Silver mining and hard coal mining have been developed in extremely opposite ways of mining and with extremely differing importance for the social recognisance for technical personal and miners, and for its machinery as well. The paper will trace these well known lines and then show how slowly on the European Continent and how fast the traditional habits were left, once coal mining came up for feeding iron smelting processes and steam engines. It is only one generation of “free” labour (between 1860 and 1890) before traditional habits were re-invented to serve the imperialist hopes of the Wilhelmine society. It took the period of another century to convince the tax payer /government, that this period was over.

THE INTERNATIONAL COMMITTEE FOR THE HISTORY OF TECHNOLOGY (ICOHTEC). SCIENTIFIC DEVELOPMENT AND POLITICS 1968 TILL 1989.

Holger Skorupa

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In the summer of 1968 the *International Congress on the History of Science, Technology and Medicine* took place in Paris. This congress was also the origin of the *International Cooperation in History of Technology Committee* (*ICOHTEC*). The current term *International Committee for the History of Technology* was defined at the symposium in Bucharest in 1981. Melvin Kranzberg, the driving force behind *ICOHTEC*, had already founded the highly successful *Society for the History of Technology* (*SHOT*) and its journal *Technology and Culture*. Kranzberg’s collaborators were Maurice Daumas (France), Eugene Olszewski (Poland) and S. J. Schuchardine (former USSR).

What were the intentions of the founders of *ICOHTEC*? How was it possible to become a bridge-building organisation in the difficult political environment of the Cold War as well as to integrate scholars from both sides of the *Iron Curtain*? Could the young society reach its aims? Of great importance for ICOHTEC were its international conferences. What were, therefore, the main topics of those symposia and how were they received in the young academic field for the history of technology until 1989? How was it possible to integrate historians from socialist countries with those from Western democracies?

ICOHTEC was established as a *Scientific Section* within the *UNESCO* organisation *International Union for the History and Philosophy of Science* (*IUHPS*), *Division History of Science and Technology* (*DHST*). Regarding its role within *IUHPS/DHST* as well as Kranzberg’s status as the founder of *SHOT*, what was *ICOHTEC*‘s relationship with these organisations? What about the links with German societies like the *Georg-Agricola-Gesellschaft* or the *VDI*? Until 1989 (Hamburg and Munich), eight *ICOHTEC* Symposia took place in Eastern *bloc* countries with nine symposia being held in the West. Most meetings were held in Europe. Regarding the link with Eastern European intellectuals and the integration of scholars of non-European countries, could ICOHTEC’s symposia provide a field, crossing borders and breaking boundaries? Furthermore, what were the possible impacts on the scientific development of the history of technology outside Europe?

Publications dealing with the scientific development of *ICOHTEC* and its position inside bipolar politics between 1968 and 1989 are rare. While there is no comprehensive work on the main topic of my paper, there are only a few articles on aspects of *ICOHTEC*‘s development. My main sources are the proceedings of *ICOHTEC* symposia since 1970 as well as special volumes like *ICOHTEC*’s 40^{th} anniversary issue (2008).

The main thesis of my paper is that, even under the difficult circumstances of the Cold War and the fact that *ICOHTEC* as a scholarly organisation faced many problems originating in Cold War politics, it has managed to achieve vital goals towards professionalization.

Symposium S-80
Practices, Views, and Networks in 19th and 20th Century Mathematics

WHAT IS 'MATHEMATICAL PRACTICE' IN THE PHILOSOPHY OF MATHEMATICAL PRACTICE?

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Currently a number of philosophers and historians of mathematics are working in what has been denoted 'Philosophy of Mathematical Practice'. A fundamental idea in this approach is that a philosophy of mathematics should agree with the actual practice of mathematics. This has led some philosophers to reject the philosophy-first principle, denying that philosophy has the priority over mathematics, as well as to the publication of books with titles like "Towards a Philosophy of Real Mathematics" (D. Corfield), and the recent "The Philosophy of Mathematical Practice" (P. Mancosu). Even though these books have lengthy descriptions of this approach, nowhere is a clear description of what is meant by 'Mathematical Practice'. It also appears that motives for studying mathematical practice vary. In some cases historical studies are made in order to determine the philosophical standpoint of a certain mathematician, whereas in other cases, the aim may be to formulate (part of) a philosophy of mathematics. This talk will try to point to different uses of 'Mathematical Practice' and discuss whether it is possible (or meaningful) to give a single characterization of what constitutes mathematical practice.

HILBERT ON DIFFERENT NOTIONS OF COMPLETENESS: A CONCEPTUAL AND HISTORICAL ANALYSIS

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Different notions of the word "completeness" have been at stake in research programs in logic and in foundations of mathematics up to the 1930's. David Hilbert did not publish any major result on completeness (the negative result in the 1928 *Grundzüge* is proved by Ackermann) neither was this, at least explicitly, his primary concern. It is claimed however that his works during three decades (form 1899 to 1928) were shaping the context in which all theorems concerning different notions of completeness were obtained both by mathematicians belonging to his own network of collaborators and by researchers of rather remote groups, practices, and, more importantly, researchers whose metamathematical views were different, if not opposed, to his own.

In this paper we point out the crucial role Hilbert's works played in the evolution and stabilization of the term "completeness", in order to study and analyze their outreaching impact: on results obtained by his own research group on the one hand, on theorems obtained by authors belonging not only to different networks, but also to different traditions of mathematical practice, and whose views (that is, mathematical and philosophical views) on the nature of their field did not agree with those of Hilbert (the major example here is Kurt Gödel). Our historiographical objective is thus twofold: to study the networks of exchange of ideas on the one hand, and on the other, to examine their double nature, as mathematical practices, and as (meta) mathematical or epistemological views.

In a first step, we go through a conceptual analysis of the term completeness, going through different notions of it for mathematicians, today. Based on works of Baldus, Hintikka, Awodey and Reck we distinguish between: completeness of a logical calculus; deductive or syntactic completeness of a theory T in a formal language L; semantic completeness of a theory T; categoricity; descriptive completeness; model-maximality or Hilbert's notion of completeness in the 1900 *Zahlbegriff*; completeness as the property of the "least upper bound"; and finally Archimedean completeness.

In the second step, we construct a historical analysis ranging between 1850 and 1930, in which the term evolves and is finally stabilized in its modern context. After a short note on Dedekind's use of the term in the 1870's, we discuss its different occurrences in Hilbert's work, taking into account both cases of synonymous and homonymous terms. This allows us to point out in what way several notions of completeness involved in major theorems obtained in that period by researchers belonging to different networks are already present in Hilbert's writings, and to discuss the eventuality of a theoretical debt of the former to the latter.

EMILE PICARD : A VIEW ON HIS MATHEMATICAL AND EPISTEMOLOGICAL IDEAS

Pierre Lamandé

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Principally across the study of its work « Modern science and its present state » dating from 1905, we'll give big traits of the vision of the development of various mathematical domains carried by Picard. Across the various comments inserted in its text, we'll see that all domains do not seem, for him, to give the same perspectives.

The text begins with a historical chapter completely dedicated to the relationship of the analysis with other sciences. Picard shows the major role of correlation between physics and mathematics until the first third of nineteenth century. The fecundity of so problems as methods then makes neglect the questions of foundation. From 1830s these questions re-emerge with force, without that the impulsion given by the study of nature exhausts itself. Of this study, Picard draws firm belief that mathematics, and more particularly analysis (with differential equations, systems of differential equations, functional equations) are the essential language of physics, what is for him a guarantee mattering from fecundity.

However, Picard is not simply an heir of the French school of mathematical physics, so rich during the beginning of the XIXth century. The chapter dedicated to mathematical sciences shows a more complex thought, absolutely opened to jobs of his time. It is divided, in effect, into three big parties, the first one on the principles of the analysis, the second on those of geometry and third on the development of pure mathematics.

Epistemological analysis that he develops is always very close of the mathematical work of his epoch, and show an intellectual opening towards all currents which share it. He remains however reticent towards certain domains. For instance, he does not speak about theories of linear algebra and, in algebra, alone the theory of groups seems to him to be indeed fecund

His jobs carry the mark of this conception which constrat, and will constrat even more after 1914, with a certain German mathematical vision. It is possible to give numerous examples, for example the absence in its studies of the Lebesgue's integral, his approach of algebraical geometry or his use of the notion of group.

HISTORY OF MATHEMATICS AS A WAY OF JUSTIFICATION. MATHEMATICIANS' VIEWS ON THEIR OWN DISCIPLINE DURING THE WEIMAR REPUBLIC.

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It was one of Paul Forman's claims in the so called Forman theses (*Weimar Culture, Causality, and Quantum Theory, 1918-1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment* [HSPS 2 (1970), pp. 1-114]) that German physicists adapted to a hostile environment after World War I, including the German mathematicians in this statement as well. These theses did not remain undisputed but the analysis of cultural influences on science (here the mathematical science) remains a very interesting idea.

In this talk I would like to present some results of my work on reflexive discourses during the Weimar Republic. Based on the concept of "Reflexive Discourse" as Herbert Mehrtens proposed it in his seminal work "Moderne Sprache Mathematik" I understand this as talking of mathematicians about their own discipline. But unlike Mehrtens this talk will focus on talking about mathematics as its role for a wider audience, mathematics itself or the market for mathematics will not be considered.

In this sense the history of mathematics received new attention as a means to justify that mathematics is part of a general culture (Allgemeinkultur). Authors like Richard Courant or Hermann Weyl began to use history of mathematics in this new rhetoric way in the mid 1920s.

VIEWS AND PRACTICES IN THE EARLY FUNCTIONAL ANALYSIS

Laura Rodríguez

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Between 1904 and 1908 appeared a series of works that became fundamental for the emergence of functional analysis: Maurice Fréchet's thesis containing the modern abstract concept of metric space (the name was given by Felix Hausdorff some years later), David Hilbert's theory of integral equations, and several articles by Erhard Schmidt and Frigyes Riesz in which first function spaces were defined.

The introduction of those spaces meant a clue achievement for the emergence and development of functional analysis. Their construction was closely related to Hilbert's theory of integral equations, and therefore some historians have searched for traces of thinking in "spatial" terms by Hilbert. After an extensive study of Hilbert's theory Bernkopf (1966) asserted weakly and unconvincingly that Hilbert at that stage "may have been thinking" that way. Although other authors (e. g. Kline (1972)) have pointed out that the step forward towards the concept of function spaces was taken not by Hilbert but by E. Schmidt and F. Riesz, still the question remains open: did Hilbert ever aimed to construct function spaces? Could he have conceived a function space?

In my talk I will discuss Hilbert's views with respect to his theory of integral equations and taking into account the mathematical practices he resorted to I will attempt to show that Hilbert's thinking followed other patterns, that he had other intentions.

A TRIPLE POINT OF MATHEMATICS: BORN AND WIENER'S "NEW FORMULATION OF THE LAWS OF QUANTIZATION"

Arianna Borrelli

Fritz Haber Institute and Max Planck Intistute for the History of Science, Germany

In late 1925, during a crucial phase of the development of quantum mechanics, Max Born and Norbert Wiener published a paper in which three different traditions of mathematical research were combined: Oliver Heaviside's operator calculus – a non-rigorous but essential tool in the practice of electric engineering – Volterra's rigorous theory of (mainly integral) operators, and the mathematically questionable but physically successful infinite-dimensional matrices with which, just a few months earlier, Werner Heisenberg, Pascual Jordan and Born himself had revolutionized quantum theory.

Born and Wiener generalized infinite-dimensional matrices to a new mathematical entity: quantum operators. These could be manipulated so, as to produce new physical meanings encompassing and expanding those of matrix mechanics. This theory has often been regarded as a missed opportunity in the history of quantum mechanics, which contained some features of later successful models, but failed to fully exploit their potential.

In the context of this symposium, the paper is of special interest as a sort of "triple point" of meeting and exchange between the formalisms, practices and views of mathematicians, physicists and engineers. Moreover, it is particularly interesting to consider how, later on, another element of Heaviside's mathematics, the delta function, would be successfully introduced into quantum mechanics by an electrical-engineer-turned-mathematical-physicist: Paul Dirac.

NETWORKS AND INDIVIDUAL AGENCY: THE CASE OF GALOIS THEORY IN FRANCE AT THE TURN OF THE 19^{th} CENTURY

Caroline Ehrhardt

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After Galois's works were published in *Liouville's Journal* in 1846, Galois Theory was developed in several European places. By the end of 19^{th} century, it was no longer a purely research matter, but also a theory included in university programs and covered in many algebra textbooks in Germany, France or Italy. In this paper, I will focus on three textbooks published in Paris in 1895-1896 by Jules Drach, Emile Picard and Henri Vogt, three mathematicians who belonged to the network of the *Ecole Normale Supérieure*.

First, I will situate these textbooks in the global social context of the rise of Galois Theory to analyze their roots both on local practices and the international competititon inherent in the development of Algebra. Then, comparing the three textbooks, I will try to determine how individual careers can influence mathematical production. In doing so, I will raise the question of the scale that historians should use to analyse the production of knowledge. Finally, I will focus on the pedagogical objective of these books to understand the kind of mathematical practices and images of Galois Theory they were meant to convey to students.

ON THE IDENTITIES OF ALGEBRA IN 19th CENTURY: ALGEBRAIC PRACTICES, NETWORKS, CULTURAL ISSUES.

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Our investigation aims at a deeper understanding of the history of algebra without focusing on issues related to the origins of structures. The theoretical identity of the 1930's "modern algebra" has often served as a lens for tracing back relevant texts; it therefore gave structure to its own history while other identities that did not fit in this retrospective glance have stayed out of sight. The question therefore arises as to the *identities* taken on by the algebraic *practices* that had been developed within various disciplines and had passed from one network on to another before the time of unifying *theories*.

As an example of the kinds of issues that may be addressed, we will wonder about Darboux's 1874 "theory of forms". We shall see that the algebraic nature of this "theory" referred to some practices and cultural issues peculiar to some networks.

Our methodology will resort to the analysis of networks along the line of "scale games" between the short-term and the long-term (1766-1874). Darboux's memoir highlights the interrelations and the structuring effects of local practices on the production of global ones and raises some issues related to the collective phenonemons of appropriations and circulations of texts.

PRACTICES, NETWORKS AND FIELDS: MAKING (HISTORICAL) SENSE OF POINCARÉ'S EARLY WORK

Renaud CHORLAY

Université Paris 7, FRANCE

The goal of this talk is to point to the methodological issues that we encountered when studying Poincaré's early works.

We will first focus on three important papers by Poincaré : a 1881 paper on the curves defined by a differential equation, a 1883 paper on the uniformisation of analytic functions, and a 1883 paper on the representation of meromorphic functions (in two complex variables). To study these papers, it is customary to rely on terms or categories that would only emerge later: these papers prove « global » theorems (a problem label) ; they show how « topology » plays an important part in analysis (a theory, later an academic discipline); the first of them is the kick-off for the « qualitative study of differential equations" (a research field).

We will endeavour to show that other, less retrospective, tools can be fruitfully used. We will mainly focus on what we call "site practices". We claim that (1) they can be positively characterised as practices, as opposed their negative characterisations as "vague" and "pre-topological" (or pre-set-theoretic, for that matter) notions (2) they can be tracked along networks that cross disciplinary boundaries (function theory, potential theory) and institutional embeddings (academic world / engineering world, research maths / school maths). We will eventually address the question of whether or not some of these networks point to actual fields (in the sense of Bourdieu).

SHIFTING BOUNDARIES. KRONECKER'S EARLY WORK ON COMPLEX MULTIPLICATION AND DIRICHLET'S LEGACY IN NUMBER THEORY.

Ivahn Smadja

Université Denis Diderot – Paris 7

In his Berlin lessons on number theory, Kronecker explicitly distanced himself from Gauss's famous dictum according to which number theory is to be sharply distinguished from analysis and algebra, and conceived restrictively as a discipline concerned with integers and rational numbers to the exclusion of irrationals [« *surdis semper exclusis* »]. Such a delimitation would no longer be justified, as far as, since Gauss's times, analysis has not only gradually grown independent of the very sources wherefrom it originated, viz. geometry and mechanics, but has considerably enhanced number theory thanks to Dirichlet's analytic number theoretic methods which Kronecker highly praised.

Focussing on Kronecker's early work on complex multiplication of elliptic functions, and more specifically on the investigations concerning the arithmetical properties of singular moduli in the light of the intimate connection between quadratic forms, algebra and elliptic functions - which were presented by Kronecker himself as an application of Dirichlet's methods - this contribution sets out to investigate how, in Kronecker's view, boundaries between arithmetic, algebra and analysis are meant to be dismissed in favor of a form of arithmetization compatible with the claim of Dirichlet's legacy.

Symposium S82
Visual Cognition in the History of Science

VISUAL COGNITION AND HISTORY OF SCIENCE

Christophe Heintz

Germany

The scientific studies of science have, in the last decades, emphasized the diversity, richness and complexity of scientific practices. In this context, where people are departing from the initial restrictive focus on language, the role of visualization in science appears to be pervasive. Scientists look at the result of their experiments, they produce images and graphs for thinking about the phenomena they investigate and they communicate to their peers with visual artifacts. Tools for the generation of images, ranging from multiple types of microscopes and telescopes to computer generating graphs and 3D pictures, are constantly being developed and are often fully incorporated in scientific practices.

In this talk I focus on the problem, why is visualization so pervasive in scientific practices and thought processes; additionally, how does specifically visual scientific cognition contribute to shaping the history of science? I hope to find answers to such questions by means of case studies of visualization in science analyzed mainly from cognitive anthropological and historical perspectives.

VISUAL THINKING IN MEDIEVAL SCIENTIFIC AND PHILOSOPHICAL MANUSCRIPTS

Anna Somfai

Central European University, Budapest, Hungary

The talk explores visual thinking through a close study of the visual and textual elements of medieval scientific and philosophical manuscripts. The visual elements I examine include conceptual diagrams as well as diagrammatic images: miniatures with diagrammatic edifice, illuminated initials, and spatially structured texts.

I suggest a new approach toward the study of medieval manuscripts departing from their traditional use as sources for various branches of history or art history, science or philosophy, or for editing unpublished texts. I suggest that medieval manuscripts, each having been designed individually and written in hand provide a unique source for puzzling over the way in which cognitive processes surface in an object. Each manuscript, having a specific page-layout, guides us in understanding the process by which the texts and images therein were arranged to contribute to a design considered best by the designer for transmitting the philosophical and scientific concepts and explanations. The close study gives me the opportunity to gain insight into individual methods of organizing knowledge, grasping the texts and images and explicating the points further through image, text or both. On a more general level, I can draw conclusions as to what were considered the most fruitful methods at various times and places throughout the Middle Ages. The nature and role of the visual elements (both individual images and large-scale structures) and the visual vocabulary used in the individual cases reflect the cognitive processes whose comprehension is the ultimate goal of the study. The shelf-life of a medieval manuscript has spanned centuries with additions by later readers hence the close study of individual manuscripts allows me to see both the initial step and the history attached to the original creation, giving me access to further layers of a visual dialogue. A further source of comparison is the study of the same text in various manuscripts covering centuries of manuscript production. This method has enabled me to outline the history of the visual representation of some concepts as reflected in the ever changing layouts and image variants that speak of new ways of approaching the concept and the text.

The case studies of individual images and composite images, their role in the specific context and the step-by-step examination of the cognitive process whose product they are, serve as the basis for the conclusions concerning the role of visual thinking in the creation and transmission of scientific knowledge and philosophical concepts during the Middle Ages.

WHAT ARE GENETIC MAPS VISUALIZATIONS OF?

Marion Vorms

IHPST – Université Paris 1, France

Genetic mapping is a technique of representation in mendelian genetics introduced in 1913 by Thomas Morgan's student Alfred Sturtevant. It consists in drawing maps of the linear ordering of genes along chromosomes on the basis of the numerical data of the linkage of characters obtained from hybridization experiments on *Drosophila*.

Though they are often called "chromosome maps", and though the idea of evaluating the "distance" between genes arose from Morgan's commitment to the chromosome theory of heredity (according to which the "factors" of heredity – i.e. the genes – lie on chromosomes in a linear fashion), the semantics of Sturtevant's maps is not straightforward. Till the 1930's, microscope techniques did not enable cytologists to provide a precise description of the fine structure of chromosomes; moreover, the chromosome theory of heredity had only a hypothetical status and was far from being unanimously endorsed. Nevertheless, one could construct and use maps to gain knowledge concerning the linkage of some genes without being committed to the chromosome theory. And even for geneticists committed to this hypothesis, the genetic "distance" (on the map) was not intended to be proportional to the physical distance between genes (Sturtevant, 1913). In this sense, maps are better thought of as spatial extensions of Mendel's symbolism, which consists in representing "factors" – without any commitment to what those factors are – as independent units by denoting them with letters: they were *visualization of the numerical data*, displayed in a diagrammatic way.

Finally, in 1934, the rediscovery of the giant salivary gland chromosomes in *Drosophila* gave microscopically observable banding patterns enabling geneticists to map linkage maps constructed with Sturtevant's mendelian technique onto X-chromosome locations. Therefore, spatial relations acquired a more (though not straightforward) "pictorial" and realistic status (by this, I mean that topological relations were kept in representation): maps became less controversially *visualizations of the chromosomes*.

Through the study of the own accounts of some protagonists of mendelian genetics (Sturtevant, 1913, 1965) around 1920 and of the debates among them on how to construct, use, and interpret maps (Castle, 1919, Sturtevant, Bridges, and Morgan, 1919), I will show that these maps can be used and interpreted in various ways, according to individual scientists' theoretical commitments, backgrounds and skills as well as to the general research framework in which they were used. From the study of genetic maps' changing semantics and of the implicit hypotheses that guide their use and interpretation, in the light of the distinctions drawn by some philosophers and sociologists of representation (Goodman, 1968, Kulvicki, 2006, Lynch, 1988) between types of representation (diagrammatic, pictorial, linguistic…), new consequences for the complex relationship between theorizing and visualization should emerge.

References

Castle, William E., 1919. "Is the arrangement of the genes in the chromosome linear?", *Proceedings of the National Academy of Sciences of the United States of America*, vol. 5, No. 2 (February 15, 1919) pp. 25-32.

Goodman, Nelson, 1968, *Languages of Art: An Approach to a Theory of Symbols*, Indianapolis: The Bobbs-Merrill Company.

Kulvicki, John, 2006, "Pictorial representation", *Philosophy Compass* 1(6).

Lynch, Michael, 1988, "The externalized retina: Selection and mathematization in the visual documentation of objects in the life sciences", *Human Studies*, Vol. 11, No. 2.

Sturtevant, Alfred H., 1913. "The Linear Arrangement of Six Sex-Linked Factors in Drosophila, as Shown by Their Mode of Association", *Journal of Experimental Zoology*, vol. 14, pp. 43-59.

Surtevant, Alfred H., 1965. *A History of Genetics*, Cold Spring Harbor Laboratory Press, New York.

Sturtevant, Alfred H., Bridges, Calvin B., and Thomas H. Morgan, 1919. "The spatial relations of genes", *Proceedings of the National Academy of Sciences of the United States of America*, vol. 5, No. 5 (May 15, 1919), pp. 168-173.

THE ROLE OF VISUALITY IN KONRAD LORENZ'S PHILOSOPHY OF SCIENCE

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Konrad Lorenz is well-known for his contribution to the science of ethology, a scientific research field of which he is one of the founders. Much less acknowledged his work as a philosopher of science. My approach to his life-work is based on the assumption that Lorenz can be primarily regarded as a philosopher of science and his ideas about science have significant historical relevance to the recent advances in philosophies of life and behavioral sciences, namely the so-called mechanistic turn represented by works of leading philosophers of science such as L. Darden, P. Machamer or W. Bechtel. For my argumentation the most important references would be William Bechtel's recent works on the epistemic aspects of mechanistic thinking in biology and cognitive science. In my view there is a strong but still unrecognized parallel between Lorenz's and Bechtel's philosophy of science. Lorenz's approach to the nature of scientific thinking is thoroughly based on a picture-oriented theory of our scientific cognition and it shows a strong connection with the history of ethology (especially with his own work in this area). In this sense, my contribution to the conference will provide a historical account. I would try to unfold the role of visuality in the philosophical underpinnings of animal behavioral science, especially the Continental tradition of ethology. Various historical and epistemic aspects of pictorial thinking mean the central elements of Lorenz's philosophy and science. In my lecture I would clarify the connection between mechanistic thinking and visual cognition and its relevance to current philosophies of science. My weak thesis would concentrate on the effects of pictorial approaches and the advances of visual techniques on the development of ethology, while my strong thesis would be about the relationship between visuality and philosophy of science as exemplified by the scientific study of animal behavior and mental life.

Symposium S83
Revisiting Joseph Nedham's 'Rivers and the Sea' Metaphor: The Construction of Modern Science and Technology in a Global Context, 17th-19th Centuries

NEEDHAM'S RIVERS AND SEA METAPHOR AND THE NINETEENTH CENTURY PERCEPTION OF SCIENTIFIC KNOWLEDGE IN INDIA

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I want to look at critically the metaphor of rivers flowing into the sea, employed by Joseph Needham to describe the emergence of modern science. The beautiful metaphor was very effectively used by Needham to question the reigning Eurocentric paradigm, particularly in the context of his insightful new researches in the Chinese history of science and technology. The metaphor also helped to explain the multi-cultural character of modern science, the various streams-Roman, Chinese, Indian, and Arab, all finally getting into the sea. Almost hundred years before Needham devised this metaphor, some Indian and Islamic intellectuals found a similar explanation to legitimize the appropriation of modern scientific knowledge within colonial constraints. They categorically declared that modern science is a shared heritage of all mankind as all of them have contributed to it at some point in history. Our interlocutors during colonial times could not comprehend the implication of their own argument. They surely configured the place of 'others' in the enterprise, like the Needhamian model did later, however both the attempts appear a bit simplistic. I will attempt to engage with the model with some concrete examples from 19th century India.

CIRCULATION INTERCONTINENTALE DES SAVOIRS ET DES TECHNIQUES AU PÉROU (XVIIE-XVIIIE SIÈCLE)

Carmen Salazar-Soler

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Au croisement de l'histoire des sciences et des techniques et de l'anthropologie historique, cette communication a le but de repérer, de décrire et de confronter des circuits et des itinéraires des savoirs et des techniques élaborées au Pérou du XVIIème et XVIIIème siècles, mais aussi d'en étudier les vecteurs (manuscrits, livres, cartes, herbiers ...) et les principes de développement (missions, explorations, commerce, conflits, ...).

MAPS, PERMABULATORS, REPEATING CIRCLES AND THEODOLITES: MAPPING IN INDIA AND GREAT BRITAIN, 1780-1830

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The construction and publication of James Rennell's *Map of Hindoostan* in 1783 played a significant, if not determinant, role in the decision to make a map of metropolitan Great Britain at the end of the 18th century and in the institution of the Ordnance Survey of Great Britain and Ireland. Although Rennell's map was to serve as a model of accuracy for the projected map of the British Isles, the methods, instruments and procedures used to make it were forged in the local context of an emerging British imperial state. The Survey of India, although partaking of the same personnel and general surveying methods, incorporated the heterogeneous techniques inaugurated by Rennell in order to collect the information for his map. The Ordnance Survey, on the other hand, adopted triangulation as the basic method to lay the grid for its own map. Instead of adopting the French repeating circle, which had already proved its worth in the mapping of France, the Survey relied on a purpose-built instrument, the altazimuth theodolite. This talk will examine the circulation of maps, instruments and surveyors between Britain, Europe and India to show how localities are made up of manifold circulations. Through the same example it will also seek to show that localities can be conceived of as nodes where specialised knowledges of diverse origins come together, interact and reconfigure each other although each locality mobilises its idiosyncratic logic to appropriate and ground knowledges: knowledge and locality are co-produced through processes of circulation.

THE JESUIT AND THE LONG LIFE. THE FIRST FRENCH TRANSLATION OF A CHINESE TEXT OF NURTURING LIFE (*YANGSHENG*) IN THE EARLY 18th CENTURY

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The first French translation of a Chinese medical text belonging to the category of "nurturing life" (*yangsheng*), (or to "get a long life ", *changsheng*), appeared in 1735 in Paris, in the third volume of the *Description de la Chine*, edited by F. du Halde. This translation was due to François Xavier Dentrecolles, a Jesuit missionary arrived in China in 1699 and died in Beijing in 1741. I shall describe the Chinese source of this translation, which was previously unknown, the choices and the difficulties of the translator and the reception in Europe of a text that mixes moral considerations and rules of daily life.

FROM STARRY ABNORMITY TO METEOROLOGICAL PHENOMENON: THE IMPACT OF ARISTOTELIAN VIEW OF COMET ON XU GUANGQI AND XIONG MINGYU IN MING WANLI PERIOD

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Before the 17th century, Chinese and western scholars have different views of comets. A Chinese exemplar in the *Tien quan shu* of the *Shi ji* explains that comets arise from the bad qi moving from the ground to interfere with the planets. The comet of 1577 was considered as a starry abnormity with their astrological implications of bad politics in Zhang Juzheng case. In ancient Greek period, Aristotle (384-322 BC) regarded comets as meteorological phenomena arising form oily airs following their natural motions up to the fire region and ignited by fire. This view had been received until Tycho Brahe (1546-1601) challenged it in 1577. He found the distance between the comet of 1577 and the Earth is far from that between the moon and the Earth. Thus, the comet of 1577 appeared in ethereal rather than terrestrial area. In brief, the comet of 1577 offered an abnormal phenomenon for the Scientific Revolution.

During Wanli period, Jesuits followed Matteo Ricci (1552-1610) to transmit western learning as alternative natural knowledge and made the encounter of Chinese and Aristotelian views of comet. At first, Xu Guangqi (1562-1633) and Xiong Mingyu (1579-1649) accepted Chinese view of comets. Under the impact of western learning, they became the first two Chinese literati who converted to Aristotelian view of comets. Their change on this topic reflects the impact of western learning resulting in their evidential studies rather than revolutionary change on natural knowledge.

Key words: late ming, the comet of 1577, astrology, Jesuits, Xu Guangqi, Xiong Mingyu, evidential study on natural knowledge, comparative study on Chinese and western history of sciences

GEWU RUMEN: A CASE STUDY OF THE INTRODUCTION OF WESTERN PHYSICS INTO NINETEEN-CENTURY CHINA

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Gewu Rumen, translated into English as *Natural Philosophy*, was the first textbook for natural science in China. Published in 1868, and compiled by American missionary William Alexander Parsons Martin (1827-1916), *Gewu Rumen* was not just a landmark textbook on physics in China, but also served as one of the most significant illustrations for the introduction of Western physics into nineteenth-century China. *Gewu,* a term meaning to study the nature of matter in order to acquire knowledge, was a traditional Chinese philosophical principle derived from Confucianism. This also corresponded to the prevailing view of Western natural science, or natural philosophy, in late Qing dynasty China. *Rumen* means elements or introduction.

Gewu Rumen contained 7 volumes and had 321 illustrations. The first volume was concerned with hydrostatics; the second with pneumatics and acoustic; the third, heat and light; the fourth, electricity and magnetism; the fifth, force; the sixth, chemistry; and the seventh, appendix for questions. Although *Gewu Rumen* mentioned, in the preface, that its sources were compiled from the original English versions of many noted textbooks, we found that its main source of material was taken from *Wells Natural Philosophy* (New York: Ivison, Phinney, Blakeman & Company, 1864) which was designed for use in schools, academies, and private institutions.

The Chinese translation of the volume titles indicates that Chinese scholars were interpreting the concept of Western physics through the lens of Chinese traditional natural philosophy: mainly utilising the *qi* and five-phase theories. For example, hydrostatics, heat and pneumatics were translated as *shuixue* (water study), *huoxue* (fire study) and *qixue* (air study), respectively. In addition, 'hydrostatics' was arranged as the first volume in *Gewu Rumen*, thus reflecting the Chinese view of physics viz-a-viz Western countries of that time, who usually listed 'force' as the first chapter. On the other hand, *Gewu Rumen* did present the latest results in Western scientific discovery and research for those Chinese interested in understanding the Western world and its scientific concepts.

As to the author, Martin did not translate according to the text and chapters of *Wells' Natural Philosophy.* He rearranged the teaching material in keeping with the physics knowledge of Chinese students. However, many of the descriptions and explanations first introduced in *Gewu Rumen* were strange to the Chinese, so that its writing and texts were considered to be awkward and difficult to understand. Nevertheless, *Gewu Rumen* was used as the textbook on natural philosophy in Tongwen College, the earliest modern government school, thus symbolizing the acceptance of Chinese scholars of Western science and technology. Despite this, what seems incredible is that, prior to the Chinese-Japanese war (1895-96), no complete and advanced physics textbook such as *Gewu Rumen*, was ever published. This may be because physics was not regarded by the Chinese as a core field in the strategy of studying Western science during the late Qing dynasty. Another explanation can also be found in the fact that the Qing government were hesitant to believe that Chinese students who became government officials in the future needed to study the natural sciences.

ARTISANAL KNOW-HOW AND MODERN SCIENCES: THE USE OF CHINESE TRADITIONAL KNOWLEDGE IN FRENCH RESEARCH ON SERICULTURE

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Since the end of the 17th century, numerous documents concerning Chinese sericulture knowledge were sent to France, essentially by Jesuits in China with the help of agents of French India company. This knowledge contributed considerably to the advancement of French scholars' studies on the culture of mulberry trees and the silkworm rearing and thus to the progress of French silk industry. Helped by the instruments and technological procedures developed during the Age of Enlightenment, the French scholars advanced their knowledge of the silkworms which allowed them to shape their own theory, and established the "French school of sericulture". At the second half of the 19th century, the silkworms breeding in France was not only an artisanal activity but also a field of scientific research.

My paper will explore the interplay between the scientific research and industrial practices on the basis of the data collected in Chinese and European libraries and archives.

Symposium S87
The Reception of Darwinism at the Subnational Level: Cities

THE EARLY RECEPTION OF THE *ORIGIN OF SPECIES* IN BOSTON

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In this paper I am going to explore the interactions, including face-to-face meetings, reviewing, reading articles, and exchanging letters, between Bostonians and English naturalists (including Darwin) and intellectuals in the first four months after the publication of *Origin of Species*. I will identify different groups of actors (naturalists, theologians, literary people) in order to illustrate the patterned complexity of personal networks in the reception of one scientific idea—Darwinism—in an urban setting and to demonstrate the proposition that non-scientists play crucial roles in the reception of scientific ideas by interacting with scientists and interpreting the ideas themselves according to various criteria.

The vast majority of participants in Darwin debate in Boston and in England, respectively were personally acquainted with one another and many of the Bostonian protagonist had wide circles of acquaintance in England: Two examples of non-scientists who played a significant role in the Boston reception are George Ticknor, a literary historian who knew nothing about science, but had a life-long correspondence with Charles Lyell; and Charles Eliot Norton, professor of Classics at Harvard, who knew the principal players in England actively involved in the discussion of *Origin of Species*, through his sister-in-law, Sara Sedgwick, who was the wife of William Darwin, a lawyer, one of Darwin's sons. William Darwin did not contribute any ideas but his house and circle of acquaintances became, via Norton, agencies that accounted for the rapid dissemination of the entire English debate in England to Boston. Because the circle was literary as well as scientific, it drew in unexpected persons, such as Henry James (via Norton) and Henry Wadsworth Longfellow (via Tennyson), both of whom had met Darwin personally. This was the last generation of American intellectuals who frequented England as a matter of course.

I will examine primarily letters and book reviews (to the extent that they constituted a kind of personal interaction among people who knew each other). Some of the correspondence is highly detailed (Gray and Darwin, Gray and Hooker, Norton and many Englishmen) and many, if not most, of the important naturalists in Boston were correspondents of Darwin, whether they favored evolution or not: e.g., Louis Agassiz, T. G. Appleton, James Dwight Dana, A. A. Gould, Alpheus Hyatt, Edward S. Morse, Charles Pickering, Alpheus Packard, F. W. Putnam, Samuel Scudder. From these multiple paths of communication, it will be possible to group participants into specific affinity groups and identify thereby the specific dynamics of the Darwin both within the confines of the city and also with respect to overseas communication.

HARMONY OF NATURE AND STRUGGLE FOR SURVIVAL: RECEPTION OF DARWINISM IN RUSSIAN PLANT GEOGRAPHY

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The makers of Russian vegetation science were are often called "Darwinians" in the Soviet tradition of historiography. Daniel Thodes in his study "Darwin without Malthus" (1989) has stressed that many Russian naturalists adopted from Darwin only the idea that all living creatures are descended from a common ancestor. Only gradually were other aspects of Darwin's vision of nature which are important for modern ecology (cruelty in the struggle for existence, the relativity of any adaptation, the rejection of the notion that florae and natural communities are rational and harmonious entities) worked into research practice. We can illustrate a gradual transition from the Linnean economy of nature and Humboldt's science to modern ecology and biogeography by considering a sequence of Russian scholars, from Anderey N. Beketov, the "grandfather" of Russian plant geography, to those scholars who established vegetation studies science in Russia in the late 19th – early 20th centuries (Sergey I. Korjinsky, Andrey N. Krasnov, Gavriil I. Tanfiliev, Valeriy I. Taliev, Andrey Y. Gordiagin etc.). The paper examines a gradual assimilation of these concepts by Russian vegetation scientists in this period. ?he Darwinian theory introduced certain ideas that were difficult for many naturalists to accept. In Darwin's vision of nature the individual struggle for existence was very important, it recognized the accidental and probabilistic character of existence. Does that mean that florae and communities are just accidental conglomerations of species and individuals? What is the role of accidental factors in the making of living systems above the organism level? These questions are still debated in ecology and biogeography. A contemporary researcher has to overcome his own aesthetic intuition in order to reject an 'obvious' notion of stable, rationally organized "natural" communities.

DARWINISM AND NEO-DARWINISM BETWEEN PRAGUE AND BRNO, 1900-1915

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The reception of Darwinian, or to be more specific neo-Darwinian thought in Bohemia and Moravia, was into large extent formed by the local experts (and intellectual elite) of that period. So, this process is to be analyzed mostly in the context of two major academic centres of the Czech Lands, that means Prague (Prag) and Brno (Brünn).

The complexity of such process in Bohemia and Moravia is underlined by a multi-national character of the scientific community. Besides the significant and traditional German scientific tradition that was closely related with another German speaking universities and academic centres not only in Austria (Vienna) but also in Germany (Munich, Leipzig, Berlin), there was also the Czech one, that was significantly newer and was concentrated exclusively on the Czech territory.

During the period in discussion the Darwinism in its “neo“ modification became highly discussed topics both in Prague and Brno. Very often the scientific disputations used to be integrated into the social and political discourse of that time.

Relating on partially new archival findings we would like to highlight especially those “pro“ and “contra“ that were used and document some special lines of argumentation that actually go beyond the Bohemian or Moravian territory as well as put together representatives of several disciplines, political orientation and cities as well.

DARWINISM AND THE BIRTH OF THE POLISH URBAN INTELLIGENTSIA: WARSAW, CRACOW, AND LWÓW

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In nineteenth-century Poland, the development of a scientific community was severely hampered by the general political situation following two unsuccessful uprisings against the Russian Empire, one of the three partitioning powers. Both the University of Warsaw and that of Wilno (Vilnius) had been shut down by the Russian authorities; there was no institution of higher education in the Prussian partition of Poland. Although the authorities consented to a reopening of the University of Warsaw in 1859, at the time when Darwin published *Origin*, Cracow in the Austrian partition was the only Polish city with a functioning science department. However, since Conservative and Roman Catholic circles exercised extensive control over the Jagiellonian University, Darwinism filtered through into Polish academic debates not only at Polish universities but also at universities abroad.

With a booming economy Warsaw, the centre of the Russian partition, became the pulsating heart of burgeoning modern urban culture in Poland. It was the hub of a rapidly growing press scene which was instrumental in spreading the word about Darwin’s ideas, but it was also home to some Catholic or Conservative papers trying to drown the voices of Darwin’s self-proclaimed adherents. At the same time, Warsaw was the city in Poland where the political grip of the partitioning powers on Polish culture was at its tightest: from 1870 onwards it was not even possible to deliver lectures on Darwinism in Polish at the University of Warsaw, and some well-known adherents as well as some critics of Darwinism were exiled by the Russian authorities to Siberia.

The general situation of the partitions, deplorable though it was for the majority of Poles, also ensured that there was competition between various Polish cities and regions for the best strategy of avoiding a loss of national identity. As far as the reception of Darwinism is concerned, after some initial vociferous debates in Prussian-controlled Poznañ, it was first of all Lwów in the Austro-Hungarian partition that challenged Warsaw’s reputation of being the stronghold of modern Polish urban culture. Warsaw’s arch rival Cracow, also part of the Habsburg Empire, pursued another course: the local Conservatives tried to achieve national survival by organizing public pageants and erecting national symbols celebrating Poland’s glorious past. This meant that Cracow developed into a stronghold of the Polish anti-Darwinist movement. Although this situation changed with the reestablishment of Polish statehood in 1918, the various concepts of urban culture which Darwinism helped shape remained a topical issue for much of the twentieth century.

DARWINISM AND CULTURAL STRUGGLES IN RURAL ASKOV AND METROPOLITAN COPENHAGEN IN NINETEENTH-CENTURY DENMARK

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In the 1870s, when Charles Darwin's *On the Origin of Species* and *Descent of Man* were translated into Danish by the botanist-turned-poet J. P. Jacobsen, evolutionary thought played a seminal role in the modern breakthrough advocated by the freethinker and literary critic Georg Brandes. A group of students and artists assembled around Brandes in the capital of Copenhagen – the only Danish city hosting a university in the late nineteenth century – and used Darwinism in their cultural struggle against what they regarded as reactionary Christian and conservative values which dominated in the country.

At the same time in the village of Askov in rural Jutland, a liberal fraction of the Evangelical-Lutheran State Church, the Grundtvigians, had a stronghold at their high-profile folk high school. Here materialism and Darwinism associated with the Brandes circle were tabooed and later condemned. However, around 1900 as Darwinism was widely criticized in scientific circles, a young generation of Grundtvigians transformed evolutionary theory into 'safe science' and made it a legitimate subject at several folk high schools in the country. This paper argues that the cultural differences between metropolitan Copenhagen and rural Askov are crucial in understanding the reception of Darwinism in Denmark.

Symposium S88
Comparative Reception of the Synthetic Theory of Evolution in the Soviet Union, Eastern and Central Europe

PECULIARITIES OF EVOLUTIONARY SYNTHESIS IN NAZI GERMANY AND SOVIET RUSSIA

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The aim of the report is to emphasize the international character of the Synthetic theory of Evolution (STE) by the examples of Nazi Germany and Soviet Russia (USSR), as well as to show its specific features in both countries conditioned by peculiarities of practice, tendencies and networks of national scientific associations and by general social-cultural context. In the USSR Darwinism was officially proclaimed to be 'the scientific foundation' of the dominant ideology. The synthesis of evolutionary knowledge on the basis of the theory of natural selection was developing in the country to the extent quite comparable to the USA and the UK. The STE in the USSR was characterized by particular emphasis of ecological aspects of evolution, a role of struggle for existence, modification variability, organism activity in evolution, etc. In the most detailed way these features can be observed in *«The Factors of Evolution»* by I.I. Schmal'hausen (1946). National specificity of the evolutionary synthesis in Germany was best reflected in a collective volume "*Die Evolution der Organismen*" published and edited by G. Heberer in 1943. German scholars stressed incompatibility of genetics and palaeontology when discussing the problems of evolution, the concept of "type" and the correlation of causes of microevolution and macrophylogeny. They underestimated the importance of taxonomy in research on evolution and gave special attention to the specifics of evolutionary processes in plants, animals and humans. In spite of the differences in scientific traditions, dominant tendencies, methodological approaches, as well as political regimes, the foundation of similar systems of evolutionary views called STE took place in totalitarian and liberal countries.

THE DEVELOPMENT OF DARWINISM BY UKRAINIAN ZOOLOGISTS (LATE 19th – EARLY 20th CENTURIES)

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The first professor of zoology in Kyiv University A. Andrzheovsky held interesting views on the convertibility of organisms. Being both a naturalist and a specialist in a broad range of disciplines he worked in the field of zoology, paleozoology, and botany. Conducting research on collected paleontological materials he was guided by the theory of evolution. In his opinion plants and animals had common origin and changed under the influence of environmental conditions. That is why it is necessary to take into account closely-related species when reconstructing the system of animal kingdom.

A specialist in the fauna of Ukraine, Russia, and the Black Sea, A. Nordman studied modern and fossilized species of animals and plants. He was holding advanced views about successive origins of the representatives of the animal kingdom. His ideas were reflected in his monograph "*Paleontology of South Russia*" (Vol.1-4, 1858-1860) and in his other works.

Early in his career K. Kessler supported G. Cuvie's opinions but later became a follower of the theory of evolution. In 1847 he delivered a speech "On the origins of domestic animals" at the grand public meeting of the Kyiv University. In this speech he expressed his views concerning wide convertibility of animals under the influence of environmental conditions. At the first congress of naturalists (1861) K. Kessler outlined the aims of the investigation of fauna in Russia. In this report he considered these goals in direct connection with Ch. Darwin's doctrine of evolution. His disciples K. Yel'sky and A. Karpinsky were active followers of Ch. Darwin.

A great Ukrainian writer, thinker, and scientist I. Franko was very active in popularizing Darwin's theory and fought for materialistic ideas. That is why I. Franko devoted several articles to the problems connected with the doctrine of evolution. His main work is "Thoughts on the Theory of Evolution in the History of Humanity" (1882). I. Franko outlined the main points of Darwin's theory, described struggle for existence, defined the origins of humans, as suggested by the most recent scientific data of his time. In his article "*Crisis in Biology*" I. Franko noted that the second part of the 19th century in biological sciences was a period of Darwinism. In 1904Franko edited and published in Ukrainian translation E. Ferrier' "*Darwinism*", while writing his own foreword to the edition.

The paper will examine and evaluate the views a number of prominent Russian and Ukrainian scholars of the period, M. Antonovych, V. Zalensky, I. Mechnikov, A. Kovalevsky, N. Bobretsky, P. Sushkin, A. Severtsov, I. Shmalgauzen, had on the evolutionary theory.

THEODOSIUS DOBZHANSKY: A LARGE STEP TOWARDS SOLVING “THE SPECIES PROBLEM" – A MAIN STEP TOWARDS “EVOLUTIONARY SYNTHESIS”

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Th. Dobzhansky was the first among the co-founders of the “evolutionary synthesis” in XXth century. Dobzhansky’s way towards his evolutionary theory proposed in his famous book “Genetics and the Origin of Species” (1937) was enough unique and concist in the synthesis experimental and naturalistic approaches in new evolutionary biology developed in Russia and in West in 1920s -1930s. Dobzhansky was able to combine these two appoaches trying to resolve the species problem.

Through the analysis of hybrid sterility between two sibling species, *Drosophila pseudoobscura* (then called “race A”) and *D. persimilis* (“race B”) he experimantally showed that the genetics of species differences—even reproductive isolation itself—could be studied with the same genetic tools that had been wielded so successfully *within* species. Arguing that “the mechanisms isolating species from each other must be considered the only true specific differences” he set out to determine if reproductive isolation itself was Mendelian. Dobzhansky’s explanation that hybrid sterility and inviability are caused by sets of interacting “complementary genes” laid the foundation for nearly all subsequent work in the genetics of speciation, including the recent explosion of papers on this subject.

Dobzhansky’s several brief reports on hybrid sterility in 1933 and 1934, his paper in 1936 were such research that was far more complete and far more convincing than any preceding it. Dobzhansky succeeded in bringing the full apparatus of genetics and of genetic observations in natural populations to bear on the observable facts of speciation and species diversity. This large step towards solving “the species problem" was a main step towards “evolutionary synthesis”. It was a synthetic element that was so compelling to his readers of the time especially in the Soviet Union.

Expected conclusions: Dobzhansky’s concept of species was the result of the synthesis of experimental results and new ideas formulated by Dobzhansky mostly in the USSR in 1920s. This concept and the whole “evolutionary synthesis” influenced deeply evolutionary researches in the USSR

News: The origin of Dobzhansky’s concept of species and his influence in the USSR has been considered in detail.

THE TEACHING OF EVOLUTIONARY THEORY IN RUSSIAN SECONDARY SCHOOLS BETWEEN THE WORLD WARS

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The history of teaching of Darwinism in secondary school is an important aspect of the Evolutionary theory development in Russia. The main object of this work is making the general vision of teaching of evolutionism in Soviet secondary schools between the Great Wars. Textbooks, educational and methodical materials, some periodicals and the contemporaries’ memoirs were used for this research. Understanding of events of the first half of the XX century is essential to solve the modern discussions in the area of natural science methodics and it could expand on history of the of Evolutionary theory development in the USSR.

For the first time the evolution theory appears in school natural science very early, the first Russian secondary school zoology text book (by A. Bogdanov) which contented the Darwinian theory appeared in 1861. But only after the October Revolution (1917) all the obstacles, religious and political, had burst and the question of teaching evolutionism at school was dealt with. Natural science became one of the main school subjects. The first years after the 1917 revolution were the time for rise of teaching natural science methods. This process was especially active in Petrograd-Leningrad where the methodists (G. Boch, V. Gerd, B. Raykov) had worked on the problems of Darwinism in secondary school even at the beginning of the XX century and had a great experience. Their first natural science school program (by prof. V. Shimkevich and others) was published in 1918. In the middle of twenties the new programs (named “complex programs”) were appeared but there wasn´t a natural science as a subject. During that time evolutionism existed in school as a general idea which was very convenient for the political situation. When the “stable programs” were put in (1931) the natural science and Darwinism returned to textbooks and secondary school.

THE SELECTIONIST TURN OF BERNHARD RENSCH (1900-1990) THROUGH THE PRISM OF PANPSYCHISTIC IDENTISM

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To the end of the 1930s Bernhard Rensch (1900-1990) turned from the strong Lamarckism and orthogenesis to selectionism and became one of the key figures in the Synthetic Theory of Evolution (STE). Rensch's major services for the STE include the Darwinization of biological systematics, the criticism of various anti-Darwinian movements in the German lands, but, first of all, the founding of macroevolutionary theory proceeding from the Darwinian gradualism. In the course of time Rensch developed his version of the STE into an all-embracing metaphysical conception based on a kind of Spinozism.

In our presentation we approach the Rensch's "selectionist turn" by outlining the theoretical context in which it happened, and by the analysis of his conceptual transformation in science and philosophy. We concentrate on his theoretical views with only a short biographical excursion into the Prague-period of his life to shed more light on the circumstances of his selectionist turn. We try to reconstruct the immanent logic of Rensch's evolution from a "Lamarckian Synthesis" to a "Darwinian Synthesis".

We demonstrate the astonishing continuity in topics, methodology, and empirical generalizations involved into the debates, despite of the shift in Rensch's views on evolutionary mechanisms. We defend the thesis that the continuity in Rensch's theoretical system can be to an extent explained by the guiding role of general philosophical principles explicitly or implicitly underlying the entire system. Specifically, we argue, that Rensch's philosophy became an asylum for the concept of orthogenesis Rensch banned from the evolutionary theory. Being unable to explain directionality of evolution in terms of empirically based science, he "pre-programmed" the occurrence of human-level intelligence by a sophisticated philosophy combined with the supposedly naturalistic evolutionary biology. Ultimately we pose a question on the methodological and metaphysical heterogeneity of the STE.

RECEPTION OF DARWIN'S IDEAS IN RUSSIA: THE STRUGGLE FOR EXISTENCE AND NATURAL SELECTION. V. N. SUKACHEV'S EXPERIMENTAL PROGRAM.

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The paper aims at analyzing the programs of the experimental research on the struggle for existence that were developed by Russian botanists in the 1920s-40s who were exploring Darwin's concepts on the struggle for existence and natural selection. Darwin's concepts were widely discussed in Russian academic literature and public press in the second half of the 19th — the first quarter of the 20th century. As a result, many Russian naturalists did not accept his theory of the evolutionary factors. Apart from Darwin's interpretation of the struggle for existence and natural selection a number of competing theories emerged:

1. Struggle for existence was seen as a real fact but leading to conservative selection. Natural selection was interpreted as supporting stability of species with no impact upon the evolutionary process (Danilevsky 1885; Berg 1922).
2. Intraspecies competition could not be regarded as the cause of the natural selection. The result of the intraspecies competition was seen in the general depression of organisms and massive or total elimination of organisms (Kropotkin 1907; Liubimenko 1920).

When the development of Darwin's theory was still at its early stages these interpretations of the mechanisms of evolution were justifiable. There were no reliable data in support of the Darwin's theory of natural selection.

There was only one way to solve this problem. It was necessary to create experimental models which would confirm or correct one of these interpretations of the mechanisms of evolution, including the Darwin's theory. In the 1920s-30s, actual programs for the experimental research of the evolutionary mechanisms were developed on vegetative objects, especially by V. N. Sukachev and his school.

Expected conclusions: Darwin's views on the struggle for existence and natural selection were experimentally tested by Russian botanists in the 1920s-40s.

Sources used: Archive of the Russian Academy of Sciences, Archive of American Philosophical Society, Library of the Russian Academy of Sciences.

Symposium S89
The Role of Rail Transport in Development of the Infrastructure in St-Petersburg (Russia) and Kiev (Ukraine) and their Interference in XIX - first half of XX Centuries

ROLE OF THE CORPUS OF RAILROAD ENGINEERS IN INSTITUALIZATION OF HIGH TECHNICAL EDUCATION ON RUSSIA

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Relying on the existing understanding of social institution and the process on instutualization, let's apply it to the analysis of the process of institualization of education in general and technical education in particular as the subsystems of social institutions of culture and teaching.

Beginning of the process of institualization of education in general and technical education in particular dates back to the time when forming of the corresponding prerequisites are being completed (social-economy, theoretical, and practical (concerning technical education – technical), and its completion dates back to the forming of the system of educational institutions of a proper type.

With regard to the higher technical education, we are to answer the question: Are the created educational institutes the technical ones?

Two criteria of evaluation of the educational institution are determined: in the first place, this is a curricular and connected with it method of teaching, and in the second place, social status and the rights of graduates. As for the first criterion, the school subjects delivered in any higher technical institute must be presented the theoretical component which must become the pivot of leading technical disciplines.

It is seemed that the Corpus of railroad engineers found in Saint Petersburg in 1809 answered the named criteria of evaluation for the higher technical school. It was created with the active participation of French polytechnic engineers, who took a constructively revised experience of Polytechnic school and School of bridges and roads as the basis for arrangement of the Corpus.

The institute of Corpus of Railroad Engineers served as a prototype for other higher technical institutes of Russia (Main School of Engineering (1819), Artillery School (1820) and others.

Therefore since 1809 it is possible to speak about the beginning of the process of institualization of the higher technical education in Russia, which developed entirely during the subsequent years of XIX century.

THE ROLE OF INSTITUTE OF ENGINEERS OF MEANS OF COMMUNICATION (ST. PETERSBURG, LENINGRAD) IN FORMATION ENGINEERS OF TRANSPORT IN 1910-1930

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The years of 1910-1930- - is the most interesting period of work of the Institute of Engineers of Means of Communication.

Conservatism, related to this Institute, played positive role in the process of technical education. It's interesting that reforms made by post-revolution government were mostly reduced to minimum as it was possible that time.

In 1909 by the initiative of Professor N. Mitinsky course of the aeronautics was included into studying process of Institute. Since that time systematic studying of the new type of transport began. The laboratory of aero-mechanic was created.

In 1920 in Institute 4 departments were created (terrestrial communication, aerial communication, faculty of water means of communication, engineer constructions). In 1922 the last department was closed but since that year land and bridge divisions were included to the terrestrial communication department. Professor N. Rynin headed the department of aerial communication, there were prepared engineers with the profession 'constructing and using aerial means of communication'.

In the next 8 years in Institute the structure of departments and divisions and their names was changed 5 times. As a result by September of 1928 there were 3 departments in Institute: Departments of terrestrial communication, aerial communication, water communication. And by the September of 1932 the Institute returned to the system which included lections connected with practical and laboratorial studying. Individual examination was restored.

Later on the base of faculty of water communication the Institute of Engineers of water transport was created and on the base of aerial faculty - Institute of civil air transport.

BORODIN O.P. CREATIVITY IN A CONTEXT OF DEVELOPMENT OF MOBILE STRUCTURE ENGINEERING OF UKRAINIAN RAILROADS (SECOND HALF XIX IN)

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Biographic research in history of natural and technique is the phenomenon rare enough, although the row of bright portraits of scientists, writers which became a standard for the researchers of future generations is created in humanities. In a most degree the necessity of development of scientific biographies is felt in a technique. The names of many prominent and less known provincial researchers were undeservedly forgotten, although them a scientific inheritance is component part of domestic historiography and deserves captious attention, as allows to enrich our pictures of development of concrete science, scientific directions and separate problems. Activity of O. P. Borodin (1848-1898) makes a noticeable deposit in a technique, in particular in its basic industry - railway transport. A founder of original scientific researches and practical developments is in this industry, an engineer-practical worker, prominent scientist O. P. Borodin, occupies one of the honored places in world science.

Borodin boned on September, 29 in 1848 in Sn.-Petersburg. Making off in 1865 gymnasium, young Borodin enters to the Sn-Petersburg Technological institute which successfully concludes in 1870 He prolonged studies in Institute of Engineers of Ways of Report and completes the technical education in 1872 years. O. P. Borodin from the beginning of the engineering activity and during all of creative way engaged in a rolling stock and traction on railways. In the activity Borodin violates and other problems of railway transport of, which are related to the rolling stock: building of new and repair of old locomotives and carriages, providing of locomotives, normalization of carriages of freight park, creation of more comfortable passenger carriages, modernization of equipment of railway workshops, and also problems of durability of details and knots of carriages and locomotives coal and water.

From 1877 begins the period of activity of O.P most protracted and fruitful in a scientific and engineering plan. Borodin. The almost twenty-year strained work links Borodin with Kiev and South-west per rail. At the beginning of 1877 Borodin occupies ïîñàäó managing Kiev-Brestskaya railways although by then was him only 28 years. Much attention he spares research of application of principle of cross-compound of pair (additive) to the locomotive machines. As a result of these researches were created under his guidance first in the world the (locomotive laboratory) and first in the world locomotive tandem-additive, which soon spread on all of railways of the world.

In 1882 - 1883 of O.P. Borodin, jointly with an engineer L.M. Levi developed the method of linear researches of locomotives and testing.

During all to history development of technique of railway transport large role in the improvement of structures and exploitations of locomotives played experimental researches them heating engineering and hauling qualities. O.P. Borodin offered the new method of research of locomotives on principle. Position about the necessity of maintenance of the permanent mode of operations of locomotive is pulled out them on all of time of the carried out research became scientific basis of subsequent development of experimental researches of locomotives which got a result as laboratory and roads methods of researches saved the value until now and with success used for the tests of new types of thermal locomotives.

THE WARSAW RAILWAY STATION IN ST. PETERSBURG

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This railway station on Obvodnoi canal embankment is the third construction after the Vitebsky station in 1837 and the Moscow railway station with which it came into force almost simultaneously in 1851.

During the construction of the St. Petersburg-Moscow railway station the problem concerning the further development of the railway network in Russia was being solved. The economical and strategic interests of the country have clashed at this point. The economical interests required the extension of the St.Petersburg-Moscow railway station to the south up to the connection with the south ports at Azov and Black seas. This would allow connecting both capitals with the fertile lands and two seas to strengthen the economy of the country. The strategic considerations dictated the construction of the railroad to the west direction. They have got the upper hand.

In November 1851 after the official opening of the St. Petersburg-Moscow railway an order of the general railway master of communication was published about imperial command of emperor Nickolai I: «1. To construct the railway from St. Petersburg to Warsaw. 2. To name this railway as St. Petersburg Warsaw railway. 3. To get down to work since 1852 starting both from St. Petersburg and from Warsaw».

On July 12, 1852 the staff of administration for construction was confirmed. E. I. Gerstfeld was appointed chief, his assistant – an engineer S.V.Kerbedz, the academician K.A.Skorginsky was appointed general architect. By the way, it was his project (according to some information together with the academician of architecture N.L. Benua) by means of which the first building of the station was built in 1852 – 1853 (a bit later a locomotive depot, remaining up to now). The first building of the St.Petersburg-Warsaw station was opened on November 1, 1853. It was behind Obvodnoi canal which was the border of the city. The first chief of the station was A.V. Poletaev, but after the fire in December 1855 he was replaced by G. Angelem.

In fact the construction of the railway began already in 1851. The first division of its length was 44, 6 kilometers up to the tsar's residence in Gatchina was opened on November 1 (13) 1853 – in two years sharp after the official opening of the St.Petersburg – Moscow railway. Only two pairs of trains moved on this division from St.Petersburg and Gatchina twice a day at the definite time.

The Crimean War interrupted the construction works. It was impossible to resume the construction at the expense of the State and only after making peace a new chief of the railway appeared - the main society of the Russian railways. It happened on January 28 (on February 9) 1857. The construction was headed by S.V. Kerbedz, P.O.Salmanovich became the general architect, he was the graduating student of the Institute of the civil engineers.

The last of the Romanovs, Nickolai II, having ascended the throne in 1984, ordered to construct the railway from one residence to another – from Tsarskoye Selo to Gatcina and vice versa – without calling in St. Petersburg, passing by the Warsaw station. In 1895 – 1896 the branch line from the post the «18 th verst» at the Alexsandrovskya station of the Warsaw railway to Tsarskoye Selo was built, where the special pavilion was constructed having got in everyday use the name «tsarskoye». Here the turn table for the locomotives was erected the special telegraph communication with the tsar`s trains stops. During the following two years one more branch line of the railway was built from Tsar`s pavilion to Alexsadrovskaya.

K.I. POTIER (1786 - 1855) AND APPLIED GEOMETRY DEVELOPMENT IN RUSSIA.

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K.I. Potier (1786 - 1855) was disciple of G. Monge (1746 – 1818). He graduated the Paris Polytechnic School and Bridges and Roads School. In 1810 K.I. Potier was in the employ in Russia. He worked the professor of applied mathematic and descriptive geometry in just established Petersburg State Transport University.

In this time scientists and engineers widely used the descriptive geometry jointly with other mathematic sections as tool of investigation. And they applied the graphic disciplines such as drawing as the best visualization method of investigation results.

The textbook “Basis of descriptive geometry” of Professor K.I. Potier was published on French language in 1816. This was the first descriptive geometry textbook in Russia. Due to his textbook K.I. Potier got colonelcy.

Also yet two works of Professor K.I. Potier "Application of descriptive geometry in drawing" and "Initial basis cutting of stones" was published in 1818. By means of these works K.I. Pottier proposed the grandiose ways of possible directions of new science application. Afterwards they were used by his Russian disciple: Y.A. Sevastyanov (1796 – 1849), A.Ch. Reder (1809 - 1872), N.P. Durov (1835 - 1879), N.I. Makarov (1824 - 1904), V.I. Kurdyumov (1853 - 1904), N.A. Rynin (1877 - 1942) and others.

Scientists of Petersburg State Transport University paid special attention on supplement of descriptive geometry methods for solution of practical engineer problems. The book of Y.A. Sevastyanov "Supplement of descriptive geometry for drawing" was published in 1830. It was not only the continuation of further development of descriptive geometry theory but also excellent manual for the study of drawing basis.

Unique work of famous geometrician Y.A. Sevastyanov "Supplement of descriptive geometry for air perspective, projection of map and gnomonika" was published in 1831. G. Monge said that the propagation of knowledge, which may be useful for skill, is very favorable for national education. These words of G. Monge were taken by Y.A. Sevastyanov as epigraph for his work "Supplement of descriptive geometry for air perspective, projection of map and gnomonika". This book was awarded to the Demidov Prize of Russian Academy of Sciences.

Heritage of K.I. Potier is huge in Russia. This is hydroengineering and transport structures in south ports of our country, school courses and scientific works on descriptive geometry.

DEPARTMENT OF PHYSICS AND ITS PROFESSORS IN THE INSTITUTE OF ENGINEERS OF MEANS OF COMMUNICATION

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Physics as a subject began to teach at institute of Engineers of Means of Communication since 1820. At first teaching were conducted French, then by Russian physicists, in particular the academician of the Petersburg academy of sciences A.J.Kupfer. Later the professor of the Petersburg University F.F.Petrushevsky conducted the lessons on physics. F.F.Petrushevsky was the first chairman of Russian physical and chemical society. It is interesting that in the middle of XIX century the outstanding Russian physicist, academician E.H.Lents reviewed all programs on the physicist at institute of means of communication.

In the end of 19 centuries the course of physics at institute was read by professor N.A.Gezehus – the expert in the field of molecular physics, an electricity, and acoustics.

Sometimes those who has already ended the University and even has received degree of the candidate of physical and mathematical sciences, got the second engineering educations at institute of means of communication.

For example: D.D.Bizjukin. After the termination of Physical and mathematical faculty of university, then institute of means of communication he became the expert in building of railways.

V.A.Gastev. He has ended Physical and mathematical faculty at the Petersburg university. After that he has finished formation at institute of engineers of means of communication in which has received the diploma of the civil engineer. He became the expert in the field of building materials and the theory of elasticity.

G.O.Graftio has ended Physical and mathematical faculty of Novorossisk University. In 1892-1896 he studied at Institute of engineers of means of communication. After the Institute he has been sent to Italy, Switzerland, the USA for studying of a new kind of traction of trains – electric traction. The next years he became the large expert in the field of an electricity

I.J.Manos. In 1888-?1892 studied at Petersburg University at Physical and mathematical faculty then he has received degree of the Candidate of sciences. At once he has entered the institute of engineers of means of communication which has finished in 1896. the Next 53 years he worked in railway branch, became the large expert in the field of communications.

THE HISTORICAL DEVELOPMENT IN KYEV UNIVERSITY OF RAILWAYS TRANSPORT

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90 years of existence of the Kiev university of railway transport (SETUT) which is one of the oldest higher technical educational establishments of Ukraine were carried out in March, 2008.

The idea of opening of independent institute was engendered in 1918. So at the Kiev Polytechnic institute (KPU) a railway faculty was opened. During three subsequent years, a faculty had to outlive the row of unfavorable terms in connection with civil war, lack of facilities, by the vagueness of position et cetera For all this period a faculty changed the names and in 1920 tacking of faculty took a place to Institute of the National economy with the name «Faculty of transport and connection», and from 1922 «Faculty of exploitation of ways of report». The primary purpose of faculty was to prepare and produce the highly skilled personals of railway business.

However, independent the institute of railway transport in Kiev was created only in 1928 on a base «Faculty of exploitation of ways of report». An apartment for an institute was former Spiritual Seminary which was on Voznesenski carrier's trade. Five faculties worked in a new institute: railway building; water reports; operating faculty; road-transport; transport-economic.

Institute, also had 10 laboratories, 2 scientific museum, 15 cabinets and club.

However, in the period of reorganization of higher education of 30-years of the last century among the far of higher educational establishments which left off to exist, there was the Kiev railway institute. The faculty of engineers of ways of report was added to the Kharkov travelling technological university. A build faculty was translated in the Dnepropetrovsk university of railway transport. On a branch was only July , 14, 1966 organized from the Kharkov institute of engineers of transport (KhUIT). Since 1991, there was a requirement in the modern personnels of railroaders – analysts of wide type. on was December, 5, 1995 created Kievan the institute of railway transport.

The Kiev university of economy and technologies of transport as independent educational establishment was created, on a base KhUIT, in august, 2001 Location in Kiev enables our university together with subsections of Mintranss to inculcate modern technologies of teaching and promote quality of preparation of specialists for a transport to produce qualifying specialists in area of railway transport and exploitation. On ability of education of students the entrance factory of leading composition of all levels of railways, teaching, is carried out.

At the beginning of 2008 an institute was got by status of the State Economy & Technologies University of Transport.

THE INVESTIGATION OF THE DEVELOPMENT OF NON-TRADITIONAL TYPES OF TRANSPORT

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At all times and in all civilizations the question of the development of transport and cargo transportation there was very sharply. At some moment, intensive progress of a certain type of transport ceases to satisfy the requirements of common production and comes to a standstill. The increase of speed, the improvements of the comfort and safety of traffic becomes not enough. The environmentally friendly transport plays an important role for the development of civilization. It is necessary to apply innovative and urgent measures for the development of types of transport in order not to remain on the roadside of the world's progress. In the history of the development of technology such situation is not new. The investigation of the regularities of formation and emergence types of transport, which are non-traditional for its time, can give the answers to many questions of our time.

In the historical plane, it is possible to select several phases of the development of innovative types of transport - craft, based on manual labor, the manufacturing and the modern, orientated machines production. It is sensible to begin the study of the progress of innovative types of transport, taking into account the practical experience of pre- industrial civilizations. It is necessary to trace the interaction between the transport branch and the different areas of science and technology, especially with applied, exact and natural sciences. Moreover, in considering this issue, we should take into account the indissoluble interdependence between the technical advance and the social - economic ambience.

So, the end of 18 - first half of 19 centuries is the beginning of the «era of steam», the time of technological revolution and the transition to machine production. The development of common production required the creation and studies of the machines, the progress of sciences, defining formation of engineering. The steam engines, which were «original» in the first third of the 18th century, replaced the horse traction, the sailing and rowing vessels. And eventually, they are become the leading before a certain period.

The first wooden monorail road was made in Russia in 1820 by I. Elmanov. It was non-traditional for its time. But at the beginning-the first third of the 20th century, the electric overhead railway of I. Romanov, monorail road of system of P. Schilovski, monorail road of S. Waldner were designed.

Previous experience, analyzed and generalized with the modern position, gives the possibility for predicting the further development of the transport science.

THE ROLE OF THE NAVAL ENGINEERING INSTITUTE IN CREATION OF RUSSIAN UNDERWATER NAVY.

Isay Kuzinets

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During the century's history of Russian Underwater Navy there were three Naval Engineering Colleges which trained the engineering officers for Russian state: the first Naval Engineering College named after Emperor Nicholas I in 1898 – in Soviet period Naval Engineering College named after F.Dzerzhinsky in S.Petersburg; the second – Naval Engineering College named after V.I.Lenin in town Pushkin; the third – Naval Engineering College in Sevastopol.

The role of the graduates of Naval Engineering College named after F.Dzerzhinsky was very important in the development of Russian Navy.

The engineering officers made a great influence of Naval Science and Technology in training of High – qualified naval engineers.

During the First and Second World Wars the graduates of Naval Engineering College indicated the high level of naval engineering training and moral qualities.

The feats of graduates of Naval Engineering College had a special meaning in the history of the Second World War.

After the Second World War it was necessary to reconstruct the Navy of the Soviet Union in wide – scale range. It was also required to improve the training naval engineering officers.

Therefore it was decided to establish (beulot) Naval Engineering College in Pushkin, Leningrad region and in Sevastopol. The personnel of the Naval Engiineering College named after F.Dzerzhinsky assisted to organize new colleges in Russia. They provided new colleagues by literature, machinery, training plans and programs. Also they sent experienced officers and teachers to the new colleges.

The reconstruction of the Naval Education in the 90-s of XX century resulted in decreasing of financial and material reserves. In the course of this reformation Naval Engineering Institute was formed in 1998. Nowadays Naval Engineering Institute is the unique and the only Russian Scientific Multipurpose centre for training engineering officers for the surface ships and submarines.

Since 2009 Naval Engineering Institute is an independent structural part of Naval Educational Scientific centre of Russia.

ORIGIN AND BEGINNING OF BUILDING OF DIESEL ENGINES IN THE WORLD (END OF XIX-BEGINNING OF XX CENTURY)

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Almost century on railways the unique type of locomotive was a locomotive. And only at the end of XIX age appeared and began to conquer popularity combustion of different kind's engines – gas, petrol. It is possible to consider a carriage-gazokhod which plied on the Drezdenskaya city ferrous road in 1892 the first diesel engine, his engine power was 7,35 kW

Idea of application for traction of trains of combustion which works on an oil-fuel arose up for the Russian engineers yet at the end of XIX ct. in engine. Yes, in 1984 professor V.L.Kirpichev developed the project of locomotive which was named Oil-locomotive, as had oil engines, that engines which work on oil. Thus, a locomotive of professor Kirpichev was as though the prototype of warmly-locomotive.

In 1897 the German engineer Rudolf Dizel' invented more perfect in comparing to oil combustion of, engine which worked also on the heavy types of oil-fuel. This engine got the name of inventor - diesel. The first diesel had power 14,7 kW, his output-input ratio exceeded an output-input of steam-engines ratio and did not depend on the sizes of engine. A very economic, compact, comfortable and simple for constructions diesel got wide distribution quickly, including on a transport.

True, railways began to utilize a diesel later other types of transport. In 1912 on the line of Winterthur - Romasporn in Switzerland the tests of the first diesel engine were conducted by power 705 kW, created Diesel and Kloze. In 1913 in Germany on a line Berlin - Mansfield made an attempt utilize this locomotive for motion of passenger train. But it appeared that he not suitable for train work, because developed greater power only at greater speeds, but at motive from a place and it was not enough on getting up of power.

Diesel engines were designed and created with, electric, hydraulic, gas and other mechanical types of transmissions. In the years of the first world war by a firm "Krosh" (France) narrow-gauge diesel engines were built by power 88 kW with an electric transmission, and by the factory of Baldwin (USA) - with the mechanical transmission of motor-car type. Swedish narrow-gauge diesel engine by power (88 kW) with an electric transmission was built in 1922

In 1924 in Leningrad the main diesel engine of Schel1 of the system of M. Gakkel was created with an electric transmission. In November in 1924 a diesel engine went out on a railway highway and in January in 1925 arrived to Moscow.

A large and difficult way is passed from the first-borns of building of diesel to the most modern locomotives of our days. Now a diesel engine already firmly conquered steel highways and conscientiously divides large, heavy train work with electric locomotives, thus each of them mutually complements each other. And on the electrified lines diesel engine while also irreplaceable in quality of basic mobile mean.

Symposium S91
Biography as a Genre in Different National Traditions of Writing about Science and Scientists

THE YEAR THAT HAS CHANGED THE EARTH

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The year 1905 is often considered annus mirabilis due to the appearance of Einstein's special theory of relativity. We point out that besides this year in the previous century exists one more annus mirabilis. It is the year of 1912 when Alfred Wegener and Milutin Milankovic made equally courageous and amply theoretical effort which has lead to relinquish of old paradigm which Earth sciences obeyed for centuries. Both scientists have very similar biographies and strong correspondence between their achievements could be noted.

Alfred Wegener (1880 – 1930) on January 6 1912 in the German Geological Association delivered lecture *The Origin of Continents* which consternated professional public because it questioned prevalent non-dynamic views in geology. Leaving behind then inviolable idea of sink bridges between continents, he wrote the first scientific paper which considers continental drift and postulate new picture of a dynamic Earth.

In the same year Milutin Milankovic (1879 – 1958) in the *Voice* of the Serbian Academy of Sciences published paper *Theory of the mathematical theory of climate*. In it he started consistent transition from celestial mechanics to the Earth sciences and transformation of descriptive Earth sciences into exact ones. Considering seasonal and latitudinal distribution of earth's insolation, caused by changes in earth's orbital geometry, Milankoviæ established the astronomical theory of climate as a generalized mathematical theory of insolation.

These two approaches led to the new dynamical picture of the processes on the earth. It lead to the concept of continents' shift as well as replacing of geocentric causality by setting up astronomical causes which force mechanisms of terrestrial thermal phenomena. Moreover in direct collaboration which started in 1924 Wegener and Milankovic developed theory of poles' wandering which definitely enabled leaving of the static picture of the earth.

Although both of them had to wait for more than fifty years to become fully acknowledged, they forced rewriting of all textbooks in the domain of Earth sciences.

THE FIRST AND THE ONLY ONE: THE DIRECTOR OF ST. PETERSBURG ACADEMY OF SCIENCES PRINCESS EKATERINA DASHKOVA AND HER BIOGRAPHERS

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Princess Ekaterina Romanovna Dashkova (1743 – 1810) was a remarkable phenomenon in the history of science and culture in Russia. For about twelve years she served as the head of the major academic institution of the 18th century Russian empire – the St. Petersburg Academy of sciences. In that capacity she influenced the governmental policy on science and education. The only woman who was enlisted in the state service in Russia at that time, she has remained the only woman who has ever occupied the position of the head of the Academy of Sciences in Russia. Her contemporaries and posterior historians and biographers have produced very contradictory accounts of her life-history: sometimes it is hard to believe that they portray the very same person. The paper examines in details her own autobiography and key biographical narratives of her life produced in the 18th-20th centuries in Russia and abroad.

ASSESSMENT OF DIFFERENT BIOGRAPHICAL APPROACHES TO WRITING ABOUT SCIENCE AND SCIENTISTS

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Today, science recognises many different forms of the biographical study of scientists. We find many different approaches to this subject in dictionaries, encyclopaedias, compilations and reviews on the development of scientific disciplines and specialities. They serve to provide information and guidelines for people with a variety of interests. Internet communication is also a new form of speedy information, albeit non-reviewed and non-guaranteed, hence, in most cases, this is only to be recommended for already renowned people.

Biography (and auto-biography), as a genre of writing about science and scientists, is a special type of biographical study. One of the essential questions is upon which primary and secondary sources the data is based. Which relations between the primary and secondary sources are scientifically sustainable. Where is the borderline - the critical point. - between scientific biography and a genre of literary writing.

Another form of biographical approach used in science is the prosopographical method (biography collections) used in historical and social science research.

From the stand point of the sociology of science, and the science of science, - as a discipline or research area - the biographies of scientists can be seen as a special form of empirical data, based on the process of their scientific work or their creativity (T.I.Rajnov, 1934).

In particular, the conceptual thinking of T. I. Rajnov is discussed here and the difficulties in writing scientific biographies will be demonstrated through the examples of the natural scientist, Boris Hessen and the linguist and ethnologist, Wolfgang Steinitz. These difficulties will be furthered examined through a case-study of the publication 'Portraits of Russian and Soviet Sociologists', complied between 1987 and 1990 by a team of Russian and German social scientists.

THE DIARIES OF THE TRAVELER PYOTR KOZLOV: A SELF-PORTRAIT IN GEOGRAPHIC SPACE

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Personal diaries and traveler's diaries which have a special place among them are of great value for the historical and especially for biographical research. They contain not only autobiographic records and reflection of daily events but also different information about a specific region: geographical description of an area, visual observation, attempts to interpret something seen immediately, letting no grass grow under feet.

Keeping diaries is an important part of a researcher's work, the first step to the future scientific publication. They afford an opportunity to observe the birth of scientific ideas, to see a daily activity of a researcher, to look in his creative laboratory.

We should mention one more diaries feature – their certain orientation not only towards the self but also to potential reading by descendants. That's why it isn't uncommon situation when the records concerning the traveler himself, his feelings and impressions caused by landscapes, events, meetings with different people are presented in a form of artistic expression. Thus it's kind of the creation of self-portrait in one or another geographical area.

The diaries of a famous Russian Central Asia traveler P. Kozlov (1863-1935) which he had been keeping for more than 3 years during his last Mongolian-Tibetan expedition (1923-1926) have all above-listed features. They contains not only the information about scientific research activity but also the notes about social and living conditions and culture of Mongolia, impressions of meetings with Mongolian statesmen and politicians, many interesting notes about the nature and people in Mongolia and about those global changes in the country, the witness of what Kozlov was. Rich of personal facts, bright sketches of daily life, conditions of life of a traveler the diaries don't let only to reconstruct his biography and to show his character, they also to fulfill «white spots» of history, add some features to the famous historical events particularly to restore the pages of history of Russian-Mongolian scientific relationship in 1920-s.

LOCAL AMATEUR SCHOLARS OF THE 19th – EARLY 20th CENTURIES IN RUSSIA: BIOGRAPHICAL TRADITION AND PROSOPOGRAPHIC DATA

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The paper examines the lives of locally-based researchers in the late 19th – early 20th century Russian empire and the early Soviet Union who were involved in 'local studies movement', exploring and describing their native regions and thus asserting their patriotism and interest in scholarship. The decades between 1890s and the late 1920s are generally considered to be the 'golden age' of local studies in Russia when hundreds of learned societies and associations for the study of local history and natural resources were established outside of the cultural and intellectual capitals of the country. Local researchers occupied a marginal position in their academic fields, acting as mediators between local milieu and scientific communities. Locally-based researchers were engaged mainly in collecting field materials and acting as informants for established academics and governmental experts.

Increasing professionalization of science was instrumental in shaping their 'amateur' status by undermining credibility of their scholarly pursuits undertaken as a part-time, voluntary activity. Yet the population displacement and a major decentralisation of power and resources caused by the World War I, the revolution and the civil war forced many professional scientists to get engaged in 'local studies' in the 1920s as a way to tap local resources of funding and to preserve otherwise collapsing infrastructure of professional research that had been created by the state agencies in the provinces in the last decades before the revolution of 1917. However an ensuing shift of power from localities to the central state agencies led to a major realignment of researchers and activists involved in the local studies movement in the course of the 1920s who began to identify themselves more with particular disciplines than with their territorial base – the trend discernable even before mass purges of the local studies societies in 1929-1932.

Since the 1960s, and especially in the late 1980s-1990s the revival of local identities and semi-independent local initiative in Russia was instrumental for the 'rediscovery' of the local studies movement of the late 19th – early 20th centuries and its activists. However the 'resurrection' of the local studies movement in a very different political, social and cultural environment led to the rise of an 'invented tradition' which validates identities and experiences of contemporary local historians and faculty members of provincial universities. The paper argues that this particular tradition has profoundly shaped biographical narratives that seek to explicate the lives and scholarship of provincial collectors, naturalists, geographers and ethnographers of the late 19th – early 20th centuries. The paper examines available prosopographic data on local studies activists, their own autobiographical accounts and the prevailing biographical tradition in order to explore the boundaries between professional and amateur research, science and public activism, local and national/imperial identities.

BIOGRAPHIC METHOD AS AN INSTRUMENT OF HISTORICAL-SCIENTIFIC RESEARCH (THE EXAMPLE OF W.F.LOUGUININE'S STUDIES IN THERMOCHEMISTRY)

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In the second half of XXth century in foreign historiography of general history there appeared a new trend – social history. Historical science, enriched by a new categorical and methodological toolkit of sociology, was able to discover new spheres of research, relevant sources, which never comprised historians' sphere of research, and also was able to more deeply comprehend the sequence of a number of historical events in the light of social life of the past.

Approximately in the same time there happened a similar turn in the history of science: application of methods and terms of sociology (for example, sociology of knowledge) to the real (cognitive) history of science. Appearance and establishment of social history of science allowed to reconsider many earlier analyzed problems in the history of science in a new way, to approach to their presentment from different side. The subject of historical-scientific work moved to the issues of defining interrelation between social structures and scientific knowledge; of influence of a certain social processes upon shifts in scientific knowledge, if to review the development of science in global scale. At the same time the scientists, using certain sociologic strategies of research engaged in comprehension of concrete historical situations, divided in course of time (e.g. advancement of separate hypotheses or theories, debates of scientists in respect of different scientific problems etc.) within the framework of sociocultural context. In case of such multidimensional analysis of events in the history of science, - as an example, “innovative activity of specific scientist”, - not only cognitive factors are taken into consideration , but also psychological (axiological orientations and preferences), communicative (in particular, sociocultural surrounding) ones, etc.

In the present paper, dedicated to the research of life and creative work of famous thermochemist W.F.Louguinine (1834-1911), the application of “biographic method” (study of scientist’s autobiography, his personal documents, correspondence) for reconstruction of his scientific achievements is demonstrated. Authors, while using alongside with journal scientific publications of Louguinine and his monographs also a large array of various sources, made an attempt to trace the genesis of choosing by the scientist of subject and methods of research; the transformation of his scientific and pedagogic views in the light of personal contacts of Louguinine with leading representatives of French and Russian scientific schools (Ch.A.Wurtz , H.V.Regnault, M. Berthelot, A.G.Stoletov, I.A.Kablukov, etc.), and also of axiological preferences of his scientific-social activity.

The basis of present research comprises documents from a number of Russian archives and also French state and private archive collections. The work was carried out with support of Fondation Maison des Sciences de l’Homme (Paris).

READING HISTORY OF WOMEN SCIENTISTS THROUGH BIOGRAPHY : LIFE-STORIES OF LYDIA RABINOWITSCH-KEMPNER, LINA STERN AND GERTRUD WOKER

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In this paper I would like to explore certain aspects of the biographies of women scientists trained at Swiss universities at the turn of the 20th century, when they first opened their doors to women and awarded them doctoral degrees. My attention will be focused on three female scientists who reached key positions in research and academia. Their lives spanned several major events of the European history of the time, such as World War I and II, Nazism and Stalinism, as well as the shifting role of women in science and, as well as in society, at large :

(1) Lydia Rabinowitsch-Kempner (Kovno (Lithuania, Russian Empire), 1871 – (Berlin), 1935), who earned her doctoral degree in biology in 1894, at Bern University, and pursued her research in Berlin, working in close association with the 1905 Nobel Prize winner, bacteriologist Robert Koch. In 1912, she became the second women in Germany to obtain the title of associate professor and dedicated her entire career to fight tuberculosis, before it was abruptly put to an end in 1933, after the Nazis took power.

(2) Lina Stern (Libau (Courland, Russian Empire), 1878 – Moscow, 1968), promoted doctor in medicine in Geneva University in 1903. The former part of her career was linked to her *alma mater*, where she became first female professor in 1918, while the latter took place in the Soviet Union, where she was offered the chair of physiology at the II Moscow State University (1925) and the possibility to found the Physiology Institute at the Soviet Academy of Sciences (1929). During the World War II Lina Stern was appointed on the board of the Soviet Jewish anti-fascist committee, commitment which made her victim of Stalinist repressions in the late 1940’s.

(3) Gertrud Woker (Bern, 1878-1968), first Swiss woman to earn the doctorate in natural sciences in 1903, at Bern University. All her subsequent career was related to this institution, where she was first appointed lecturer in biological chemistry (1906), and later associate professor (1933). Her research made her aware of the disastrous consequences that could be brought by chemical weapons. Gertrud Woker actively engaged herself in international peace movement and in the Swiss movement for women’s rights.

The careers of these three scientists are documented in full-length individual biographies. While those of Lydia Rabinowitsch-Kempner (Schimpke, 1996; Graffmann-Weschke, 1999) and Lina Stern (Rosin and Malkin, 1988) belong to the genre of scientific biography, the one of Gertrud Woker (Leitner, 1998) is written from a feminist perspective and focuses more on her political and social commitments. My objective in bringing this small group of exceptional women together is to assess the sameness and the particular features of each biography, such as relationship to issues of gender and politics. In the course of the discussion I shall, therefore, reflect on some methodological problems, when researching the lives of women scientists through biographical writings.

VICTOR CONRAD AND THE SEISMOLOGICAL SERVICE OF AUSTRIA

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In 1904 Victor Conrad became the first head of the Seismological Service of Austria. He was born on August 25, 1876. In 1896 he inscribed at the University of Vienna to study Biology – and later on under the guidance of Franz Exner, Viktor Lang and Ludwig Boltzmann – he studied Physics and completed his studies in 1900. Shortly afterwards, in 1901, he became employed as University Assistant at the ZAMG where he found himself confronted with research tasks of Physical Meteorology.

In 1904 the ZAMG became responsible for the seismic monitoring of the Austrian-Hungarian territory, and Victor Conrad was appointed Head of Department. During this time Conrad developed an own small version of a seismograph – the Conrad-pendulum, capable of recording stronger ground motions.

From 1910 until the fall of the monarchy in 1919 he was appointed as Professor for Cosmic Physics at the University of Czernowitz and served afterwards again at the ZAMG. During the following years Conrad concentrated on seismological research which culminated in his paper *"Laufzeitkurven des Tauernbebens vom 28.November 1923"* where he detected P*-waves leading him to suggest the Earth's crust consists of two layers. The separation of these layers became world-wide known as the "Conrad discontinuity".

On April, 30, 1934 when he was put on leave due to his social-democratic engagement. The "Anschluss" of Austria to the German Reich in 1938 caused Conrad to leave Europe. Beno Gutenberg – a student of Emil Wiechert – assisted him when settling down in the U.S.A.

From 1939 to 1940 Conrad worked at the Pennsylvania State University, Department of Meteorology. The history of this department shows that Conrad's research was highly appreciated. From 1940 to 1942 he joined the New York University, the California Institute of Technology, the University of Chicago and finally the Harvard University in Cambridge, Mass., where he worked as well as teacher and researcher until the age of 80.

Conrad's scientifically lifework comprises more than 240 papers concerning Meteorology, Climatology and Seismology.

Conrad's achievements live on in the "Conrad-Observatory" – one of the most modern Geophysical Observatories worldwide – situated 50 km to the SW of Vienna in the Eastern Alps. The Observatory serves now as a base for scientific and technical developments regarding seismology and gravimetry as well as a centre for training courses too.

L'HISTOIRE DE LA SCIENCE ET L'HISTOIRE DE LA VIE : UNE NOUVELLE LECTURE DE LA BIOGRAPHIE DU SAVANT

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Le debut du nouveau siecle pour les historiens nationalde la science s'est signale par "le boom d'archives". Parmi les etudes historique et sciegtifique diverses est toujours la plus repandu le genre de la biographie des savants. L'historien de la science devient dans une certaine mesure l'historien social. Il etudie les recits des gens de leur vie personnelle, mais decouvre puis l'histoire des changements sociaux. Cela permet de reconsiderer les versions "officielles" de l'histoire de la science, decouvrir leur non-dit ideologique et politique.

Dans la sociologie distinguent trois principals comme "les histoires de la vie" : complets (esquissent toute l'experience de vie du sujet "du berceau à la tombe"), thematiques (sont consacres principalement à une partie ou la phase du cycle de vie du sujet) et edite (dans lesquels la matiere initiale biographique est organisee et interpreté conformement à la logique de l'investigateur).

Certainement, les moyens de l'organisation de la matiere d'archives peuvent etre differents, mais le dechiffrement du sens des documents et le recherche de leur authenticite n'arrivent jamais definitif. L'investigateur, en tentant de comprendre les faits biographiques dans le contexte des faits historiques du passe, agit inevitablement dans la limite de l'horizon semantique de l'epoque. Utilise l'arsenal methodologique et les schemas theoriques acceptes dans la communaute scientifique. Autrement dit, chaque investigateur, en procedant à la reconstruction (a sa propre maniere) historique et scientifique, s'appuie (peut etre même implicitement) pour l'image standard de l'histoire de la science, formee à la periode donnee historique. Dans la composition de "l'image de modelage de l'histoire de la science" peuvent entrer les elements divers, mais toujours definis, au moment donne de l'histoire les elements socialement signifiants, qui refletent les normes de la mentalite historiographique dans l'orthographe de l'histoire de la science.

Historisation de l'autoreflexion de la science va des historiens et des philosophes français (P.Dugem, E.Meyérson, A.Koyré, G.Bachelard). C'est la suite adoptention (probablement, implicite) à des certaines approches et des installations, qui sont dehors des cadres du paradigme positiviste et presentent l'inversion de la conception de la science et son histoire. Par les efforts de M.Foucault fait etait montre que l'histoire des sciences ne se reduit pas à la somme des representations et les resultats acquis par les savants du passe.

Une nouvelle relation au temoignage pointe non vers l'eclaircissement comment etait le passe en fait, mais pour la revelation de la resonance du passe dans le present et le futur, pour l'acquisition de l'emotion definie par le destinataire aspirant le parfum de l'epoque partie. Une telle approche permet de voir le caché, inexprime par l'epoque passee, alors le temoignage retrouve le sens et la signification dans la conjugaison avec la mentalité des epoques plus tardives.

Symposium S93
History of Prospective Technology Studies

COOPERATION WITH MIDDLE AND EASTERN EUROPEAN COUNTRIES IN THE FIELD OF TA – RESULTS AND EXPERIENCES

Gerhard Banse

ITAS/Forschungszentrum Karlsruhe (Germany)

The basis of the presentation is the cooperation in the field of technology assessment in Middle and Eastern European countries in the last ten years. The aim of these activities is to "watch" institutional and content-related activities in the field of interdisciplinary technology and environmental research (monitoring) in order to create starting points for cooperation opportunities.

With the transformation processes of the last nearly twenty years in these countries the opportunities in the field of interdisciplinary technology and environmental studies have improved on the one hand, but, on the other hand, they have also deteriorated at the same time.

The presentation will give some examples.

HISTORY AND PERSPECTIVES OF PTA - THE CASE OF THE EP

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PTA was institutionalised in the EP with the launch of STOA in 1987, in parallel with a similar development in general EU policy: the institutionalisation of the Research Framework Programme. Both developments intended to introduce a new feature in EU policy-making: the use of research and technological development in order to support political decision-making.

Following this, one can distinguish three main periods in the development of PTA in the EP:

1. a first ground-setting period, when the practice of PTA commenced in the EP by establishing a rationale for TA at EU level with an associated project cycle,
2. a second period, following a first restructuring of STOA activities in 1994, with the establishment of a new framework for project work,
3. a third period, following a major reform in 2003-2004, when the basis for PTA in the EP was reshaped with the aim to better focus it on strategic science and technology issues and make it more relevant to parliamentary work.

The third period saw also a multiplication and diversification of methods and instruments for delivering TA for parliamentary usage.

THE DEVELOPMENT OF PARLIAMENTARY TECHNOLOGY ASSESSMENT (PTA) IN THE NETHERLANDS

Jan Staman

Rathenau Institute, The Netherlands

During a period of 20 years PTA developed from a basically scientific endeavour into a practice build on five building blocks. First and for all evidence based reports, second focus on the political realm for instance by influencing the political agenda and producing reports with concrete recommendations for parliament and administration, third the involvement of citizen participation procedures and public discourse, fourth a professional attitude towards the media in order to promote public and parliamentary debate, five from a single project to long standing campaigns. Nowadays innovation and foresight give rise to new developments in PTA and these will be discussed.

PARLIAMENTARY TECHNOLOGY ASSESSMENT IN EUROPE – A SHORT HISTORY

Michael Rader

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The contribution retraces the history of parliamentary technology assessment in individual European countries and the European Parliament. Special attention will also be given to EPTA, the network of Parliamentary TA Units in Europe. The contribution will address the influence of US experience in the institutionalisation of parliamentary TA in Europe and the impact of OTA's demise on European parliamentary TA. It will be shown how individual aspects of culture and political constitution affect the organisational solutions for PTA.

EXPECTATIONS AND EXPERTISE MEET. NUTRITIONAL THEORIES AND FUNCTIONAL FOODS.

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Scientific views and expectations in the public discourse on functional foods and nutritonal recommendations are producing a body of knowledge that emphazises the relationship between food habits and nourishment patterns with health issues and concerns. The rise and development of functional foods requires not only the application of a biotechnological technique, it also entails to mobilize a network of knowledge and practices about nutrition, and health issues. In this contribution, we will propose an approach to the study of functional foods along with an understanding of the scientific developments of nutrional recommendations in relationship with functional foods enterprise from the 90's onwards in the European context.

TECHNOLOGY, LITERACY AND KNOWLEDGE SOCIETY.

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The diverses forms to understand through the history the building and transmision of knowledge are associated with availables technologies and strongly dependent of these. The emergence of new technologies allow the generation of new forms of creation and difussion of knowledge and seem to be an possible indicator for the transition from literacy society to knowledge society.

PARTICIPATION IN SCIENCE AND TECHNOLOGY: LEARNINGS FROM THE SWISS PUBLIFORUMS AND PUBLIFOCUS

Sergio Bellucci

Swiss Centre for Technology Assessment

The presentation will provide an overview of the results, conclusions and recommendations of several participatory TA processes conducted by TA-SWISS. It will also discuss various criticisms of the participatory method.

TECHNOLOGY ASSESSMENT IN POLAND – TRADITION, CURRENT INITIATIVES AND EXPERIENCES

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The polish experiences in the field of technology assessment are not great neither broad.In Poland in 80 th years of 20th century there were undertaken some attempts to built the institutions of TA although it did not bring any positive effects. Those difficulties showed the limitation for the application of TA , not only in the specific situation in Poland and manifested oneself in the earlier indicate issues:

1. scientifical and technological- it exist the definite lacks and for example the lack of institution of TA and the lack of persons, there research the problems of technology; the lack of scientific staff in the area of TA is connected among others with the educational programms in technology; in those programms lack TA as a educational object; the problems of development of science and technology haven't been in Poland the object of interdisciplinary research and therefore it not exist the definite experiences in this field;
2. economical- it not exist the effective connections between science and economy and in consequences it provoke the lack of the definite politic in the range of scientifical and technological researches
3. political- the lack of the definite democratic structure to take up of choosens and control; it means the lacks in the area of political culture , that is important in the participation model of TA; it not exist up to here in Poland so much experiences and examples of the local initiatives and participation in technological choosens; it haven't formed in this case the societal accepted and practicable skills of participation in the control of technological development;
4. societal and cultural- it manifest oneself in the area of broad understanding technological culture ;it exist in Poland the economical and political differencies and they are the negative factor for the building of those skills and competencies; e.g. in the case of unemployment the economical factors have the decisive meaning; it exist the passive acceptance for definite choosens about technological development.

Above mentioned factors provoke that the development of science and technology is not the object of effective control neither choices of different social groups. In Poland we have rather experiences in the field of ecological issues of technological development, which concern scientifical and technological research as well as the partizipation of citizens in the process of TA.

THE METHODS OF HERMAN KAHN IN THE YEAR 2000 FORECAST REVISITED

Klaus Kornwachs

(TU Cottbus, Germany)

In 1967 Herman Kahn and Anthony Wiener from the famous Hudson Institute, N.Y., published The Year 2000, A Framework for Speculation on the next thirty-three years. It covered many items, including technological forecasts in many fields. My contribution tries to systematize the forecasts done in this book, won with certain methods, and to compare them with the actual state of technologies today. Moreover the methods from Herman Kahn and his institute are compared nowadays methods .

PROSPECTIVE STUDIES OF TECHNOLOGY IN MEXICO AND LATIN AMERICA: PAST AND FUTURE OF NETWORK BUILDING

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This paper examines the past and future of network building in prospective studies of technology in Mexico and Latin America. In addition, it compares selected cases of Mexico and Latin America in terms of network development, accordingly: incentives, selection and management; rules of participation; context; kinds of participants; hierarchy and institution's capacity; trust, reciprocity and benefits' distribution; collective results and its scale. The cases selected, one of Mexico and the other of South America, have been selected in terms of its success and results.

ON HISTORY OF ROAD MAPPING AND SCENARIO BUILDING

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Both road mapping and scenario building are important tools for developing strategic intelligence. Road mapping started as a tool to connect the technological options with the business model. Scenario building also begin with rather simplistic task as industrial foresight tool in the early seventies. By now both of them are regularly used in strategic management. In this case problems of representing special sorts of uncertainty become dominant. The presentation tries to asses advantages and disadvantages of roadmapping and scenario building in developing “strategic intelligence”.

THE RESEARCH AND PUBLIC DIFFUSION OF SCIENCE AND TECHNOLOGY IN THE MUSEUMS.

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In recognition of the importance of scientifically literate citizens, the number of initiatives has increased proportionately. Universities, research centers, museums, etc. carry out scientific and technological research and engage in promotion and diffusion. In this context, this paper focuses on analyzing what type of research is being conducted in Spanish museums of science and technology as potential sites for the public diffusion of science and technology in order to answer the question why promote scientific research from museums?

NATIONAL FORESIGHT PROGRAMMES IN CENTRAL AND EASTERN EUROPE

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The main challenge for the countries of Central and Eastern Europe (CEE) has been the transition to market economies, and for several of them, it has been coupled with accession to the EU and cohesion with the more advanced EU Member States. Given the planned economy heritage, not only has the ‘usual’ macroeconomic stabilisation been required, but a much more challenging and more complex modernisation programme, involving fundamental structural and institutional changes, has also been requisite. Systemic changes have been necessary in order to transform CEE countries into viable economies, capable of economically, socially and environmentally sustainable development. Some countries have progressed further than others, so that across the region, the demanding and socially rather costly process of political and economic transition has been achieved to a different degree.

An inherent contradiction of the transition and catching-up process has lay in the tension between short-term and long-term issues, which have had to be tackled simultaneously, while intellectual and financial resources have been insufficient to deal with all these issues at the same time. Besides establishing the fundamental institutions of market economies and political democracies – which undoubtedly have had long-term impacts – up until the mid- or late 1990s, most efforts had been directed towards solving short-term problems. Thus, it had neither been possible to pay sufficient attention to emerging global trends, nor to devise appropriate strategies to improve long-term competitiveness in these new settings. However, in recent years, several CEE countries have started to consider the longer-term more systematically. Among these still rather limited efforts are a number of national technology foresight exercises, launched with a view to setting S&T priorities that take account of longer-term developments, and, in some instances, to improving dialogue between scientists, business, and policy makers. These national level exercises are the subject of this chapter.

The paper offers a brief description of developments in science, technology and innovation in the transition era, highlighting the many challenges faced and the main problems that remain. It is suggested that the CEE countries suffer from a serious innovation ‘deficit’ to varying degrees and that this acts as a drag on future sustainable development. The prospects of technology foresight addressing some of these problems and challenges are then briefly examined, followed by descriptions of national technology foresight efforts in six countries: Hungary, Czech Republic, Russia, Ukraine, Romania, and Poland. The paper finishes with a discussion of these experiences, highlighting their strengths and weaknesses, and speculating on how technology foresight might develop in the region over the next few years.

TECHNOLOGY FORESIGHT IN CHINA AND ITS RECENT PROGRESS

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The presentation discusses the development of technology foresight in China ,which consists of four parts:(1) The traditional approach of S&T foresight and selection priority areas,(2) the approach of Selection of Critical Technologies in 1990s,(3) China Technology foresight Program (MOST, 2002-2006),(4) Technology Foresight of China towards 2020 Project. (4) Recent progress of Technology Roadmap in MOST and CAS.

S&T FORECASTING IN THE SOVIET UNION AND THE POST-SOVIET COUNTRIES

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First attempts of the sytematic studies of the possible developments of S&T in the Soviet Union could were made in late 1940s, when Soviet authorities started to compete with the West in military sphere. These researches were of top secrecy but some methods, developed by the Soviet specialists were used later for civilian sector too. So, method of forecasting graph was proposed by Academician V. Glushkov and his colleagues, independantly form similar methods, developed by the US scientists. It was used widely for solving problems of development in defence sphere in 1960s-1970s.

In late 1960s- beginning of 1970s the Soviet specialists started to prepare special long-term programs of S&T development. They usually comprised 20-15-10-years perspectives and they were focused on different apects of S&T development. Soviet authorities considered them as an important component of the system of planning of the Soviet economy. Such programs were perepared at the all-Union level and on the level of all republics. They have comprised all sectors of the economy, hundreds of experts took part in their preparations. However, in many cases, the results of the reseacrh findings were pre-determined by the 'party directives' and they were not concentrated on 'alarming' problems of the development of Soviet society.

During the 'lost decade' of 1990s, forecasting and other types of prospective studies were forgotten. Only in 2000s in the biggest post-Soviet countries , Russia and Ukraine, Foresight-types programs were initiatited with the help of Wrstern experts. In the paper the results and methodology of these programs will be reviewed.

FLORIDA TECH - BUILDING A RESEARCH UNIVERSITY (A CASE STUDY)

Linda Ward

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Florida Tech was founded in 1958 to serve the growing population of space workers arriving at Cape Canaveral. During its first 3 decades it was largely a "teaching" institution. With the arrival of President Lynn Edward Weaver in 1987, the university moved with the stated goal to become a "research" university. Today, Florida Tech has 6400 students from some 103 countries. The Florida Tech College of Science (COS) has over $20 million in current research contracts, which is 58 percent of the university total. This paper will discuss the strategies inherent in the development of the College of Science as a "research engine". Implicit in that growth is the availability of research grants (largely Federal Government) funded on the basis of peer review, the hiring of bright young faculty, and the acquisition of research facilities which permit faculty to conduct research in their areas of focus.

A CRITICAL APPROACH TO PUBLIC UNDERSTANDING AND PARTICIPATION IN SCIENCE AND TECHNOLOGY

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This paper essays a critical revision of the concept and traditional measurement of scientific culture, while defending the need of developing a multidimensional approach to such a concept, sensitive to the phenomenon of *formative participation*. We also comment on different experiences of public participation in S&T public policies and assess them as to their capacity to generate social learning.

Symposium S94
Brief History of Characterisation of Engineering Materials and Structures

THE ROLE OF THE NATURAL AND ENGINEERING SCIENCES IN THE ECONOMICAL AND SOCIAL REORGANISATION

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One of the basic questions in discussions of the people interested in the natural or engineering sciences and the historians is what kind of driving forces exiting (existed) in reorganisations of the civil society and economical life? A bit more general question is that the civil society s the driving force for economy, or inversely, i.e. the economical state has a dominant influence on the reorganisation of society? It is obvious, that the interconnection exited always in the past and will act between the two sectors. This question will be discussed from the engineering point of view. In the Fig.1. the "Revolutionary Forces" of the society are summarised.

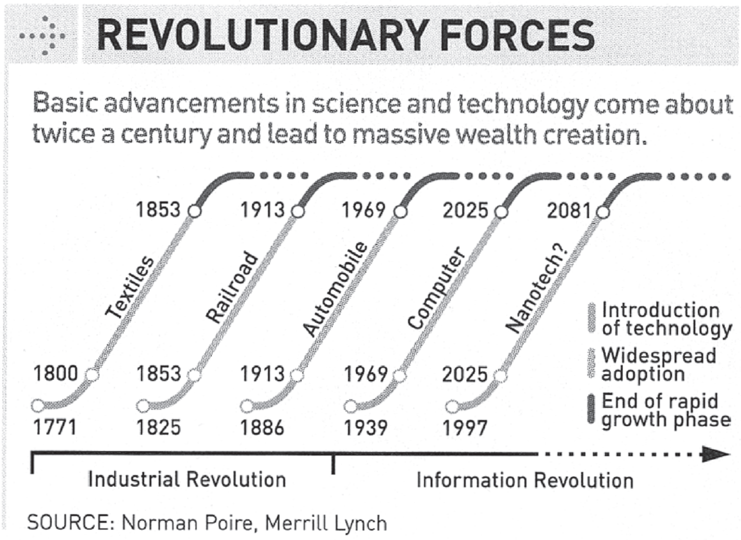

Fig. 1. The Driving forces in reorganisation of economy and society.

The Fig. 1. demonstrates exactly, that the "revolutionary forces" are always the "products" of engineering sciences which are based on the basic natural sciences. Appearing and wide implementing the "products" (i.e. textile-, railroad-, automobile-, computer-, nanotech industry) the relation of the peoples need to be changed, i.e. the structure of the society has been and has to be changed. By appearing the "textile industry" the working class has been created. The industrial revolution was the result of the railroad and automobile industry, which totally reorganised both of the society and economy. In our days we have direct experience of the effect of the "Computer industry" and the indirect effects of the "nanotech"

The present contribution attempts to provide a brief overview about the main steps, results of the engineering sciences developed from the beginning of the industrial revolution up to now. All the presentations in the Symposia S-94, provide a brief historical overviews of developments of different engineering sciences.

HISTORICAL BACKGROUND AND DEVELOPMENT OF IMPACT TESTING

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Many industrial components are constructed from ferritic steels which, under certain conditions, become susceptible to brittle fracture when they are tested at relatively low temperature and at high strain rate under impact loading. This behaviour is responsible for many catastrophic failures, including recent disasters. The impact test method, based on a pendulum, generally called the Charpy test, is one of the most cost-effective material testing procedures, with respect to both product acceptance and component surveillance. G. Charpy (1865-1945) was a French scientist who played a key role in the development of these impact testing methods. He presented his fundamental idea in the Proceedings of the Congress of the International Association for Testing Materials (IATM), which was held in Budapest in September 1901. A conference devoted to the centenary of Charpy test was held in France in 2001, where the historical background and the development of this impact test were presented by L. Toth.

The present contribution attempts to emphasize the role and the position of impact testing methods, starting at the early beginning of the intense industrialization in the second half of the 19th century. The main steps in the evolution of Charpy impact testing are discussed in detail. The emphasis is laid on the ductile-to-brittle transition concept which is of crucial importance in the assessment of structural integrity methods. It is shown how this technological approach to brittle fracture remains so widely used, and how the use of modern numerical tools and a better understanding of the physical micromechanisms have now allowed to derive fundamental properties related to the fracture behaviour of metals, in particular the temperature dependence of fracture toughness.

METAL FATIGUE – THE STORY OF AN ENIGMATIC SCIENCE

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Like many other sciences, Metal Fatigue owes its pursuit to the advent of the Industrial Revolution. Steam, then electric power and thereafter, the inter-combustion engine and finally, the turbine completely changed the way engineers built structures and machines. These technologies demanded lighter designs, while at the same time driving stress levels up. Safety factors that determine how much lower, maximum operational stresses must be, when compared to the failure strength of material came under increasing scrutiny. However, these could not avoid the devastating consequences of metal fatigue.

Early railway engineers were shocked to discover that wagon axles could inexplicably “break like glass”, even though allowable stress levels were far less than the tested static strength of these superior quality steels. Metal Fatigue thus made frequent headlines for the wrong reasons – railway catastrophes from crashes due to broken axles with gruesome statistics of fatalities. Wohler’s work of the mid nineteenth century effectively laid the foundation for contemporary fatigue design. While he may not have been able to get to the bottom of the *science* behind metal fatigue, he succeeded remarkably in laying the engineering framework for design against premature failure. Wohler introduced the concepts of the S-N curve, fatigue limit as well as what is known today as the Goodman Diagram. Most of the effort for the following decades was expended on experimental testing to determine fatigue properties for a variety of materials.

The first scientific advancement of Metal Fatigue was associated with the discovery of the nature of slip and plastic deformation of metals. Dislocation Theory and advances in Electron Microscopy in the 1950’s lay the foundation for scientific interpretation and modeling of slip. This new found understanding was quickly extended to metal fatigue. Thus, almost a century after Wohler laid its engineering foundation, metal fatigue at last got a scientific leg to stand on.

The sixties saw the advancement of low-cycle fatigue, which is controlled by cyclic inelastic strain, supporting the development of such highly stressed components as gas turbine discs. Simultaneously, considerable understanding developed about fatigue as a multi-stage process, governed largely by the process of formation and growth of one or more fatigue cracks. These together have made significant contributions to the durability of most structures and machines including aircraft structures and aeroengines.

Contemporary research is extending to what is referred to as gigacycle fatigue and is being extended to many diverse fields such as MEMS, engineered materials including composites, etc.

BRIEF HISTORY OF STRUCTURAL INTEGRITY CONCEPT

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The objective of the paper is to introduce the most important categories, principles and methods of the structural integrity concept, based on national and international prescriptions and typical applications.

During the operation (traditional word) or lifetime management (up-to-date word) of a structural element or a structure we can apply many approaches, according as follows: (i) microstructural approach; (ii) design concepts; (iii) operational approaches (conventional methods, fitness for purpose, structural integrity, integrity management and risk management); (iv) applied methods (engineering methods and fracture mechanical methods).

Both historically and in engineering point of view, the operational approaches are the most important and the most prevalent. Among the possible variations of the operational approaches, the structural integrity concept can be applied to wide variety of engineering or industrial fields.

Integrity of a structural element or a structure means it is fit for purpose at all times during its total lifetime. Three levels can be interpreted: (i) the global level; (ii) the testing level and (iii) the calculation (traditional word) or computer technology (up-to-date) level. These levels can also be divided into further elements, which are closely connected to each other. The global level summarizes the material characteristics referring to the damage processes, the geometry of the structural element including the geometry and the distribution of the flaws, and the loading conditions. The testing level contains the destructive testing, the non-destructive examinations and the experimental stress analysis. Finally, the calculation or computer technology level consists of three parts, too: material properties or material databank; structural elements data (drawing) or structural element databank; and calculation and estimation methods or software. A good visualization of this is to imagine the levels as the faces of a tetrahedron; in this case the summit of the tetrahedron will be the materials characteristics, the results of the destructive examinations, and the material properties data.

This approach means that the structural integrity involves the whole life-cycle of the structural elements or structures. Therefore, there are documents, standards and prescriptions containing rules for design and operation (traditional words) or lifetime management (up-to-date word) of different engineering applications. The paper reviews the more significant documents, their theoretical background, developmental directions and application limits. In line with these, the paper alludes to the relevant disasters, institutions and persons.

EVOLUTION OF THE HARDNESS TESTING

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In the second half of the 19th century the technical revolution has been ignited by the wide spreading application of the Steam engine, which is boosted the development of the material science as well.

As a side effect it also initiated the massive development of different transportation devices for short-haul shipment.

The daily usage of steam engines has resolved the global transportation and large volume forwarding (steam locomotive, steam vessel etc.), thus the technical improvement was driven by a new area, has been growing with a tremendous speed- namely the automotive industry.

This new area is quite different from its predecessors, as it is demanding to manufacture parts in large quantity, with a very uniform quality, and just in time delivery. The new technology claimed procedural controls tests, which is providing a prompt and reliable information about the quality of the manufactured parts. This demand has been addressed with introducing the different hardness testing methods.

The first test method, which was providing quantified information about hardness, has been introduced by Hertz in 1181. This is followed by Brinell, which is very commonly used hardness testing method nowadays. The procedure has been presented by the Swedish engineer in Paris World Fair, held in 1900. Shore was also using ball as an indenter, but the result of the test was a force required to produce a defined penetration depth. In the year of 1907 Ludvig has proposed to use a steel cone for an indenter - however this method is not suitable for testing hard materials. Therefore Rockwell was suggesting the use of Braille (diamond cone) as an indenter in 1922. The reproducibility and accuracy of hardness testing was significantly increased by changing the indenter to Diamond Pyramid, introduced by Vickers on 1925.

A new wave of development in test techniques has been experienced only after the second world war, namely from 1950- because the warfare is not an ideal environment for developing sophisticated test techniques. The new test methods has been recommended by Drozd (1958), Kaldor and Barczy (1967) Brunner and Schimmler (1978) in most of the cases was addressing the challenges introduced by the new modern materials and their different behaviours from the traditional industrial materials.

Thanks to the rapid development of the electronics, a new way of hardness testing was meaning to record and evaluate the „answer" or counteract of the material to the applied load by the indenter.

The continuous development of the material science and production engineering also demanded similar requirements but in micro ranges.

The presentation will be providing an overview about the hardness testing methods used in the history of industrial development from the history till nowadays.

EVOLUTION OF THE NON-DESTRUCTIVE TESTING IN HUNGARY

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Between the two world wars the laboratories within the big industrial companies had the leading role in material testing in general and, in some early NDT methods, in particular. An intensive development has been started in the field of NDT after the Second World War, during the country's reconstruction (restoration of industrial plants and bridges, material selection by spectroscopy). X-ray testing became a daily NDT method.

In the 50-60s other NDT techniques have been introduced into various fields of industry such as metallurgy, machine production, rail transport. In the 70-80s the construction of Hungary's nuclear power plant was the driving force behind the NDT development (with special regard to mechanized ultrasonic and eddy-current testing). Manufacturing of NDT equipment in Hungary: portable X-ray equipment, multi-channel acoustic emission instruments, etc.

NDT research at the universities, academic and other research institutes (in Hungary X-ray testing was first performed at the Budapest Technical University in 1936; nation wide research program on nuclear power plant safety prior to building the plant). Establishment in the 50s and liquidation in the 90s of some dedicated research institutes.

The NDT society life in Hungary: establishment of the Society of Hungarian Material Testers at the end of the 19th century (it was terminated as a consequence of the Second World War); establishment of the Scientific Society of Mechanical Engineers in early 50s, then its Material Testing Section as well as its NDT Subsection in 1957); establishment of the Hungarian Association for NDT (MAROVISZ), the current representative of the Hungarian NDT.

A short overview on what impact the Hungarian great scientists' had on the NDT development (Zoltán Bay, Georg von Békésy, László Gillemot).

Symposium S95
History of Travel, Travel Medicine and Traveler's Medical Kits

HISTORY OF TRAVEL MEDICINE AND THE TRAVELERS

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The history of travel medicine is as old as the traveling itself. In ancient times traveling meant the movement of the armies and merchants. It was soon realized that traveling is a risky thing: in the footsteps of armies infectious diseases had been emerged, and the merchants' goods was the carrier of many unknown microbes and diseases. During the caravans' trip motion sickness and high-altitude illness has been recorded. In the middle ages, the contagious diseases regularly caused pandemics. The religious visions considered the terrible infections as God's reprisal for the sins of humanity. In order to conciliate the Lord thousand of pilgrims visited the holy places: and also triggered new pandemics. The human race had to be learned how to prevent these diseases: quarantines, primitive methods had been served as an early form of prevention.

The curiousness for foreign countries has arisen in the late 19th. Century: the rapid development of the railroads and ships made holidaymaking possible for the upper class. This kind of traveler has already been equipped with some medical kits and tools, respectively. The real mass tourism has begun after the WW1. After the WW2 a „travel industrial revolution" has been occurred: the commercial airlines and the motoring make the distances shorter/ make the long distances short. The travel industry appeared and new forms of travel-related diseases has been developed (such as the jet lag, the venous thromboembolism, etc.) The present craze for the adventure tourism and extreme sports gives a new interpretation of tourism and traveling. All of this induced the recent development of safety and sport devices. New devices, new tools and new countries appear day by day, and the first space-tourist has already launched.

The history of travel and travel medicine is not a common topic for research in the traditional history of science; yet, it is worth to study, because of their impact on our everyday life.

FROM THE FIRST "FOUNTAIN PEN" TO BALL POINT PENS – WRITING INSTRUMENTS FROM AND FOR MEDICAL DOCTORS

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While the invention of the feather quill for the purposes of writing with ink marks a milestone in the development of writing techniques, problems with the hardness of the pen's tip and of the amount of writing possible after it had been dipped in ink persisted for centuries. Dante's complaint about the short life span of such a quill in Inferno (XXIV.6)–"Ma poco dura alla sua penna tempra"–is well known. Not only was the repeated dipping of the feather a nuisance but carrying an adequate ink supply on travels made writing difficult for those persons who wanted or needed to put down their thoughts in a stage coach or similar conveyance.

It seems, though, that the first attempts at solving this problem did not occur until the 17th century. Authors dealing with the development of writing utensils generally credit Daniel Schwenter (1585-1636), a professor of Oriental languages and mathematics at the Altdorf Academy near Nuremberg, with such an early, documented invention. While it became better known after his death in a widely published collection of such novelties, it was first included in the earliest German handbook on secret communication or cryptology that appeared anonymously some time after 1610 and was revised in its two later editions (**Ill. 1).** Schwenter listed his invention in a section entitled "The art of writing in secret" and described it as the preparation of a "quill that was capable of retaining ink so that an entire sheet of paper (or more) could be written without dipping the pen in an inkwell." Although the description was encrypted with the help of a simple substitution cipher it was clear that the innovation consisted of a small metal tube that was to be inserted in the lower part of a quill. A tiny hole in this tube was to regulate the flow of ink stored above this tube; ink sucked into the pen up to the level of the stopper was then to be slowly discharged due to the supposed vacuum created.

Some 100 years later, Nicolas Bion (1652-1733), mathematician and engineer of the French king, described a "Plume sans fin," an endless quill (**Ill. 2**), in a 1703 *Traité de la construction et des principaux usages des instruments de mathématique.* The pen incorporated some of Schwenter's elements but was constructed entirely of metal–except for the tip, which was still cut from a bird's feather and, along with the problematic ink flow, remained the weakest element. At the end of the century, Friedrich Nicolai (1733-1811), publisher, philosopher, and also a travel writer documented his journey through Germany and Switzerland in 12 volumes. As he needed to put down his impressions during his travels, he devised a "portable pen with ink" **(Ill. 3)** similar to Bion's–yet still with a quill glued into the tip of his instrument. A north German medical doctor, Johann Jakob Heinrich Bücking (1749-1838), felt a similar need except that he had to write out prescriptions and keep medical diaries on visits to his poor patients in the country. With the help of Bion's and Nicolai's inventions, he had his instrument fashioned after the two others **(Ill. 4)** although he was keenly aware of both the ink flow and the quill as their weakest points. For this reason, he experimented with brass and silver pens but found that the former oxydized too quickly with the type of ink he used and the latter were too soft–which means that he reluctantly went back to the quill of yore.

It would take John Waterman's 1884 invention and the later perfection of the gold-tip pen and the capillaries regulating the ink flow under it to create a writing instrument that was the favorite means of communication for a century or so–until László Biró, a medical student and the son of a medical doctor before he became a newspaper journalist, noticed that printer's ink would dry up fast and not smear. Biro experimented and created a tip with a ball bearing that would rotate during writing and pick up ink from the ink cartridge, thus leaving it on the paper. The ball point pen **(Ill. 5)** was patented in 1938, and again in 1940 in Argentina, where Laszlo and his brother George emigrated. After many ups and downs immediately after WWII, the ball point pen–or biro, as it is still called in many countries–is here to stay.

JOURNEYS OF MEDICAL PURPOSE IN ANCIENT NEAR EAST (2nd MILLENNIUM B.C.)

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In Ancient Near East, some personnel serving for the palace was being sent to a neighboring country from the country they lived in. upon the demand from the other party, among the personnel sent to another country were doctors as well beside artists and artisans. The transfer of the doctors was realized in the manner that the doctor went to some country from another country and after staying there for a while he turned back. The fact that the period for which the doctors sent stayed as well as their turning back was determined on strict rules indicates that they were very significant and valuable for the countries they lived in.

In the 2nd millennium B.C. a number of foreign doctors arrived at the Hittite palace. As a consequence of the Hittites' demand for help doctors were sent to Hattie lands from Egypt and Babel. Foreign doctors were needed not only in the Hittite palaces but also in the kingdoms loyal to the Hittites. Due to the fact that Hittite vassal kingdoms were forbidden to make direct contracts themselves with other countries, the kingdoms loyal to Hittites were not directly sent doctors but doctors were provided through the mediation of Hittites.

Hittites paid great value to the foreign doctors and those doctors were much respected in the Hittite palace. The Hittite kings were aware of the superiority of Egypt and Mesopotamia in medical field and they were trying to benefit from the medical developments realized in those countries.

The period the doctors would stay in the countries they had been sent to being strictly restricted and the doctors being sent back again only after requests sent a few times indicates that the foreign doctors sent were tried to be kept in the Hittite land for as long a period as possible. To prevent those doctors to turn back, many methods were appealed to. Those doctors tried to be kept in comfort were given various goods as gifts and they were made to depend on the Hattie land by establishing kinship relations with them.

The fact that expressions promising those doctors received from foreign countries would be sent back in time were come across frequently in international correspondences indicates that those countries were very sensitive about the issue that the doctors sent would be sent back.

In the 2nd millennium B.C. Egyptian medicine was at a more advanced level that other contemporary ancient Near East civilizations. Egyptian doctors were individuals specialized in their fields. The achievements of the Egyptian doctors in medical field went beyond the boundaries of Egypt. Not only Hittites but other peoples needed Egyptian doctors.

Symposium S96
Seeing and Measuring, Constructing and Judging: Instruments in the History of the Earthsciences

PERCEPTION OF STRONG WINDS IN EARLY MODERN TIMES

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The study of early modern history is such that the historian, unlike his or her subjects of study, does *not* enjoy the privilege of direct observation. Visual perception was the most important source of knowledge for historical subjects. Therefore, the eye of the historical subject may be conceived as an observational instrument. However, this eye is virtually unavailable for historians today. Instead, in this contribution I will use a collection of early modern images from 1600 to 1750 depicting strong wind phenomena in the Eastern Alps and Holland. These pictures serve as a source of how these phenomena were visually perceived by the historical subjects.

As a historian, I am interested in the interplay of written and visual accounts of history. Visual accounts can help steer me towards important information in written accounts—often acting as "eye-catchers" in flyers and other historical periodicals. Visual and written accounts can enhance one another, but they also often offer disparate information. It is my task to balance these various presentations to better understand the perception, interpretation, and management of such winds in the Eastern Alps and Holland. My particular aim is to compare and contrast the two climates—the foehn storms in the Eastern Alpine region and the sand storms in Holland offer two very different natural phenomena to explore. For example, one primary difference is the overwhelming presence of land-locked images in the Eastern Alpine accounts, whereas storms and winds in Holland are typically depicted with water elements.

My methodology is to balance various accounts of events—written, visual, memorial, etc. In this contribution, I will focus on pictorial representations of strong winds in the Eastern Alps and in Holland. I will accept these pictorial representations as records of observation and, with their help, to retrospectively analyze how the people of the Eastern Alps and Holland perceived, interpreted, and managed their experiences with these winds. My contribution is unique in that the visual accounts which are a focus of my study are virtually unexplored as historical raw material, with the exception of a number of studies from the Czech Republic. Accepting and focusing on such pictorial accounts as instruments of the study of history is an important step in broadening our approach to retrospectively analyzing natural disasters.

SEARCHING FOR MODERNIZATION – INSTRUMENTS IN THE DEVELOPMENT OF GEOLOGICAL SCIENCES IN PORTUGAL (18th CENTURY)

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A mercantilist vision of the wealth of the kingdom was in the agenda of the 18th century Portuguese governments based in part on an industrialization process relying on mineral resources, as occurred in other countries. The cycle of gold in colonial Brazil was declining and new methods were needed to stop its multiple losses and to search for new mines of gold, iron, mercury, coal, etc. Those were the times of Illustration: in the reformed University of Coimbra the Faculty of Natural Philosophy and in Lisbon the Royal Academy of Sciences and the Ajuda complex favoured Natural History studies. Also the quantification spirit that invaded the 2nd half of 18th century came to favour careful practices in the laboratories of such institutions for the analyses of minerals, ores, water, etc., as well as in the Portuguese Mint and in the "casas de fundição" of Brazil. Preparing naturalists to travel in Portugal and in the colonies was also a task of the institutions mentioned above, which was supplemented by stays and visits abroad for them to get a better preparation in the area of the geological sciences (mineralogy, mining, docimasy, metallurgy, geology, etc.). The institutions got new mineralogical collections for their students and the preparation of collections intended for the technical education of miners was also suggested. The naturalists travelling abroad acquired or ordered books, scientific instruments, models and machines that they left in the Portuguese legations to be sent to Portugal.

In the field of *mineralogy*, progress was made by D. Vandelli, who determined some physical properties of diamonds from Brazil and from India and by Andrada e Silva who discovered some mineral species. Both authors used instruments of physical and chemical mineralogy of the institutions where they worked. *Mining* procedures for gold in Brazil - prospecting, extraction, dressing, panning and amalgamation – were described by several authors who made references to the paraphernalia of machines, tools and instruments in use in the field and in the lab. Surveying was an important part of prospecting leading to the preparation of very simple maps of mineral occurrences. In Portugal, occurrences of coal, iron and gold deserved special attention. *Docimasy* was dealt with by several authors: S. Telles described methods for gold and silver; Vandelli suggested the replacement of the method in use in the Portuguese Mint to analyse gold and wrote abundantly about the analysis of pyrites. F. Camara discarded the method used in the "casas de fundição" to assess the fineness of gold and spoke about the use of standards. As for *metallurgy* several books were published in the 2nd half of the 1700s (two of them in Vienna and Dresden and one in Coimbra by J. Barjona), where mention was made to the huge number of varied instruments, apparatus and machines. The Lisbon earthquake of 1755 called the attention to the relationship between the nature of the ground and the methods and materials adequate to building construction, which belongs to *geo-engineering*.

The circulation of books, instruments, apparatus, machines, models, collections, etc. served the modernization of the geological sciences in Portugal in the 1700s.

THE 'MINERALOGICAL' TASK OF HUMAN SENSES - A SURVEY ON THE LANGUAGE OF 'MINERALOGY' IN WEIMAR-JENA CIRCA 1800

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This paper is going to survey the language of 'mineralogy' – focusing the task of the human senses. It will be based on the thesis of a specific historical constellation in "Weimar-Jena" circa 1800; On the one hand this means a high level of communication: There is a close network and an intensive linguistic discussion following from that. On the other hand it concerns the strong philosophical background [a result of the very active reception of Immanuel Kant], framing every disciplinary approach.

The survey founds on a description of Johann Carl Wilhelm Voigt – had studied in Freiberg (Sachsen) at Abraham Gottlob Werner, he managed the mine of the duchy Sachsen-Weimar und Eisenach in Ilmenau. Which linguistic elements did Voigt use for his 'mineralogical' descriptions? And what for a task had the human senses? Were they just serving for an easy personal imagination, as a sort of a mechanical 'instrument' or was their role an epistemic one?

TRAVELLING WITH INSTRUMENTS: ITALIAN GEOLOGISTS IN THE FIELD BETWEEN THE 18th AND 19th CENTURIES

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The different practices of scientific travelling mainly developed in connection to the use of measuring instruments are particularly relevant in the history of the Earth sciences.

While a certain number of common tools and instruments were normally used by many geologists during their travels and fieldwork, other instruments were originally designed and made for specific purposes. Some of them were sucessfully tested and later adopted in the field, while others remained as projects or proved to be awkward to use, especially in mountain areas.

The records of these attempts may be found within unpublished primary sources or in technical papers related to geological surveying and mapping. However, the references to the instruments used in the field (and sometimes later in the laboratory on the collected specimens) are also frequent in major printed works on scientific travels, such as, for example, in Lazzaro Spallanzani's *Viaggi alle Due Sicilie ed in alcune parti dell'Appennino* (Travels in the Two Sicilies and some parts of the Apennines, 1792-97).

The aim of this paper is to provide an overview and discuss in detail the role of the instruments in some significant cases related to geological travels undertaken by Italian scientists during the second half to the 18th century and the early decades of the 19th century.

MINERALS SCRUTINIZED: ALBERTO BETIM PAES LEME (1883-1938) AND THE APPLICATION OF SPECTROGRAPHY

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Alberto Betim Paes Leme (1883-1938) was born in Rio de Janeiro, and got a degree in mining engineering in 1906 from the *Ecole des Mines de Paris*, as many other of his countrymen throughout the 19th century. Soon afterwards, he came back to Brazil and worked in several public institutions, such as the Brazilian Geological and Mineralogical Survey, the National Museum, and in the embryo of the future University of Rio de Janeiro, besides being one of the founders of the Brazilian Academy of Sciences in 1916. His international connections, particularly with France through the Académie des Sciences and the Société Géologique, made him quite well known and quoted outside Brazilian frontiers. His seminal contribution, despite the wide range of subjects he addressed, is in the field of determination of minerals, in which he published, among others: “Sur un nouveau procédé d’analyse quantitative” (1918); “Procédé cinématique d’analyse spectrale quantitative” (1934); and the book “Analyse espectral applicada a mineralogia. 138 pp, 20 figs. Rio de Janeiro, 1918", cited in *The American Mineralogist* (*New Books)*, 1920. This paper will focus on the use of this instrumentation in his analysis, and discuss his practices and results.

ASPECTS OF THE ROLE OF MICROSCOPES IN THE HISTORY OF PETROLOGY IN JAPAN

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The study of geology in Japan started with the help of Western geologists employed by the Japanese Government during the Meiji Era in the late nineteenth century. After learning from the German teacher, Edmund Naumann (1854-1927), Japanese students went to various European countries to take more advanced studies in geology. One of them, Bunjiro KOTO (1856-1935) went to Leipzig University and studied microscopic petrography under Ferdinand Zirkel (1838-1912). He returned to Japan and initiated microscopic petrography, using imported German microscopes. The Japanese geologists claimed that they could become better than Naumann because of their use of microscopes. Until the late of 1890s the Japanese Government was trying to change the one-sided and unequal commercial treaty with Western countries that had been concluded prior to Meiji Era, and one of the points that raised was the claim that Japanese geologists had a superior knowledge of Japanese geology, as compared with some Western scientists working in Japan.

Microscopic petrography in Japan developed gradually and made some significant contributions. For example, Koto’s student, Seitaro TSUBOI (1893-1986) devised a dispersion method of determining plagioclases in cleavage-flakes in 1923. This technique came to be known as the ‘Tsuboi method’ and was used all over the world.

Before and during World War II, Japanese geologists prospected for uranium based on the chemical analysis of various rocks. Hisashi KUNO (1910-1969), Tsuboi’s student and associate professor of the University of Tokyo, went as a soldier to the front of Northeast China, where there were no good geological linstruments other than microscopes. He found small differences in the refractive indices of the quartz in different granites. So the Japanese petrologists and soldiers had to measure the refractive indices of the minerals in various granites using only microscopes.

After the War, one of Kuno’s students, Akiho MIYASHIRO (1920-2008), advanced a physico-chemical theory of the metamorphic rocks of Japan on the basis of microscopic petrography and discussed the origin of the Japanese island arc.

THE EARLY HISTORY OF GEOLOGICAL MAPS AND THEIR USE AS INSTRUMENTS OF DISCOVERY, WITH EAST–WEST COMPARISONS

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The earliest ‘geomaps’ in both East and West were more akin to pictures than maps. In Europe, there were first ‘picture maps’ (or even ‘word-maps’); then maps showing the sites of mines and ore bodies; then ‘lithological/geognostic’ maps; and eventually biostratigraphical mapsfrom which developed the typical geological maps of the nineteenth century. It has been argued that the transition from lithological (or ‘geognostic’) concerns (and maps) to biostratigraphic concerns (and maps) marked the emergence of a historical approach to the study of the Earth and also the emergence of geology as a distinct discipline. In Germany, we can see a transition from ‘geopictures’ to ‘geomaps’ in the 1760s, and a further, more gradual, transition from 'lithological/geognostic' to geological maps from about 1780 to 1820. (Biostratigraphic mapping tended to lead the way in this change more in Britain and France, but a little later.) When fully developed, geological maps became *instruments of discovery*: they could be used to work out structures and *make testable hypotheses* about where particular rock types or ore bodies might be found. They were thus of economic importance and their development was linked to the Industrial Revolution.

These developments appear to be relatable to the analytical approach to the study of the world, associated with interest in the internal structures and working of things, which characterized 'Western' thinking. Things were very different in China and Japan, where nothing akin to what would today be regarded as geological maps appeared until the introduction of Western geoscience, towards the end of the nineteenth century. In China, information about the Earth's interior (e.g. in mines) appears to have been transmitted orally, which would account for the primitive state of mining in the East, well into the nineteenth century. Thus the different epistemic approaches to Nature of the Eastern and Western cultures had a significant impact on the development of geoscience and on technological development also. These differences were manifest in the histories of geomapping in the cultures of East and West.

The paper will be illustrated by examples of maps used to support the preceding argument.

"THE GEOLOGIST'S HAMMER – TOOL, EQUIPMENT, INSTRUMENT AND/OR BADGE?"

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Proposals for classification, in historical and theoretical research, concerning the large number of instruments and their use distinguish their very different functions. These include: exploration of phenomena, isolation (constructional instruments), production of such as cannot be observed with the natural senses, demonstration for purposes of learning, imitation ('mimetic'), representation, enumeration and storage (instruments of registration), routine measurements, and games and entertainment.

The functions that accrue to the geologist's hammer at different times and in different places form the research topic of this paper. Although the geologist's hammer is certainly not one of the most important instruments of geology, it has long exerted a particular magic power, and today it is still used as a logo by the scientific geological associations.

Like almost no other tool, the hammer is to be found in all areas of manual work in the early modern period. The precursor of the geologist's hammer is the mountaineer's hammer, from which the newly constructed geologist's hammer was already distinct at the end of the 18th century, when its form was being perfected.

Every use of a particular instrument has its own history. My thesis is that the acceptance in the community and in practice correlates with the importance that is attributed to the instrument in a particular context and epistemic valency. This relationship of acceptance and the special function of an instrument will be pursued through changes in geology. For instance, it should be asked whether the role of fieldwork as one of the constitutive elements in early geology and its practice is not related to the introduction of the hammer as a piece of equipment in the field, whilst its long-term devaluation to the arsenal of the collector belongs to the area of professionalization and to an increase in the importance of theoretical questions in geology.

MEASURING THE INACCESSIBLE EARTH: DEEP TIME AND UNREACHABLE SPACES

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The usual problems of measurement and its meaning are complicated and magnified when the object of study is in principle and in fact inaccessible. When a phenomenon occurred long ago or when a phenomenon is occurring in a place where our instruments cannot reach, what can the relation between the instrument, its reading, and the phenomenon be? How can we think of bridging such a temporal or spatial divide? This paper addresses these questions based on the related investigations of Earth's paleomagnetic history and of electromagnetic processes at Earth's core-mantle boundary in the mid-20th century. The main characters in this discussion are University of Cambridge geophysicists Keith Runcorn and Teddy Bullard.

"A BURSTING LANDSCAPE IN THE MIDDLE OF PORTUGAL: THEORIES AND EXPERIMENTS BY GEORGES ZBYSZEWSKI (1909–1999)"

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This paper aims at analysing the circumstances in which the geologist Georges Zbyszewski (1909-1999) published work on geological models he constructed and tested in order to choose between rival hypotheses on the origin of the "typhonic valley", a geological structure in the centre of Portugal.

In 1946, the *Companhia de Sais de Potássio Lda*, a Portuguese company that was interested in the exploitation of rock salt and potash salts, carried out a geophysical survey accompanied by some probing in the region around Caldas da Rainha, a village situated in central Portugal. The Service for Mining Prospecting (SMP), a Portuguese public institution in charge of the reconnaissance and research of mining resources, carried out both the geophysical survey and the probes. Georges Zbyszewski, a French geologist that worked for the Portuguese Geological Survey (PGS), was in charge of supervising the work and doing the geological mapping of the region. This fact became quite important in Zbyszewski future geological research, as he decided to change the topic of his PhD – the study of quaternary formations – to focus instead on the geology of the Caldas da Rainha region.

The region is known as a "typhonic valley", an expression applied to certain specific tectonic structures somehow related to diapiric phenomena. In Caldas da Rainha, the "typhonic valley" is limited by a series of faults and the rock formations that constitute the bottom of the valley have been lifted up, "bursting" over more recent formations. It is the special tectonics of the "typhonic valley", namely, its origin and association with salt formations, that Zbyszewski intended to clarify with his study. He carried out some experimental work by using devices which he described, explained, and interpreted in two papers released in 1947, and in his PhD dissertation published in 1959.

In 1947, Zbyszewski conducted several experiments using materials such as kaolin, gypsum, water-saturated sediment, or even paper sheets, to build up models that simulated different geological conditions corresponding to different hypotheses explaining the mechanism from which the "typhonic valley" originated. Each material corresponded to a different geological formation and all models were tested in accordance with the geological conditions postulated by each hypothesis. Zbyszewski describes all the procedures and the results obtained, accompanying the description either with photographs or sketches. When applying the results obtained in the experiments to the region of the "typhonic valley", Zbyszewski was able to reach a conclusion and decide for one of the hypothesis, explaining in this way a geological structure that had been puzzling Portuguese geologists for so long. All the evidence points to the fact that Zbyszewski was the first geologist in Portugal to publish on the use of analogue geological models in order to compare the results obtained with fieldwork data and decide between several different hypothesis.

TIME MACHINES: MODEL EXPERIMENTS IN GEOLOGY

„The whole surface of the earth seemd changed - melting and flowing under my eyes."
(H.G. Wells: *The Time Traveller*, 1895)

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I want to look at one very peculiar geological instrument: dynamical models to simulate mountain folding. Introduced in the early 19th century, mimetic experiments in the form of boxes filled with clay or other pliable material became a means for making geology an experimental science. By pushing together miniaturized strata, scientists like Stanislas Meunier, Henry Cadell or Hans Cloos hope to acquire knowledge about the the genesis of geological structures and the fundamental laws of folding. Such instruments can be understood as time machines in a literary sense: they rendered processes visible that would otherwise be completely unaccessible to the geologist. By drawing, photographing and filming the experiments, it was possible to produce time-lapse images of movements that take up millions of years on the grand scale and are therefore far beyond the reach of human perception. In my talk, I want to investigate how such experiments were conducted, which questions they were supposed to answer and which objections were raised against them.

UNDER THE SPELL OF THE PHOTOGRAPHIC CAMERA: A CASE-STUDY OF THE USE OF PHOTOGRAPHY IN NINETEENTH-CENTURY PALAEONTOLOGY

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This paper focuses on the use of photography in palaeontology, in the second half of the nineteenth century. The interpretation of fossils is not always straightforward, especially the ichnofossils which are merely traces resulting from the behavioural activity of animals (tracks, trails, footprints, burrows, etc.). In specialised publications, images of fossils replace direct observation and are key elements in conveying information and base interpretation. The second half of the nineteenth century saw the transition from drawings to a mechanical process of producing images - photography.

In the 1880s, a controversy on the origin of 'Bilobites' (*Cruziana*) - fossils which are presently known as resulting from the activity of Trilobites, the most ancient Class of arthropods inhabiting the Palaeozoic seas -divided the international scientific community, but three experts emerged as the main protagonists: the Portuguese geologist Nery Delgado (1835-1908, the Swedish palaeobotanist Alfred Nathorst (1850-1921), and the French Marquis of Saporta (1823-1895). The approaches used by these naturalists differed fundamentally and led to different conclusions, but the use of photography vs. drawing emerges as an important element in the discussion.

Unlike Saporta for whom drawing was part of his working method, both Nathorst and Delgado preferred photography to ensure objective representations. However, the objects they photographed in the context of this discussion had a distinct nature: Delgado, who believed *Cruziana* were fossil algae, pictured fossil samples, while Nathorst photographed simulacra obtained from experiments, as he believed that *Cruziana* resulted from the activity of marine crustaceans.

In the case of Delgado, for whom seeing, observing and describing were fundamental, the process of printing his photographs of fossils became also relevant. Joseph Leipold (1833-1916), a disciple of the Viennese Paul Pretsch (1803-1873), inventor of photoelectrotypia, worked most of his life in Lisbon and printed Delgado's exceptionally accurate images. The quality of these prints led the French botanist Edouard Bureau (1830-1918) to rank them among the most beautiful ever produced by photography in publications devoted to natural history. In this way, aesthetic considerations added to the power ascribed to photography in representing objectively natural objects, despite the fact that Delgado's interpretation came to be rejected by the scientific community in favour of Nathorst's.

Regular Sessions

Regular session T02
Classical and Oriental Antiquity

A PREHISTORIC GNOMON

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A paper by N. Kameswara Rao (2005) on prehistoric observational astronomy in India refers to Harappan (around 2000 BC) brick platform about 11 feet in diameter, which has five concentric rings of burnt bricks set on edge and one brick in thickness. At the centre is a wooden object embedded in a socket, projecting above the platform.

He notes that the layout of the rings is similar to sundials seen in later years. The shadow of this central wooden peg would vary in length from a minimum at noon to a maximum at sunrise and sunset crossing the five rings in succession during the day. This length of the shadow is thus a measure of the passage of time. The ranges help to graduate the time. Explicitly, this indicates that a ring structure is a gnomon, one of the earliest instruments to find the time of day.

We follow up Kameswara Rao's suggestion by calculating the exact paths of the tip of the gnomon shadow, and the times it crosses the five rings.

The Pancasiddhantika also gives the exact trigonometric formulae for the gnomon shadow for the first time. This was later transmitted to Arabic astronomy.

ACCOUNTS OF LIVING AND DYING IN ARISTOTLE'S *DE LONG.* AND *DE JUV.*

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The subject matter of the collection of small Aristotelian works handed down in the *Parva Naturalia* (*PN*) is announced, in the opening lines of *De Sensu*, as those characteristics of living things that are "common to body and soul." Many of the topics treated in the first part of the collection touch on phenomena that arise from the faculty of perception (including sensation itself, waking, sleeping, dreaming, etc.), but those treated in the final two works, *On the Length and Shortness of Life (De Long.)* and *On Youth and Old Age, Life and Death, and Respiration (De Juv.)*, have a markedly more "physiological" or "biological" character. These two final treatises consider the causes of the length and shortness of life, both within and across species, as well as the primary causes of life and, especially, death in all living things. The doctrines presented in these treatises exerted a profound influence on the history of medicine and the life sciences, figuring prominently in the theories of important figures from Galen to Harvey and beyond.

One might wonder why these two works, although traditionally grouped together, are separated at all. Why not treat the causes of life and death and the causes of the length of life in the same treatise? Is it not reasonable to think that whatever causes something to have a relatively longer lifespan would be somehow importantly related to what causes that thing to live at all? Or, put another way, is it not reasonable to suppose that something that lives relatively longer would do so by being somehow more resistant to whatever brings about its death? So understood, a complete explanation of the length of life would seem to entail an explanation of life and death in general, such that the latter might reasonably appear before the former. However, this is not the order in which we find the works in *PN*, and, based on references within the two particular works, it appears not to be the order in which Aristotle intended the discussion to proceed.

Further, it is not immediately clear whether there is a consistent doctrine or theory regarding life and death that emerges from the two works. While *De Long.* emphasizes the importance of both the hot and the wet for the maintenance and preservation of life, *De Juv.* focuses almost exclusively on the hot. Indeed, the long discussion of respiration in *De Juv.* is addressed primarily towards the preservation of the natural heat present in all living things. In addition, while *De Long.* identifies the presence and action of contraries as being responsible for the destruction of living things, *De Juv*. characterizes such destruction by contraries as "violent" and somehow "unnatural," and thus a topic of secondary importance compared to the discussion of "natural" death, regarding which *De Juv.* focuses.

In this paper I address these questions by comparing the discussions of life and death in *De Long.* and *De Juv.* I hope to show that the doctrines presented in the two works are consistent with one another, and that their differences lie in what might be characterized as their different levels of explanation. *De Long.* introduces the hot and the wet as two principles that are somehow causally responsible for preserving and maintaining life, such that their absence brings about death, and the degree of their presence, both in quality and quantity, brings about longer life. But how these two principles function to cause life, or how their absence brings about death, is not discussed. These topics are saved for the more general discussion of life and death in *De Juv.* Although *De Juv.* primarily focus on the importance of natural heat, it does touch upon the role of the wet in promoting life. In fact, the discussion in *De Juv.* makes it apparent why the hot is emphasized more than the wet, and why this emphasis would have been out of place in *De Long.*

THE INTERACTION OF MATHEMATICAL AND PHYSICAL ASTRONOMY IN ANTIQUITY: THE EARTH-SUN DISTANCE IN PTOLEMY'S ASTRONOMY AND COSMOLOGY

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It is a common thesis of historians of science that, in Antiquity, mathematical astronomy and cosmology were two different sciences. Even if the same person worked on both sciences, he distinguished clearly between them. Cosmology (or physical astronomy) might take data from mathematical astronomy, but the influence could not run the other way. In the case of Ptolemy, we find his mathematical astronomy in the Almagest and his cosmology or physical astronomy in his Planetary Hypotheses. In this talk I will try to show that, in the calculation of the Earth-Sun distance presented in the Almagest – a calculation that clearly belongs to mathematical astronomy – Ptolemy used cosmological methods and physical hypotheses, even if he did not say so, and thus that he crossed the supposedly unbridgeable gap between these two sciences. I will argue that, even if Ptolemy accepted the methodological distinction between them, he allowed bidirectional influences in his everyday scientific work.

Planetary models as expounded by Nīlakaṇṭha **in his** *Āryabhaṭīya-bhāṣya*

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Since the burgeoning of the human intellect, astronomers of different civilizations being fascinated by some of the celestial phenomena such as the variation in the brightness of the planets, their change in the angular velocities as well as retrograde motion, came up with different models that could satisfactorily explain them. As far as Indian astronomical tradition goes, a clear mathematical description of two planetary models, namely the eccentric and epicycle models, is to be found in the *Āryabhaṭīya* of Āryabhaṭa composed in 499 AD. By virtue of being very terse in nature, several commentaries have been authored on it and one of the most brilliant expositions is the *Āryabhaṭīyabhāṣya* (also known as *Mahābhāṣya*), of Nīlakaṇṭha Somayājī, (c.1444–1545 AD) a celebrated astronomer and mathematician belonging to Kerala. It is a prodigious commentary, which among several other things, also presents a detailed discussion on planetary models.

Āryabhaṭa towards the end of the *kālakriyāpāda*—the third chapter of his monumental treatise *Āryabhaṭīya*—gives a succinct account of planetary models in about five verses. Nīlakaṇṭha's, commentary on these verses runs to several pages. Starting with a discussion on eccentric model, Nīlakaṇṭha explains the *mandakarma*, which is essentially the same as the 'equation of centre' correction in modern astronomy. In the process he also explains how to obtain the hypotenuse (*mandakarṇa*), that gives the distance between the planet and the centre of the *kakṣyāmaṇḍala* (deferent circle). He then proceeds to elaborately discuss on the epicycle model along with the reason for introducing it. A graphic description of how to draw sketches on the ground, for a geometrical representation of these models is quite absorbing. Such descriptions provide a clear evidence to the fact that there had been a practice of drawing sketches to explain the principles involved in the computational procedure. In both the eccentric and epicycle models, Nīlakaṇṭha discusses how to compute the iterated hypotenuse *aviśiṣṭa-karṇa*. Another interesting feature that is noteworthy is the recommendation to construct circles using bamboo sticks for drawing various geometrical sketches. A detailed procedure for obtaining the mean position from the true is also discussed. Nīlakaṇṭha, then explains how the other correction namely the *śīghrakarma*—which is the equivalent of heliocentric to geocentric transformation—can be understood using these two models. The present paper aims to discuss this section of the commentary, with several illustrations and in a language that is palatable to a modern reader.

Computation of Lunar Eclipses in Indian Astronomy

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Among the multitude of celestial objects that we observe in the sky, the sun and the moon play a key role in governing our daily life as their motion around the Earth forms the very basis of division of time such as year, seasons, months, etc. As these two objects keep moving around the earth—as observed by observers on the earth—it may so happen that one of them may get obscured by the other, i.e., enter into the shadow cast by other. Consequently, they slowly disappear, either partially or fully as the case may be, from the observer's view and then reappear after sometime. This phenomenon of obscuration of the sun or the moon for a small period of time is referred to as an eclipse. If the sun gets obscured by the moon, it is said to be a solar eclipse. The obscuration of the moon by the Earth's shadow is called a lunar eclipse.

Though references to such events can be found even in the Vedic literature, systematic procedures for their computation are to be found in the texts composed from much later. The text *Āryabhatīya* composed in 499 AD, besides succinctly describing what an eclipse is, also presents algorithms for the computation of solar and lunar eclipses. Even the *Vaśiṣṭha* and *Romaka Siddhānta* that form a part of the text *Pañcasiddhāntikā*—which is supposed to be a compilation of the five schools of astronomy that was prevalent around the time—of Varāhamihira (c. 505 AD), give algorithm for the prediction of eclipses.

During our presentation, besides highlighting the algorithm given in Indian astronomical texts for the calculation of eclipses, we will illustrate the computation of the lunar eclipse according to the procedures deliniated in the Indian texts with numerical examples. This would enable us to analyse the accuracy and optimality of the algorithms presented in these texts by comparing the results with the modern astronomical calculations. For this purpose we plan to choose two texts, namely *Khaṇḍakhādyaka* of Brahmagupta composed in 7th century and *Tantrasaṅgraha* of Nilakaṇṭha composed in 1500 AD. The choice of these texts is based on the following considerations: (i) these texts have been composed eight centuries apart (ii) the former is a *karaṇa* text while the latter is a *siddhānta* text and (iii) the latter includes some improvised procedures for the computation of distance of separation between the earth and the moon called *dvitīya-sphuṭayojana-karṇa* etc. It would perhaps enable us to make an assessment of how the astronomers tried to improve the accuracy of calculation over centuries both by the revision of theoretical tools employed as well as analysis of the data obtained from prolonged observations and thereby revision of parameters involved in the computational scheme.

EARLY GREEK MATHEMATICS AND THALES GEOMERTY: A PLAUSIBLE REINSTATEMENT

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The ancient sources saved, (much) posterior and (very) excursive thought they may be, consider Thales of Miletus (6th century B.C.) as the first Greek to provide proof of geometrical theorems. The most part of the newer historiography of mathematics agrees with these sources. Nevertheless, some researchers, be it occasionally or systematically, have negated the credibility of the ancient sources and consider the contribution of Thales to ancient geometry as myth or fabrication of the ancient sources.

So far, the lack of sufficient ancient sources on Thales has been the greatest obstacle in the research on his contribution to Greek geometry, whether carried out by its deniers or by supporters. However, the sufficiency of sources cannot serve as an excuse or argument to any of the two sides, as this is a permanent and fundamental issue in the history of science. The issue of credibility of the ancient sources on Thales needs to be posed again and researched using new means.

Therefore, we will initially point out the credibility problems of certain ancient sources on Thales (Diogenes Laërtius, Plutarch) and we will insist on I) the critical analysis of the credibility of the basic ancient source on Thales, i.e. the *Commentary* of Proclus on the first book of the Euclidean *Elements*, which are based on information from the work of Eudemus of Rhodes *History of Geometry* II) the central position of the pre-Euclidean proof saved in Aristotle on the equality of the angles at the basis of the isosceles triangle. The aforementioned analysis will allow us to suggest the (reasonable) foundations, as well as the (reasonable) limitations of the geometry of Thales: though it was (possibly) founded on the knowledge of the Egyptians – Babylonians, and did introduce some kind of proof in the research of geometry, it failed to overcome the problem of parallels and measurement of the angles, later solved by the research carried out by the Pythagoreans.

SUSRUTA:THE SAGE SURGEON OF ANCIENT INDIA & HIS SURGICAL INSTRUMENTS

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The Golden Age of Surgery in ancient India rests largely on the accomplishments of Sage –Surgeon Susruta, who lived sometime between 800 ands 600 B.C. Susruta practiced and taught the Art of surgery at the University of Benares in the ancient city of the same name, located on the banks of the river Ganges. His monumental treatise on Surgery, S*usruta Samhita* established him as the Father of Indian Surgery. He was the first surgeon to systematise surgery by dividing it into separate fields. He is known as the originator of cataract operation, laparotomy, and vesical lithotomy.. Susruta's *Samhita*, covered all the branches of medicine, including hygiene, midwifery, ophthalmology, toxicology, psychosomatic ailments and materiamedica.As a pioneer Surgeon, Susruta described and used 101 blunt instruments and 20 sharp instruments, several of which had an edge so fine that it could divide the hairs on the skin! The great highlight of Susruta's surgery was however, the operation of rhinoplasty. The making of a new nose captured the imagination of the medical world and brought him fame as the originator of plastic surgery.

The paper further enquires about the connection of Ancient Indian medical especially the surgical system with the contemporary Greek and Arabic systems of medicine which were in vogue during that remote era.

GREEK PARADOXOGRAPHY: THE BEGINNING OF POPULAR SCIENCE IN THE HELLENISTIC WORLD, BETWEEN ENTERTAINMENT AND SOCIAL PRESTIGE

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Ancient Greek culture is defined by a special sensitivity for every aspect in the surrounding reality that could be considered « astonishing » or « extraordinary», that reaches its highest point during the Hellenistic period, with the emergence of the lists of strange news regarding natural science known as paradoxographic literature.

Using the word « paradoxography », thus, we call a specific literary genre that was born precisely at this moment, and that consists in lists of curiosities compiled quoting history or natural science texts, mostly produced by Aristotle's school.

Paradoxographic literature is clearly the result of coincidence at the same time of three main factors: the development of peripatetic science, the foundation of great libraries, the most famous of whom is the library of Alexandria, and the news about the strange nature of far countries brought to the Greeks by the followers of Alexander the Great in his campaigns to Orient. Every one of this factors leaved its trace on the catalogues of curiosities. The genre's origin is, thus, clear, but not its function inside the Hellenistic society.

Scholars agree about the little literary quality of paradoxographic works, as well as the lack of originality and scientific depth of its contents. It is, however, necessary to highlight the importance of paradoxographic literature as a testimony of the way how Hellenistic science reached the large public, as a sort of what now-today we call "popular science". Arises, then, the question about the reading public to which this kind of literature could be directed, in a social and cultural environment where the production of books was expensive, and just a few could afford such a luxury article.

The answer probably has to be searched in the symposial custom, an institution half way political and social during the Archaic and Classical periods, but that had to renounce to any political character when the arrival to power of the ptolemaic kings instituted an autocratical regime in the Greek world, absolutely different to the city-state system of former periods, when democracy allowed political discussion. Science, in its lightest, playful variety, seems to have been the alternative to politics among symposial meetings, and seems as well to have been considered as a sign of distinction and social prestige among the wealthy people at the moment.

THE THREE- AND FOUR-LINES LOCUS IN APOLLONIUS'S *CONICA*: GEOMETRY AND ALGEBRA

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In his introductory letter to Book I of the *Conica*, in which he gives, inter alia, a description of the contents oh his treatise, Apollonius extols the novelty, uniqueness, and merits of Book III, dealing with the synthesis of solid loci and diorismi relating to them, boasting therewith about his being the first to solve completely, unlike Euclid, whom he mentions by name, the problem of the three- and four-line locus. There is no other place in the entire treatise where the three- and four-line locus is ever mentioned or its **explicit** solution provided. This seems strange. What is a likely explanation of this odd behavior?

It is the claim of this paper that what seems to us strange in this matter is quite understandable and normal when considering the differences between Greek and modern mathematics, the synthetic geometric style of the *Conica* and the modern analytic style of post-Cartesian mathematics, and, specifically, the different conceptions of geometric loci in the *Conica* and *La géométrie*, say.

For the Greeks, and for Apollonius in particular, loci are places, *topoi*, on previously defined curves that have the property designated by the locus. The formerly defined curve has, in addition to its definitional properties, its *ousia*, other properties defining the locus. It is, as a rule, not the locus that generates the curve for the Greeks, but rather the otherwise generated curve that displays the locus, which is secondary to the curve's generation. Loci, in other words, are not, as a rule, generative of curves, in Hellenistic mathematics, they are only expressive, manifestative, demonstrative, epiphanic of hidden properties, not always obvious among the essential properties of otherwise generated curves.

This is indeed the case with the three- and four-line locus, which is **derivable** from propositions III.54-56 of the *Conica*, a derivation which Apollonius never deemed worthy of disentanglement.

Such a "neglect" is consistent with his viewing the vaunted locus as a mere byproduct, a consequence, an aftermath of the claims proven in the last three propositions of Book III.

This approach differs fundamentally from the modern approach, which traces a curve (locus) by points and sees the curve and its equation as interchangeable, giving priority to the latter. Whatever we know about loci from ancient literature, including Pappus's *Collection*, and the information it provides about Euclid and his elder contemporary, Aristaeus, both of whom wrote, reportedly, now lost books on loci (*Surface Loci* and *Solid Loci*, respectively), as well as Apollonius's own lost *Plane Loci*, is consistent with the above characterization. Thus, when Pappus says in Book VII of the *Collection*, "If from any point straight lines be drawn to meet at given angles five straight lines given in position, and the ratio be given between the volume of the rectangular parallelepiped contained by three of them to the volume of the rectangular parallelepiped contained by the remaining two and a given straight line, the point will lie on a curve given in position," it is striking, indeed, that the point in question lies on a curve given already ahead of time in a certain place, i.e., given in position. The curve, which is, by the way, a conic section, and the five given lines, precede conceptually the point from which the five lines at arbitrary angles are drawn, and, it so happens that that point lies on the conic section.

lthough this is a rigorous mathematical world, it is another world than the analytical one of post-Cartesian mathematics, in which loci are given by equations, and moving points fulfilling given conditions describe them.

ANALYSIS AND DISCOVERY: THE BABYLONIAN MATHEMATICS IN THE LIGHT OF THE EUCLIDEAN *DATA*

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When interpreting mathematical documents from archaic civilizations, we risk distorting their original meaning by using the theoretical language and methodology of modernity. Sometimes, it's our own view that prevents us from seeing clearly, since we observe and judge the mathematical expressions by applying optics already consolidated and alien to the investigated context. It is difficult to escape this tendency when most of a mathematical text is unknown: authorship, origin, dating, and environment in which it was drafted. And, above all, in case that document neither includes deductions nor explanations that justify the use of a particular strategy or reasoning.

From the Old Babylonian culture, we retain a lot of mathematical texts recorded on clay tablets and written in cuneiform. Most of them are school exercises where only the statement and a series of calculations leading to the final solution appear. The set of operations carried out is similar to an algorithm or formula, but this is not expressed in a general way but by means of numbers and specific amounts.

The algebraic language has been very useful in clarifying these exercises, but that does not mean that Mesopotamian mathematicians had an analogous tool for solving them. So many similarities we believe to have found between these algorithms and those described by medieval algebraists that Babylonian texts are often reinterpreted according to the formalism of modern algebra. However, what matters is not to confirm the insightfulness of Babylonian mathematicians, but to understand their techniques and procedures.

In this paper, we will consider a problem text of geometric content from Old Babylonian Period. We will trace the footsteps of the scribe to reach the solution proposed, without introducing alien elements to his culture and era. Once the mystery is unveiled, we will make a retrospective study of it, in light of what the ancient Greek thinkers used to call *analytical method*, in its two shapes: the one proposed by Euclid in his *Data*, and the one proposed by Pappus of Alexandria centuries later, in *his Mathematical Collection*. We try here to find out whether the strategy applied in this problem could be the origin of the Euclidean methodology. If this were the case, we could have managed to clarify two things. First, there are two different uses of analysis which condition the modern interpretation of some Mesopotamian mathematical texts: from a reading Pappus connects directly with Vieta and algebraic analysis; if we chose instead the *Data* as a research model, the controversy about this supposed algebraic nature of the exercises disappears. Second, we will have succeeded in catching the real meaning of the heuristic Babylonian mathematics.

INDIAN ASTRONOMY AND INSCRIPTIONS

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The literary sources of mathematical astronomy in India from the 5th cent. A.D. to the 19th century are quite extensive. They deal mainly with planetary, motions, determination of direction, space and time; eclipses; conjunction of planets; zodiacal star groups and instruments. While these have been studied by scholars, both Indian and foreign, little or no attention has been paid till now to the Indian inscriptional sources which are large in number – about 90,000 catalogued ones, and almost an equal number of the uncatalogued ones.

The author recently initiated studies in this direction and so far about 8,000 inscriptions have been examined. Records of nearly 400 eclipses – lunar, solar, total, partial or annular – have been found in them, with dates of their occurrences. These dates have been found to be accurate by the modern ephemeris method of verifying the past eclipses. In the case of a few other eclipses, there are dates on which grants or gifts were made by the Kings either to commemorate or propitiate the phenomena of eclipses. It is estimated that the Indian inscriptions might provide a record of about 2000 eclipses from early times to the 18th cent.

Some inscriptions speak of the prediction of an eclipse by an astronomer, as well as the lineage of astronomers. The dates of solar ingress into zodiacal sign have also been recorded in a large number of inscriptions. The occurrence of eclipses and the solar ingresses were regarded, then as now, as special occasions for religious and other rites. The paper discusses these and allied aspects along with their social nuances.

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VIEW ON THE CLASSIFICATION OF ANIMALS BY AL-JAHIZ (776-868)

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In the History of Natural Sciences in the Medieval Arab Sciences, a great scholar of the ninth century , famous for its qualities as a man of letters, as a theologian, looks at the living world, and devotes a considerable volume between other literary and theological considerations, to the animal world, the Al-Kitab Hayawân [Book of Animals].

Voluminous work, full of observations, descriptions of animal behavior, inspired by Persian culture, Hindu, Arabic, pre-Islamic and Greek with essentially Aristotle and his naturalist works translated into Arabic; this book tells us about the philosophical concerns of our author, his curiosity, his desire to explain, analyze this wonderful world of the living beings that fascinates with its diversity, and the various properties or characteristics of these animals.

We look at a few selected passages of this book, the attempt of classification of animals made by Al-Jahiz: his methods of classification (morphology, mode of transport, environment, food, etc..), Its methodology, both scientifical and filled by his literary style very special combining observations, logical reasoning and irony, poetry; the role or the possible influence of his classification on the zoological sciences of his time and in the History of Natural Sciences.

THE CORRELATION BETWEEN LOCAL CULTURE & PUBLIC SPACES ALONG THE HISTORY OF ISLAMIC CITIES(CASE STUDY, LOFT PORT, QESHM ISLAND)

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Public Activity is the main consideration which can give soul and life to an urban context. In Islamic countries, home is the society for women and the main spatial urban context is defined just for men; especially in traditional Islamic cities, such as Loft Port which has been selected as the case study of this research project. In the old context of this ancient port there are two main squares which defined as quarter centers of the community and also as public spaces which work daily for the local inhabitants. In these two squares the significant public activities of the local society have been considered, religious activities.

In this traditional context just a public activity and a public place have been introduced to the local society: religious activities and mosques as the spaces dedicated to such an activity. In Sunni Islam, women are not being able to attend mosques as a religious place; this is the main reason to make them inactive and sedentary. Our first undertaking throughout the organization of old context was to interview with the local habitants to find out how to invite women to be active as a member of the local society and feeling the built environment and enjoying the surrounding nature and beauty. The second step was to be more familiar with the local values to be respected throughout the renovation and rehabilitation process. And finally decision making occurred: suggestion of two main public spaces for local women considering what they really need and feel about the community and public activities. This process makes us be more sensitive about the gender issues in urban context which can make a group to be more effective in a regional colony.

Keywords :
Women, Gender issue, Public Spaces, Mosques, Sunni Islam, Qeshm Island, Loft Port.

THE EXPERIMENTAL AND INSTRUMENTAL CONTEXTS OF EARLY ARABIC OPTICS

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This paper addresses the experimental and instrumental context of early Arabic optics with reference to specific historical sources, and documents an early combination of instrumental and experimental components in an optical text that may be dated as far back as the third/ninth century. The presentation begins with an introductory section on the historical development of optics from the "mathematical" and "mixed mathematical-physical" science that it was since Greek antiquity, outlined with reference to the *Optics* of Euclid and Ptolemy (third/fourth c. BC, and second c. CE respectively), to the "experimental" science that it became during the Islamic and European Middle Ages, discussed with reference to the *Optics* of Ibn al-Haytham=Alhazen (fifth/eleventh. c. CE). The focus is on an early combination of instrumentation and experimentation, presented with examples, with reference to the *Optics* of Ahmad ibn 'Isa, an early Arabic text with a little known author and date, and particularly revealing conceptions and expressions related to the historical meaning and developments of some key concepts and methods. The discussion includes a set of samples from earlier Greek and later Arabic and Persian optical traditions to highlight relevant distinctions and document recent re-examinations.

TREES OF KNOWLEDGE: GENERIC TEMPLATES FOR AL-FARABI'S *ENUMERATION*

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The Enumeration of the Sciences by Al-Farabi (d.950, Damascus) is a text that has bewildered historians due to its presentation – previously unattested in the Arabic tradition – as much as the original classification it contains. I argue that comparison with better-known genres of the period can yield alternative readings of a perplexing work. There are many genres that Al-Farabi could be drawing on, from classical, late-antique or earlier Arabic traditions, but here I focus on just one: tree diagrams. Although these are not used in the *Enumeration*, Farabi's prose reads like such a structure, with his numbering of each part of each science, and each part of each part. Tree diagrams were a common pedagogical tool from Late Antiquity, and Farabi was certainly familiar with texts containing them, for example the abridgments of Galen that were made for medical students. Given the *Enumeration*'s self-confessed pedagogical agenda, these diagrams seem a natural genre for comparison despite difference in content: my argument rests on the fact that generic elements may be employed in texts varying in purpose or content. In addition to exploring an obscure medieval text and its predecessors, I ask questions about allusion, textual interpretation and the transmission and reception of knowledge, offering genre theory as a tool of overcoming the historiographical problems associated with understanding medieval philosophical texts.

COMBINATORIAL PROBLEMS ON CHESSBOARD FROM 11th CENTURY IRAN

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The following table is taken from the manuscript of an Arabic treatise on chess (*Kitab al-shatranj*) extant in Istanbul. It is the solution of a problem in which we want to start from a corner (right-down here), make alternately horse move (L-shaped as today) and elephant move (two slant steps, not as many steps in modern rule), so that all the squares are swept without repetition.

49	42	40	51	9	34	36	11
47	52	54	45	39	12	14	33
41	50	48	43	37	10	8	35
55	44	46	53	15	32	38	13
61	22	16	63	5	26	28	7
19	56	58	21	31	64	2	25
17	62	60	23	29	6	4	27
59	20	18	57	3	24	30	1

In the manuscript, the numbers are shown in alphanumeric *Abjad* system in which the Arabic alphabet letters are used to denote numbers. Then the above solution is also given in an Arabic poem of 32 couplets (64 lines). Each line starts with two letters that provide the coordinates of the squares in the required order. The poem is from a certain Ali ibn Abi Abdullah al-Shirazi. Leonhardt Euler later studied the same mathematical enigma which belongs to combinatorial mathematics, and the problem therefore bears his name.

The manuscript is copied in the 12th century and contains materials from a chess expert named Sauli (died in mid 10th century), a famous Arab scholar whose ancestors were Turks coming from the south-eastern coast of the Caspian Sea. So the problem dates back to about 10 centuries ago. The manuscript has been published as facsimile by Prof. Fuat Sezgin in Frankfurt (1986) and contains several problems of the kind which I will discuss in this paper.

GHÂZÂN KHÂN'S INNOVATIONS OF THE ASTRONOMICAL INSTRUMENTS IN THE SECOND PERIOD OF SCIENTIFIC LIFE AT MARAGHA OBSERVATORY

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Ghāzān Khān, the seventh patron of the Mongol-Ilkhanid dynasty of Iran (r. 1295-1304), was no longer a savage ruler like his ancestors. As child, he was baptized as Christian, and instructed by Mongol Buddhist monks in his youth. Finally, he converted to Islam, and was trained in the social context of the powerful Islamic tradition, which little by little changed the savage Mongols into protectors of this wealthy heritage. His attempt of widespread political and social reforms in Iran, which had been devastated during seven decades of Mongol rule, makes him a different kind of patron. Besides politics, he was also a prominent artisan, and interested in theology, alchemy, medicine, botany, mineralogy, and astronomy.

It has been known that Ghāzān founded an observatory in Tabriz. Historical sources always claimed that he was an expert in astronomical instrumentation - a claim that up to now neither could be confirmed nor refused. However, a newly investigated anonymous treatise, originally dating to about 1300 and probably attributable to Shams-'l-Dīn al-Wābkanawī, titled *Ghāzān's Treatise on the Observational Instruments* and available in 2 copies dated 1683, describes in high detail "twelve new instruments, unknown to the ancients, invented by Ghāzān and built on his order in Maragha". The claim that these instruments represent a great innovation could be verified by comparison with other instrument treatises dated before and after this one.

As major innovation, these instruments consisted mostly of straight copper rules in explicit avoidance of error-prone circular parts. 10 of the 12 are described in conceptual pairs, in several cases with a simple version first, then a variant. Two pairs use fixed triangular and square frames with movable alidades. One pair uses long wires instead of heavy rules. Other instruments use movable chord rules. Some of the instruments were huge, and appear to have been barely movable due to their weight, but others appear quite elegant and definitely require attention as important milestone of astronomical instrumentation in a line of Ptolemy, al-'Urḍī (Maragha, 13th ct.), Ulugh Beg (Samarkand, 15th ct.), or Tycho Brahe (Denmark, 16th ct.).

In our paper, we have not only translated the text, but also rebuilt all instruments in three-dimensional space using *virtual reconstructions*, so that the functionality of the instruments could be tested at least in virtual space. Several inconsistencies and apparent scribal errors have been identified during this reconstruction.

Two instruments appear especially remarkable with respect to later European developments: The square frame with movable diopter is practically equal to Peuerbach's *Quadratum Geometricum* (ca. 1460), while a pinhole projection device for observation of the magnitude of solar eclipses precedes the hitherto known earliest description by Levi ben Gerson (1288-1344) by at least two decades. The way of probable knowledge transfer in both cases is however currently unclear.

A Comparison between the Optical Doctrines of Ibn al-Haytham (Alhazen) and Ibn Sīnā (Avicenna) by Kamāl al-Dīn al-Fārisī

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Kamāl al-Dīn al-Fārisī (665/1267 - 718/1319) is an eminent mathematician and physician of 14th century A.D. His most impressive work is *Tanqīḥ al-Manāẓir*, a commentary on the optics of Ibn al-Haytham or Alhazen (354/965 - 430/1039) on the advice of his teacher Quṭb al-Dīn al-Shīrāzī (634/1236 - 710/1311) who was himself writing a commentary on works of Avicenna (370/981 - 428/1037) at the time. When al-Fārisī completed *Tanqīḥ al-Manāẓir* another master of his, Jamāl al-Dīn Ṣā'id al-Turkistānī (contemporary with al-Shīrāzī) recommended him to write a pedagogical book on optics for the students. Al-Fārisī named this new book: *(Kitāb) al-Baṣā'ir fī 'Ilm al-Manāẓir* which was finished on 708/1309 ten years before his death. This book is one of the most profound and detailed optical works of the time, and contains accurate critiques and effective definitions and rules of optics.

This article is based on my edition and translation of a part of the book so far unstudied, a part that contains a brief summary of the optical doctrines of Avicenna and Alhazen on the quality of Light, Shadow, Color, Transparency, Opacity…, and shaped by the author in a such manner that it could be studied as a comparison between the two main schools of optics before the modern period.

TRACES OF MATHEMATICAL HISTORIGRAPHY IN ISLAMIC MATHEMAICAL WORKS

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History of science was not of proper important in Islamic historiography. On the other hand, Muslim scholars were not bound to mention references and citations at most. Meanwhile, there are important exceptions such as mathematical and astronomical works of Bīrūnī, Khayyām and Tūsī. Regarding numerous citations from previous works, their works are of most important sources of the history of mathematics. This article is to highlight methods of citation of these three scholars, and to show how this may help modern science historians.

TEXTS, INSTRUMENTS AND LEARNING IN THE 14th CENTURY MAGHRIB. THE SINE QUADRANT AS A DIDACTICAL RESOURCE

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The relation of *mīqāt* instruments with teaching in the *madrasas* in the 14th century Maghrib is the subject of this paper. Studying education and learning in al-Andalus is a topic with many headings. Among them is the pedagogical tradition that links the legacy of the classics with the Islamic world, as well as the formation and continuity of scientific research groups in al-Andalus, the travels to the East and, in particular for our aims, the significance of the demand for tools and resources (texts, instruments, tables) in the *madrasas*. *Maghribī* sources appears as deeply interesting material because the projection of the *andalusī* science and teaching in Maghrib up to the end of the 13th century. We seek to connect the higher demand for specialists of *mīqāt* in the East during the Mamluk period, the scholar travels, and the demand of *muwaqqits* and *muᶜaddils* in al-Andalus and Maghrib.

The sine quadrant (*al-rub^c al-mujayyab; al-rub^c al-jayb; al-jayb*) had a large use in the Islamic world because its simplicity as a practical device to teach basic elements of mathematics, trigonometry and *mīqāt.* The main collection of early texts on the sine quadrant is composed by at least three pieces (al-Khwārizmī, 9th century; al-Sijzī, 10th century; and al-Bīrūnī, 11th century). In the 13th century, Abū-l-Hasan ^{c}Alī al-Marrākushī wrote about this subject. In my doctoral thesis I have investigated for the first time the life and context of ^{c}Izz al-Dīn ^{c}Abd al-^{c}Azīz ibn Mas^{c}ūd, a chief Mālikite judge in Damacus and Fez in the second half of the 14th century, as well as his treatise on the sine quadrant, the largest work on this instrument known until now. Moreover at least eleven *muwaqqitūn* wrote short didactical texts about the sine quadrant during the Mamluk period in Egypt and Syria. The textual history of this instrument continues in the next centuries both in the Islamic world and in Europe.

Starting from some representative manuscripts devoted to the sine quadrant, I intent to show in this paper a map representing their geographical and diachronic diffusion. Furthermore, I will speak about how theoretical and practice information is selected and organized with didactical aims in some of the above mentioned manuscripts.

PREDICTION VIA NUMBERS AND LETTERS

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Fifteen Row Finder (Mustahsila), is the name of a method in Jafr by which one can find the answer of an asked question. At first, the letters of question are extended. Then after a fifteen stage procedure, a row of letters will be obtained. The resulted letters represent the words of the answer without any need to change the order. This method uses astrological rules in addition to occult properties of numbers and letters; for instance, the ascendant, time and date (according to Islamic lunar calendar) of asking question should be known for finding the answer. Apparently *Mudhakarāt Shādhān b. Bahṇr* of Abū Ma'shar (albumasar) is the oldest citation of this method. Later on, a similar method, called Zā'irja (different from astrological horoscope), became prevalent in Islamic societies.

Surveying the history of this method, this article is to analyze it from a mathematical point of view and try to find the answer of a known question using the method, on the basis of extant works.

A Comparative Study of Quṭb al-dīn Shīrāzī's Models on the Configuration of the Outer Planets

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Abstract: The astronomical works of Quṭb al-dīn Shīrāzī (1236-1311 C. E.) include two rich and lengthy texts in Arabic and one in Persian, none of which have been translated or studied extensively. As a member of the "Marāgha School," Shīrāzī and his theoretical work in astronomy belong to the tradition of the earlier astronomical work of his teacher Khwājeh Naṣīr al-Dīn Ṭūsī. A primary focus for these scientists was the conceptual inconsistencies between the models of the heavens as they appear in Ptolemy's Almagest and the Aristotelian ideals of celestial motion. Of Shīrāzī's texts in astronomy *Nihāyat al-idrāk fī dirāyat al-aflāk* (the limits of attainment in the understanding of the heavens) was written c. 680 A. H. and is the earliest of Shīrāzī's *hay'a* works. *Al-Tuhfat al-shāhīya fī 'ilm al-hay'a* (the royal present regarding the knowledge of the configuration of the heavens) and *Ikhtīyārāt-i Muzaffarī* (dedicated to a ruler in the Chopanid dynasty in Anatolia) are later works that are based largely on the *Nihāya* but which include revisions and changes. An example of these revisions appears in Shīrāzī's theoretical model for the outer planets. In the *Nihāya* these follow closely the models of Ṭūsī's *al-Tadhkira fī* *ilm al-hay'a.* Each of the two subsequent books listed above afforded Shīrāzī the opportunity to revise his models. As such a comparative study of these texts provides an account of how Shīrāzī's thinking with respect to his modeling work on the outer planets changed in time. In addition the comparison of the two Arabic texts with his *Ikhtīyārāt* should prove useful in understanding the nature of scientific texts of the period written in Shīrāzī's native language, Persian. This study is a textual comparison of Shīrāzī's respective chapters on the outer planets in the works cited above with a view to illustrating Shīrāzī's changing ideas in regards to his models and to clarifying how the choice of language affected the content of Shīrāzī's texts on *hay'a*.

PLANETARY MODEL OF QUTB AL-DIN SHIRAZI FOR SUPERIOR PLANETS

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Ibn al-Haytham (d. 1039 AD) in his "*al-Shukuk 'ala Batlamyus" (Doubts on Ptolemy),* mentioned some problems of Ptolemiac models. These problems were later taken up by 'Urdi (d. 1266 AD), usi (d. 1276 AD), Shirazi (d. 1311 AD) and Ibn al-Shatir (d. 1375 AD), among others. They have been referred to in the literature as the 'School of Maragha', mainly because of the association of the first three with the observatory built by the Ilkhinid monarch Hulago in the city of Maragha in northwest modern Iran in AD 1259.

The Maragha School astronomers not only produced original mathematical astronomy, but also left their imprint on later astronomical research, mainly in the Latin West, and may perhaps have laid the foundation for Copernican astronomy itself. (Saliba 1996)

The main problem of Ptolemaic model of the superior planets was about "equant point". It is a geometrical point relating to which the motion of the deferent sphere is uniform. But it cannot be real on the basis of Aristotle's philosophy on the motions of celestial spheres.

Astronomers of Maragha School devised some new models to avoid this problem, while they were in accordance with Ptolemy's observations. Qutb al-Din Shirazi has provided his own model for superior planets in his works: "*Nihayat al-idrak fi dirayat al-aflak*", "*al-Tuhfa al-Shahia*" in Arabic and "*Ikhtiarat-i Muzaffari*" in Persian. His model in *Ikhtiarat* has not been studied yet and is different from the one that Saliba (1979) and Kennedy (1966) has introduced

In this paper I introduce Qutb al-Din's model for superior planets provided in eighth chapter of the second book of "*Ikhtiarat-i Muzaffari*".

I will compare his model with his predecessors' models, Tusi and Urdi, and his criticism on them. Then I will explain Shirazi's own model and its details.

THE INTEGRATION OF PHILOSOPHY, LOGIC AND EXACT OBSERVATION, IN LABOUDY'S MEDICAL INVESTIGATIONS (1210-1263 AD)

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This report paper highlights the elaborated scientific thinking presented by the scholar *Yahia Ben Shams-ul-Dīn Mohammad Ben Abdan Ben Abdel-Wahed Al-Laboudy*, entitled *Al-Saheb* (the Companion) or *Najm-el-Dīn* (the star of the religion); born in Aleppo 1210 and died in Damascus 1263 AD. In one of his most fruitful and unique medical manuscripts, *Tahkik Al-Mabaheth Al-Tebbeya, Fi Tadkik Al-Masael Al-Khelafeya*, or "Checking Medical Studies, in Verifying Controversial Questions". The report overviews, as well, his origin, education and personal characteristics, as factors that influenced his thinking procedures; together with a full documentation for his multidisciplinary written works.

The report evaluates the integrity of his wise philosophy, simple logic, exact scientific observation and broad-minded comparison with others opinion's, in two main cases. The first deals with his investigation on the fetal heart embryogenesis; where he concluded precisely, within the limits of his time's knowledge, the sequence of embryogenesis of brain, heart, liver, and the umbilical cord in the human fetus. His findings preceded what modern science confirmed 800 years later.

The second case is his view on pain at the time of skin separation. He applied philosophy, scientific observation and logic together to prove that the pain is not directly related to skin cutting. A case that has been confirmed just in the 20th century, after the advancement in research techniques and understandings. Therefore, Laboudy's writings were not just simple "opinions", but a true basic methodology of scientific research procedures and thinking.

LINEAR ASTROLABE ACCORDING TO ITS INVENTOR

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Astrolabe is one of the oldest astronomical instruments and was in use by the astronomers from ancient times. This instrument was produced in three types: spherical, plane and linear. Though there is not exact information about its origin, the inventor of its linear type is known: Sharaf al-Dīn ūsī (1135-1213 A.H.). He was the great mathematician and astronomer of 12th and 13th century who is mostly well-known because of his innovations in the field of algebra. Sharaf al-Dīn very ingeniously invented an astrolabe which its accuracy could be simply increased by increasing its length: linear astrolabe. Because of its similarity to staff, the astronomers called it "ūsī's staff". He wrote two treatises on his astrolabe's construction and application, which they are extant.

This article is to describe the linear astrolabe according to these treatises.

A HISTORY OF PRECISE CALCULATIONS IN EXACT SCIENCES: ANCIENT AND MEDIEVAL TIMES

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Precise calculations made sense in the determination of irrational quantities, e.g. the Sine of 1 degree, š, etc. which they were used in applied mathematics and astronomy. Approximation of such quantities made considerable errors in calculations involved great numbers e.g. the determination of the dimensions of universe.

The main idea of this article is to investigate the contributions of the mathematicians and astronomers with approach to precise calculations, in ancient times and medieval Islamic period.

MUKANNA "MOON MAKER": DISCOVERER OF MERCURY TELESCOPE?

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There are no historical data on application of the concave mirrors and lenses in astronomy earlier than Galileo in 1609 despite of them thousands-years history. An astronomical knowledge about starry structure of Milky Way, mountainous landscape of the Moon and ring of Saturn from ancient manuscripts have same age too.

Discovery of historical documents and other examinations on invention of the telescope in early middle ages and in ancient time would be additional argument for benefit of Galileo's genius, which has made a telescope an important tool of astronomy.

The liquid mirror telescopes (LMT) which is an evenly rotating vessel with mercury have greatest chance to open in all times. Form of liquid mirror of LMT is parabolic and it's focal distance varies depending on velocity of rotation. These two properties could guarantee the invention of LMT to many inquisitive researchers.

Henry Skey built the first LMT working on water-driven turbine at 1872. However mercury telescope of Robert Wood is more known. Public demonstration of this small telescope in 1909 established at the bottom of a well has caused sensation. This sensation helps opens a secret of the legendary phenomenon of the "Mukanna moon" which were taking place in the ancient Central Asian city of Nakhshab at the end of the eighth century.

Al-Muqanna, the Veiled Prophet of Khorosan leader of anti Arabian revolt in the Middle Asia also known as moonmaker (Sazindah-mah, in Persian language). He made a great many proselytes at Nakhshab and Kash, draw people with the several miracles and particularly by causing appearance of a moon to rise out of a well at same time when the real Moon rise. The medieval historians reports about exceptional brightness of his moon "Nakhshab moon", it's synchronize with the real moon and about for afterwards founded at the bottom of the well a great bowl filled with mercury also.

Historians write about the scenario of its optical trick using of numerous pair of mirrors for creation of bright light round his head.

To the wide popularity of Mukanna's optical experiments testifies twilight rays named as Mukanna ray on the Syrian mountains (present Khirbet al-Mukanna in Israel) and the name of wadi al-Mukanna, where Mukanna has ostensibly stolen the Moon through of magic crevices also.

Comparison of information of historical documents, their scientific analysis and analysis of condition of the medieval science allows to interpret the Nakhshab well as a mercury telescope, and the Moon of Nakshab, as the telescopic image of the Moon.

STAIRWAY TO HEAVEN OR SULLAM-AL SAMA FROM JAMSHID KASHANI

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The meaning of treatise of Sullam al-Sama is the stairway or ladder of heaven, which is the name of the precious book of kashani, an eldest Iranian mathematician & astronomer.

A survey of Sullam al-Sama can be very important since this book has not been translated to Persian or any other foreign languages.

Ghiyath-al'Din-Jamshid-Mas'ud-al'Kashi,was born: about 1389 in Kashan, Iran and died on 22 June 1429 in ancient Persian city, Samarkand or Transoxania (now Uzbek). He is a Persian mathematician and astronomer who wrote his book in his mother tongue in Arabic**.** He was borne in Kashan city at around the center of Iran.

It is known that during his lifetime he witnessed three eclipses of the moon, the first being visible at Kāshān on 14 Ze'l-Hidja**,** or June 1406(808 H). Although**,** the details of Jamshid Kashani's life and his works are more known than many of the others in his period, but they are sketchy. One of the reasons is that he dated many of his works with the exact dates on which he has completed, and the other reason is that a number of letters which he wrote to his father have survived and provides fascinating information.

In this article we talk about one of his book that was finished in 1407/809 was his Risāla Kāmaliyya or Sullam al-samā which deals with the Size or Distances of the celestial bodies**.**

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THE HISTORY AND PROSPECT OF BANGLADESH TO INDIA NATURAL GAS PIPELINE PROJECT

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It has been widely recognized that natural resource rich developing countries often face political, economic, technological and marketing difficulties to utilize their own natural resources. This study explores such difficulties in the case of Bangladesh's natural gas marketing, focusing on the problems that the US-based gas and oil company Union Oil of California (later renamed as Unocal, and now as Chevron) encountered when it tried to build a pipeline in Bangladesh to transport natural gas to India. This case of Bangladesh's natural gas exploration and consumption may offer new insights into the utilization of natural resources in developing countries. It also looks at the political factors that often constrain and sometimes even prevent the implementation of a big project as the Unocal's Bangladesh to India pipeline project. In November 2001, Unocal submitted to the Bangladeshi government a formal proposal for building a pipeline. The project generated a wide public debate and speculation on Bangladesh's natural gas reserves as well as on the question of exporting gas. Although there was a great interest in the project, nationally and internationally, the government approval was, however, not and has not been forthcoming, and no pipeline has been built so far mostly due to political problems. This major pipeline project has naturally drawn considerable attention, but its history has not been fully told. This paper, firstly, outlines a brief history of Unocal's operations in Bangladeshi oil and gas exploration. Secondly, it explores the idea of a pipeline to India for exporting natural gas from Bangladesh. Thirdly, it examines the details of Unocal's natural gas pipeline proposal. Fourthly, it discusses the economic prospects of a Bangladesh-India pipeline and places it in its international context. By looking at the historical evolution of natural gas markets and various gas related projects around the world, it analyzes how economic and political factors affect the growth of natural gas markets. Fifthly, it defines the political issues associated with this pipeline project and the subject of gas export. Finally, it concludes with an assessment of what benefits Bangladesh may draw from such a pipeline.

PERCEPTIONS OF WESTERN TECHNO-SCIENTIFIC PROGRESS: KARIM KHAN MUSHTAQ JHAJJARI- A VISITOR TO BRITAIN (1840-41)

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Karim Khan Mushtaq Jhajjari an Indo-Muslim elite, who visited Britain in the mid-nineteenth century, evinced deep interest in the contemporary British technical developments and western scientific thought, especially astronomy. Karim Khan provided a lucid exposition of the modern astronomy from Copernicus' revolutionary idea of a revolving-earth to Newton's great synthesis of the physical world. Use of instruments especially the telescope, with which the traveller observed celestial objects at the Greenwich Royal Observatory, was thought to have revolutionised the entire study of astronomy. Furthermore, the Indian commentator also sought to elaborate upon Newton's classical theory of gravitational force without explicit mention of the scientist. Similarly Keplar's laws of planetary motion and Galileo's telescopic discoveries of moons of Jupiter and phases of Venus are described without mentioning the names of the scientists. Among the modern scientists it was only Copernicus whose views are described under the epithet of 'Copernicanism.' Of course, the Greek philosophers and their contribution were known. The celebrated Greek philosopher Claudius Ptolemy's conception of earth centred geo-centric universe was thought to have dominated the astronomical thought. Another Greek scientist Pythagoras proposed the notion of spherical earth but his views could not gain acceptance. Modern science was considered an improvement over the concepts and ideas of the Greek philosophers. Furthermore, the observer also elaborated upon the nature and composition of the planet earth, and reasons of earthquake with the Royal Astronomer, John Herschel at the Greenwich Royal Observatory. The learned academies, museums and astronomical observatories were considered a direct reflection of the intellectual advancement of Europe. Indian traveller's unique and fascinating account was based upon the scientific treatises written earlier, direct observations, and discussions with British friends and scholars with whom he interacted during his sojourn in the British capital. British industrial and technological progress as evident in the mechanisation of textile industry, railways, shipbuilding and use of steam, was nothing less than a source of bewilderment for the Indian visitor.

Karim Khan's discourses of the Western scientific and technical progress represented an advance over the existing knowledge as contained in the Indo-Persian accounts. He explicitly accepted the helio-centric theory and rejected the geo-centric world-view. Nonetheless our author's account of the European techno-scientific progress remained

confined to mere description rather than an act of 'appropriation.' The answer to the problem could be sought in the nature and impact of colonial rule in India. Moreover, there were also some constraints on the vision of the visitor. British technical progress which was evident to the sensitive observer is mostly described as isolated events without noticing their interrelationships, or the socio-economic impact of industrialization. The paper is largely descriptive based primarily on two manuscripts: Mirat-i-gitinuma (world reflecting mirror) and Siyahatnama (book of travels) written by Karim Khan, both preserved in the British Library (U.K.) In any account of the reception/assimilation of the European scientific and technical ideas by the non-Western societies, these accounts should not be excluded.

ON THE HISTORY OF BRAHMAGUTA'S MATHEMATICS AND THEIR TRANSMISSION TO ARAB COUNTRIES

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The history of the passage of extraordinarily brilliant and fundamental mathematical discoveries of ancient Indian scholars (period 500-700 A.D.) from India to Arab and then to Europe has not been widely studied. This paper primarily concentrates on the history of mathematics of Brahmagupta (598 A.D) and their transmission to Arab countries. It has been acclaimed by historians that Brahmagupta's work played the most pioneering role in establishing a unique intellectual cultural bond between India and Arabia. The Arabs studied Brahmagupta's work with deep interest and rejuvenated their own investigations on astronomy, algebra etc. Brahmagupta's discoveries became the fundamental source of Muslim astronomy. A synthesis of creative ideas took place and the process continued for several centuries. This interactive process defied geographical boundaries and extended to Europe through Spain, Italy and Greece. The methodology adopted comprises a composite structure: history, culture, geography and mathematics. Brahmagupta's original contributions are contained in two illustrious treatises composed in **Sanskrit** verses: **Brahmasphutasiddhanta** and **Khandakhadyaka**. The contents on arithmetic, algebra, geometry and astronomy are reviewed in the context of world mathematics. There exists some 'missing links' in the history of passage of ancient Indian mathematics to Arab countries. It is known that Brahmagupta's treatises reached Arab during the reign of Khalif Al Mansur (753-774 A.D.) of Bagdad and were translated by Al Fazari and Yakub Ibn Tarik at the initiative of the Khalif. Drawing the correct picture of the exact geographical paths followed during this transmission, the correct times, the details of the Indian and Arab scholars (their names and works) and others involved in the intellectual scientific-mathematical knowledge transmission processes, the roles played by the then rulers of Indian and Arab countries in this type of transmission operations, constitute the second important aspect of the study. The Arabic sources and references are reviewed. Some observations are made on the socio-economic-political situations of the times that nourished the scientific-intellectual pursuits of Brahmagupta and others of the statures of Aryabhata (476 A.D.) and Varahamihira (505 A.D.) and enabled their transmission to Arab countries. In this context the transmission of place-value system and use of zero also come into focus. Brahmagupta's method of solution of the indeterminate quadratic equation in two variables has been discussed in detail.

ROLE OF TECHNICAL THOUGHTS IN SOCIAL CONTEXT

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The goal of surfing is to catch a technique that will give you the longest, most gratifying ride. And the key to catching such a technique is knowledge and timing. But knowledge and timing are also key elements to catching technology. Just as professional surfers acquire their skills through practice and observation, so should professional technical communicators. In order to anticipate which technology to catch, technical communicators need to practice their craft as well as analyze the actions and events that have come before.

Since the technological boom that led to the rapid development of the field of technical skills, we seem to be constantly chasing the latest and greatest technology, eternally one step behind. So, how do we get out of this rut and position ourselves so that we're ready to catch the next technique? Our continual struggle to establish the field of technical skills yet assert dominance over new technological domains seem to be in direct conflict with each other. How can we possibly establish our dominance over a moving target? To answer this question, instead of trying to peer into future, perhaps we need to look toward the past. By analyzing the history of technical skills in the context of technological development, perhaps we can leverage lessons learned to propose possible predictions.

In this paper, I will briefly address the importance of studying history. Next, I will offer a definition for technological determinism and provide a subsequent analysis of the effects two specific technological developments. I will then discuss the state of the field from both an explicit and implicit perspective. Finally, I will conclude with suggestions for positioning the field of technical skills so that we can successfully catch the next technique.

PLANNING AND TECHNOLOGY FOR NATIONAL RECONSTRUCTION, THE NPC INITIATIVE IN COLONIAL INDIA

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The endeavour of the National Planning Committee (NPC) in the last phase of British rule in India was a unique event in the history of the world. It was unique due to two broad reasons: First, It was a massive and courageous effort by the best minds from amongst the Indians (scientists, social scientists, politicians, professionals, businessmen and so on) to plan their future even when they were still under subjugation. Second, it was a grand idea to plan all-round progress of the country with the help of science and technology on modern lines. Unfortunately, this historic exercise has failed to draw the attention of historians appropriately, so far. Why?

The NPC had been constituted, in 1938, by the Indian National Congress, the leading political party carrying forward the freedom struggle in India, to prepare a plan for national reconstruction to be executed after the country became free. The plan was inspired by the latest ideas of human development of the time, and, through the use of science and technology, wanted to reconstruct India to achieve a desirable level of development based on equality, liberty and social justice for all. Interestingly, the committee tried to envisage the progress for India in consonance with the progress of all across the globe. For this, while it envisaged large-scale industrialisation in a basically agricultural country and pleaded for such radical measures as eugenics and massive use of machine for human welfare and progress, it called, at the same time, for a reordering of the earth in terms of distribution of natural resources and human population under the guidance and control of the best brains of the world---scientists, philosophers, statesmen and others. Understandably, the NPC placed great emphasis on education, science and technology, natural resources and environment, and human values needed for global progress.

But why do we hardly know about this great event today? What were its real achievements and what are its long-term legacies? These are some of the questions we would try to find out in this paper.

TIME TO CHANGE AND UNCHANGING TIME- MODERNITY, COLONIALISM AND THE NATIVE CALENDAR REFORM IN LATE NINETEENTH CENTURY TAMIL NADU

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Social life takes place in time and space. Calendar is often the device to specify time, more or less precisely, as the civil or religious purpose demands, generally in years, months, dates, week days, or other divisions of time (Eg., Tithi in Hindu religious almanacs- Panchang). That is, calendar is at the basis of our temporal accounting. Different cultures, regions and religions have been using different calendar systems from very ancient times. Calendar reforms, stemming from technical as well as ideological considerations, have occurred periodically. Technical considerations have to do with adjustments necessary in the lunar and solar calendar due to 'errors' that accumulate and become 'noticeable' over a period of time. However, at times reforms in the organization of days and months have responded to socio-cultural and political considerations.

In India a number of calendar systems have been introduced by various rulers. British colonial government introduced Gregorian calendar in India during the late nineteenth century. The Madras government issued a proclamation on March 26, 1878 that time keeping would be based upon the standard Christian calendar on all official records and deemed it necessary that all the Panchangs published in its jurisdiction provide concordant date, month and year in Gregorian calendar system along with any preferred traditional system. At the outset, this action may look like the usual overreach of Colonial Government with the aim to 'discipline' the colonial subjects, however careful examination of the context would show that the action of the government was actually culmination of the efforts by 'native' interlocutors, in this particular case, Chintamani Ragoonathachary.

Chintamani Ragoonathachary, a 'native' astronomer, first Indian to be elected as Fellow of Royal Astronomical Society, famous for his works related to variable stars, minor planets, Transit of Venus and Solar eclipse, took initiative to modify and publish a new Panchang (almanac and native calendar) during 1880s thereby produced a change in the clanderical system followed in Tamil region in southern part of India. Inspired by the modern astronomy, the project of modernization of Panchang is an effort towards secularization of time. To engender reform he utilized popularization of astronomy. Often the introduction of modernized Panchang is seen as merely part of the colonial project of standardizing all measurements, such as land, weight and so on that make the local customs legible for the colonial masters. However, in this paper, it is argued that this project of modernization by Chintamani Ragoonathachary is not a colonial project but a project of 'native' elites to secularizing time in Tamil with the aim to meet the needs of modern industrial society.

REWRITING THE HISTORY OF INDIAN ARCHEOLOGY

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Histories of archeology by Western scholars routinely say that archeology began in India with the reports of European travelers of the 16th century. In his book *A History of Archaeological Thought* (1989, p. 181), Bruce Trigger says, "Archaeological research in India began in a colonial setting. . . . European travelers began to note ancient monuments as early as the sixteenth century and systematic scholarly interest in these monuments dates from about 1750." Even Indian scholars have accepted this perception of the history of archeology in India. About the writings of the early European travelers, Chakrabarti says in his *History of Indian Archaeology from the Beginning to 1947* (2001, p. 1), "Without doubt these records constitute the first group of archaeological writings on India." In his paper "Theoretical perspectives in Indian archaeology," published in the book *Theory in Arch aeology: A World Perspective,* edited by Peter Ucko, K. Paddayya (1995, p. 112) states, "My main point of emphasis is that archaeology in India is a European innovation." He goes on, like Chakrabarti, to attribute the beginnings of archaeology in India to "travelers and sailors who visited sites like the Elephant caves, rock-cut temples at Mahabalipuram and the temples of Orissa." Such passages reflect and reinforce the impression that archeology is a distinctly European enterprise, imported into India by representatives of the colonial powers.

Although the view of archeology introduced by the colonizers holds that archeology began in India with the early European travelers, Indian historical texts reveal a rich parallel indigenous archaeological tradition, involving the excavation of lost artifacts, deities, temples, and sacred sites. The archeological activities of Gaudiya Vaishnava saints in the Braj Mandal region of northern Indian in the fifteenth and sixteenth centuries provide an example.

In this paper, I want to remove the almost total invisibility of the indigenous Indian archeological tradition, with the hope that when made visible, it will be recognized and incorporated into future histories of archeology in India. This could be a general protocol, that histories of archeology of various regions should acknowledge the existence of indigenous archeological traditions, past as well as present.

CONCEPT OF *SUNYA* IN THE INDIAN ANTIQUITY

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The genesis of "zero" as a number, that even a child so casually uses today, is a long and involved one. Though a great many persons concerned with the history of its evolution today accepts that the number "zero", in its true potential, as we use it in our present day mathematics has its root, conceptually as well as etymologically, in the word "*Sunya*" of the Indian antiquity, and it was introduced in India by the Hindu mathematicians, which eventually became a numeral for mathematical expression for "nothing", and via the Arabs, went to Europe, the time frame of its origin in Indian antiquity is still hotly debated. One recent suggestion, from some astronomical calculations is that it was in 458 CE. in the Jaina cosmological text "*Lokavibhaga*"(The parts of the Universe). Furthermore, some recent works even try to suggest that a trace of the concept, if not in total operational perspective, might have a Greek origin that traveled to India during the Greek invasion of the northern part of the country.

In this article we would like to discuss the available references to the concept of "Sunya" or its numerous synonyms in its broader social and philosophical contexts as was used in Indian antiquity, which eventually paved the path for the evolution of the corresponding mathematical concept. From the works on Vedic prosody by Pingala (*Chandahsutra*) [3rd Century BC] to the concept of "lopa" in the grammarian Panini (*Astadhyayi*) (400-700 BC, by some modern estimates) it appears very likely that the thread of rich philosophical and socio-academic ambiences of Indian antiquity was quite pregnant with the immensity of the concept of "Sunya"- a dichotomy as well as a simultaneity between *nothing* and *everything*, the 'zero' of void and that of an all pervading 'fathomless' infinite.

IDEAS AND INSTRUMENTS: THE INDIAN CONTRIBUTION

K.S. Murty

India

The ancient Indians were said to be poor recorders of events and developments which explains why archaeological studies brought out most aspects of the Indian civilization. But it does not mean that they were short of ideas. The classic works in Sanskrit, like the Vedas, Vedangas and other works belie this misconception and confirm that their powers of vision formulated ideas about such topics as origin of universe, the earth, creation etc . The studies confirmed that the first industrial or technical transformation took place in history between 4000 B.C. and 3000 B.C. The instruments used in those times also reflected the inventive capability of the inhabitants of those periods. When the river Saraswati was flowing in full splendor, stable agricultural growth took place around 5000 BC. Architecture and art of town planning were well advanced. The geometrical planning of the cities and the well-developed drainage systems confirms both scientific understanding and technological capability to use appropriate knowledge for the betterment of everyday life. Standardization of gauging devices facilitated angular measurements and measurement for construction. The discovery of the first dock in Lothal(2400 B.C.) confirms knowledge of hydrography and maritime engineering. The earliest furnace dates back to that period as do the swords of copper and bronze. Intense aridity in 2000 B.C. seems to have destroyed evidences of origin of Indian cartography . Use of flint in the 3rd millennium BCE was confirmed by the Harappan quarries. Mining activity was high in the lead and zinc mines of Zawar areas and iron implements came into use indicating smelting operations on a bigger scale in various parts of India The Vedic period (1500 -900 B.C.) saw rise of astronomical studies. The Vedanga Jyotisha being the first Indian astronomical text (1200 B.C.) which was applied for timing the social and religious events. This perhaps led to social stratification in the Society then. Medical sciences too rose and were described first in the Atharvaveda.. Sushruta knew cataract surgery while Charaka was a physician. Nagarjuna developed alchemy. Metal currency was minted in India before the 5th century BCE and the coins were made of silver and copper with animal and plant symbols on them(400-100 BCE) . Kautilya's Arthasastra devotes a few chapters to mining. Mining rules and mining management, as also construction of bridges and dams. Making of Wootz steel began during that period. Varahamihira's Brihatsamhita deals with rainfall, cloud formation, measuring of rainfall and related topics, besides exploration for groundwater by geo-botanical indicators. Astronomical studies reached their peak between 500 and 1200 A.D. Aryabhata, Varahamihira, Brahmagupta and Bhaskara made lasting contributions. Pythagoras theorem was already known to Indians. The decimal system and the concept of zero as a number was developed by the 9th century in India. The Sulva sutras was the oldest work on geometry. Medieval India saw translations of Sanskrit texts into languages like Arabic, Chinese and others. Alberuni did yeoman service in this context by studying the Hindu philosophy, culture and traditions. Thus fundamental ideas led India to a state where the world knew more from it. Likewise, India too received ideas and concepts from outside, as the Romaka Siddhanta mentioned by Varahamihira.

JESUIT CONTRIBUTION IN SCIENCE EDUCATION, RESEARCH AND POPULARISATION IN BENGAL (INDIA) DURING THE LATE 19th CENTURY

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Indian history in the late 19th century marks a perfect blend of science education and research with its rich cultural and spiritual strength as evident from the worldwide recognition of scientific works of genius like J. C. Bose, C. V. Raman, S. N. Bose, M. N. Saha and others. The state of Bengal in the eastern part of India had always been a hub of renaissance activities on all spheres. Interestingly St. Xavier's College was founded here by a group of Jesuit Fathers belonging to the Society of Jesus (SJ) in 1860 under the University of Calcutta and soon it had become a center of lot of scientific activities in addition to the regular running of science courses mainly in two forms. Firstly, popular science shows comprising themes on day-to-day utilities like X-ray, Phonograph, Camera etc. were held under the leadership of Father Eugene Lafont and secondly, active research studies were carried out in the field of Meterology and Planetary Science in its own Observatory. Father Lafont, a close friend of Dr. Mahendra Lal Sircar assisted in the foundation of a Reseach Institute "the Indian Association for the Cultivation of Science" which got famous for being the place of discovery of Raman effect later. He had been able to form a core group of dedicated science teachers in this college. In 1867, Fr. Lafont successfully predicted the arrival of a Cyclone in Kolkata, later confirmed by Govt. Observatory officials. Later in 1868, Father Eduard Francotte of the Chemistry Department extended studies in atmospheric research by setting up a standard laboratory. With the arrival of Father Alphonse de Penaranda of the Mathematics Department in 1874, St. Xavier's College Observatory was further expanded for studies in Planetary Science. Acharya J. C. Bose, one of the best Indian scientists was in the making during this period through the pedestal of this Institution. For the next couple of decades, active research was followed and published till the deaths of Fr. Penaranda in 1896 and Fr. Francotte in 1926.

SALTPETRE MANUFACTURE TECHNOLOGY IN MEDIEVAL INDIA

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As we know India was one of the major suppliers of saltpetre in Medieval times. The saltpetre was an important major component of gunpowder. The significance of saltpetre enhanced manifold with the beginning use of gunpowder for military campaigns worldwide. In the 17^{th} Century the demand for saltpetre attracted the attention of overseas companies like Eslado da India, Vereenigde Oost-Indische Compagnie (V.O.C: The Dutch East-India Company), English East India Company, Ostend East-India Company, French East-India Company etc.

In the context of India as a major producer of saltpetre and arrival of Europeans in India, a new phase was initiated in the history of saltpetre technology. We on the basis of our access to Dutch East-India Company sources, find crucial information on Dutch participation in the saltpetre trade. Saltpetre constituted one major item of Dutch Company's invoices of exports from India.

Interestingly, by 1640's the Dutch Company started establishing their own production centres in various parts of India. In the process they introduced metallic copper ketels in manufacturing saltpetre. The introduction of copper ketels was not appreciated by the indigenous manufactures. The response of the indigenous manufactures towards European innovations is an extremely interesting subject. It will provide a chance to look into the question of reasons for apathy or acceptance as the case as might have been.

Saltpetre industry had special political, social and economic implications in the context of seventeenth century India which will be discussed in detail in the paper.

THE LESSONS OF MILLENARY WATER USE IN THE ANCIENT ISRAELI KINGDOM (VIII BC– II BC)

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Russia

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Israel

Now a day there is a big concern of the increasing shortage of fresh water in the world. Despite all obviously negative consequences of so called Stalin's "building of communism" (among them there are the lands' salinization and destruction on the huge surface of Kalmykia, Orenburg's steppes and Golodnoy steppe), in recent years in Russia disastrous ideas to transfer the waters of the Northern Siberian Rivers appear again. In this regard, it is more interesting and topical to refer to the millenary experience of water use in the regions where the water famine exists for a long time.

The ancient Israeli kingdom appeared in the time of biblical King David on the both sides of Jordan river that never had been full-flowing, if we compare with Nile in Egypt or Tigris-Euphrates in Mesopotamia. The population of Israeli kingdom, especially of Judaic mountains and Judaic desert could rely only on few constant outcrops of underground waters resources and not numerous precipitation, the level of which could hardly exceed the present norms (in Judaic mountains about 250 mm/year, for the regions close to the Dead Sea – about 100 mm/year, and in Judaic desert – even less). The rainfalls are only in the winter in this region, usually as skits in certain days. The main task that occurs is to raise these waters till the last drop and save them for the usage during the year.

Modern archeological excavations carried out in Israel for the last 40-50 years discovered numerous man-made water systems that successfully solved the survival problem of the ancient inhabitants of these regions in conditions of water famine.

The most ancient water ducts solve the problem of water transportation from the few outcrops of underground waters resources to the inhabitancy of water consumers. Some of them act till the present time, for example, from Vadi Kelt sources to Ierihon. Here amaze the pitches of 20 km length of rocky open water line that continuously working during several centuries. To the times of King Davin belongs the constructing of underground tunnel that takes the waters of Hyhon source to the Siloam drain inside the fortress. The similar water systems were developed and complicated during the long period (including the Solomon's and Maccabeus's reigns). They are discovered not only in Jerusalem, but all over the country: Hatsor, Megido, Ioknaem, Geder, Terr-Sheve. Most recently the constructors of these systems that included shafts, adits, stairs, water ducts and drains, used the natural cleft, rifts, emptiness in the rocks.

The water system of underground storage ponds impresses by its size and ingenuity of the constructors. It is based on the chain of natural caves, thoroughly worked up for the century by its users. The water ducts are covered for all its height (to be more concrete – depth) till 6-8 m and all its length till 880 m by the multilayer coating with disinfectant properties that prevent percolation and makes the loss of water impossible.

The last of outstanding contractors of the period was Irod Valeriy, during his reign the water system of Jerusalem of the different times was perfected and such masterpieces as Masada, Irodion and Kessaria were created.

The main outcome of the millennial water use by the Israelis in the conditions of the water famine is care of water resources and inventiveness of the users, based on the deep understanding of the water conditions and possibilities.

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THE JIUDIAN BAMBOO SLIPS AND THE SPACE AND TIME CORRELATIONS OF THE YIN AND YANG CONCEPTS

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The concepts of yin and yang correlated with several concepts of the space and time in the second half of the Warring States Period (481 B. C. – 221 B. C.). The words yin and yang appear many times in the "book of days" (rishu) which is written on the 3rd group of bamboo slips (slips no. 25-36) discovered in the near past in the Tomb No. 56 at Jiudian. The first part of my study briefly discusses the space and time correlations of the yin and yang concepts. The second part examines that the space and time correlations of the yin and yang whether or not manifest themselves in this "rishu".

THE BEGINNING OF *WASAN*: MATHEMATICAL PRACTICES WITH DISPARITIES

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I will present a part of the work I did last year. In Japan, during the Edo period (1600-1868), the scientific practices had an unprecedented development. A. Horiuchi has highlighted an essential turning point for traditional mathematics (*wasan*) in the end of the 17th century. It was characterized by the emancipation of Japanese scientists from Chinese knowledge as well as an established and efficient state of research. Over the last year, I studied the beginning of the 17th century, in order to specify the main works that contributed to the evolution of mathematics in the first decades of the *wasan*. I especially focused on two books : the *Jinkōki* (1627) and the *Jugairoku* (1639). I discovered that, at this time, the practice of mathematics revealed a lot of disparities.

First of all, the matters of the type of problems and the language used in textbooks is essential: it reflects, at the very beginning of the Edo period, two different ways of practicing the art of calculation. Indeed, the content of *wasan* was, on one hand, heavily influenced by the commercial class which widely contributed to its circulation and, as a consequence, to its development. Therefore, most of the first mathematical books were written in Japanese, the working-class language, and contained subjects that were close to everyday life (trade, harvest management, tax payments…). Yoshida Mitsuyoshi's *Jinkōki* belongs to this category. On the other hand, some mathematicians, such as Imamura Tomoaki (author of *Jugairoku*), were trying to transpose mainland tradition in the Japanese mathematical landscape. As a result, the more precise Chinese language was used and the aim of the textbooks was to clearly describe subjects of Chinese tradition. As these two types of practices were coexisting in the beginning of the Edo period, I think one of the most important questions of the history of *wasan* is how and why were certain subjects and mathematical languages finally fixed at the end of 17th century? To begin responding to this major question, I asked several questions about the early Edo period's works : What kind of subjects were described in each type of practice ? What was the frontier between the "popular mathematics" and the parts of *wasan* produced in Chinese ? What were the argument to choose the language used in textbooks ?

Then, even if there was no pure mathematical innovation in the textbooks of the beginning of the Edo period, I have noticed that, depending on which audience the book was for, mathematicians developed new interesting items. Studying the *Jinkōki*, I observed that Yoshida used new ways of presenting techniques, with a great "pedagogical value", in order to make the novice learning easier. This new method of learning was probably in line with the characteristic tendencies of mathematic books in the Ming dynasty. In the *Jugairoku*, Imamura clearly attempted a "formalization" of geometric practices, especially concerning the names of the figures. He also "systematized" the presentation of geometric relation by organizing it with mathematical arguments. If popular readers couldn't understand his book, the names and the organization he created were used by his successors.

CONTINUING JOSEPH NEEDHAM'S TRACES OF THE "GREAT EXTENSION NUMBER": THE ORIGIN OF THE "GREAT EXTENSION MATHEMATICS " (INDETERMINATE ANALYSIS) IN CHINA

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As Dr. Joseph Needham, the author of *Science and Civilisation in China*, pointed out, indeterminate analysis was always a marked mathematical interest of Chinese. He realized that its Chinese name "Great Extension Mathematics " (Ta yen shu was derived from an obscure statement in the I Ching (Book of Changes) that the "Great Extension Number is 50". He suggested: " indeterminate analysis was connected with, if not actually derived from, an ancient method of divination using yarrow stalks."

Following his traces, this paper will have both mathematical and archaeological evidences to show the mathematical implications of the statement in the I Ching (Book of Changes) that the "Great Extension Number is 50". This statement means that as a meaningful number in Fu Xi numbering system, 50 was a most widely used parameter derived from the three means of Chinese ancestors' livelihood: (1) to establish and improve the ancient Sifen (old four quadrantal) Calendar; (2) to grasp the Pythagoras theorem and it applications to terrestrial and celestial measurements; and (3) to master the mathematics of circle and square and its applications to implement makings and civil engineering. This was the reason for Chinese to be so interested in this mathematical field. Based on these evidences, the process of evolution of the Ta yen shu from solar observations to a classical method of calendrical calculation and hence to the ancient method of divination will logically and historically be recovered. The co-evolutionary history of counters and calandrical lore will reveal the truth of the mystery behind the Ta Yen Shu.

THE ORGANIZATION OF TECHNICAL KNOWLEDGE TRANSFER ON THE EVE OF JAPAN'S INDUSTRIAL REVOLUTION

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This paper will show that semi-formal and formal technical education in Japan started much earlier than hitherto recognized. Concerning the education of engineers and the transfer of Western technology, most Western and Japanese publications refer to the establishment of a faculty of engineering at the University of Tokyo, where formal engineering education according to Western standards started in 1886.

A few authors mention the earlier "College of Engineering" *(Kōbu daigakkō),* established in 1872, the first institution in Japan to set up a curriculum similar to European polytechnics. Almost all the teachers at this college came from England, and the engineers who studied there were the first systematically trained technicians in Japan. Most were employed by government industries upon graduation.

Even before that, though, during the late feudal period in the 1850s, the central government and some feudal lords established schools where foreign engineers and natural scientists taught young Japanese mining, chemistry, metal casting and other Western technologies. While few sources about them have survived, these schools represent an early transfer of technical know-how on the eve of Japan's industrial revolution. This paper will discuss the reasons such schools were established and their impact in a country, which officially still adhered to its 250-year-old policy of seclusion.

CHANGE IN MEANING OR STYLE OF THE KNOWLEDGE: DIVERSIFICATION OF EQUIPMENTS IN ACUPUNCTURE RESEARCH IN CONTEMPORARY CHINA

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Both manual acupuncture and electroacupuncture have been used in acupuncture research since 1959 in China. Before 1990, there are only the two kinds of acupuncture and no transcutaneous electrical nerve stimulation (TENS) in acupuncture research in China, though TENS had been used for pain research since 1975 and been compared with acupuncture in 1980s. After 1990, TENS was gradually used and reformed to replace acupuncture partially.

Acupuncture is based on Jingluo theory in Chinese Traditional Medicine (CAM). Manual acupuncture is a traditional method with needles whose force and directions mostly reply on practitioner and his (her) sense. Electroacupuncture still need needles penetrating into the skin, but it produce stimulation by some electrical current not practitioner’s hand. TENS and its substitute such as HANS (Han’s acupoint nerve stimulator) discard needle with electrode sticking to acupoints. These kinds of acupuncture with no needles have impacts like acupuncture by electro stimulation of certain frequency.

The study reveals that change from manual acupuncture to TENS means acupuncture change from nonobjective “sense of needle” to objective stimulation and from practitioners’ sense to controlled frequency. It means that the ideas behind the equipments have been changed. Moreover, Owing to spread of the acupuncture recipients groups (many of them are not Chinese or Eastern Asian), change of public attitude to penetration, modern medicine advocating objectivity and standardization, and limited acupuncturist, equipments of acupuncture have been changed. Thus not only the style of the knowledge of acupuncture but the meaning of that has been changed.

INTRODUCTION OF THE UNDERSTANDING AND PRACTICE COURSE OF MANAGERIAL PSYCHOLOGY IN CHINA IN THE 20th CENTURY

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China’s Confucian philosophy always emphasizes on analysis of human nature. From Westernization Movement (1865-1895) to May 4th Movement of 1919, Western Technology, science and democracy were introduced into China gradually, but the society progress still retarded. In 20th century, Methods of experimental psychology in western have been studied by Chinese aboard students, through application of education, engineering and business fields. Since 1915, scholars in Social Science of China (1915 -) and the Chinese Vocational Education Society (1917 -) introduced Psychology Science, especially Occupational Psychology and Industrial Psychology which had a great effect in World War One and Scientific Management Movement. The Managerial Psychology was considered as a “soft technology” which can make up China’s “hardware equipment” deficiencies. From 1930s, psychologists, like Pan Shu (1897-1988), XIAO Xiaorong (1897-1963), Chen Li (1902-2004) and so on, made a deep research in this area. However, after 1950, as the suppress of “Left” Deviation in ideological field and in particular “Gang of Four” took Psychology Science for “pseudo-science” in the Cultural Revolution. Psychology Science made no progress and almost completely vanished in China. Fortunately Managerial Psychology and Behavioral Science reemerged in Schools and research institutes in 1978. This article explored rare historical materials, outlined the main clues, and discussed several underlying causes.

THE MAIN CHARACTERS OF THE TRADITIONAL CHINESE MEDICINE

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How traditional Chinese medicine (TCM), a classical system of medicine without any connection with modern western medical sciences, can still develop in itself history? Is TCM a science or just a description of collecting experience? Does TCM still have the possibility and space to further develop itself along its own orbit? These questions, related to the main characters of TCM and frequently being worried about, have been responded and illustrated in following five aspects.

Analogical thinking was frequently described in classical Chinese philosophy as interaction in the idea of "integration of the heavens and human beings". Such an analogy has been used often in the medical books compiled in Chinese, especially in establishing the theories and developing the therapeutic methods of TCM.

Huangdi Neijing (Yellow Emperor's Canon of Medicine), *Huangdi Bashiyi Nanjing* (Yellow Emperor's Canon on Eighty-one Difficult Issues), *Shennong Bencaojing* (Agriculture God's Canon of Materia Medica), *Shanghan Zabinglun* (Treatise on Cold Diseases and Miscellaneous Diseases), compiled in the Donghan Dynasty (A. D. 25-A. D. 220) and had developed into medical cannons, as they were comprehensive and systematic in contents, usually theoretical important, and contained knowledge concerning many other fields related to traditional Chinese literature factors.

In TCM, the understanding of nature and human physiology and pathology, the diagnosis, treatment and use of drugs could be illustrated and explained according to the theories of Yin-yang and Wu-xing (five elements), interacted with Viscera and their manifestations, Channels and collaterals, Etiology and Diagnostics (Wang-inspection, Qie-taking pulse or palpation, Wen-listening and smelling, and Wen-inquiry) have been practiced in clinical manifestations.

The concept of taking human body as an organic whole in TCM made a strict division of medicine relative. In fact doctors in TCM had to use both the internal (prescriptions) and external therapies (acupuncture and moxibustion etc.) at the same time in order to effectively treat diseases.

Knowledge of Materia Medica, pharmacological studies, drug administration and market, processing of herb, interacted with life cultivation in the four seasons, integration of food and medicines, sports and health, emotions and diseases, have been increasingly developed in the circumstance of the scientific exchanges between the Western and the Eastern medicines, and cultures as well.

THE MEANING OF SOLAR ECLIPSES FOR THE ANCIENT CHINESE BASED ON THE "JING JIAN NEI ZHI" TEXT FROM THE CHU BAMBOO SLIPS COLLECTION OF THE SHANGHAI MUSEUM

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Astrology can easily be regarded as most important field of science for the ancient Chinese. Its position over other sciences is quite clear as well considering how calendrical calculations inspired modular mathematics, its relation with medicine based on the correlation microcosmos-macrocosmos and the emergence of the Five Elements theory from the correspondence of the seasons and constellations.

Its prominence is in accord with its "external" factors: place in the political ideology, in the bureaocracy and religious importance of both calendrical calculations and celestial portents. We can already identify stellar deities in neolithic findings and during the 1st milennia B.C. with Heaven becoming the central entity of divinity instead of the anthropomorph Shangdi the religious outmost importance of stellar phenomena was evident.

Astrology deals with two different fields of phemonena: the regular cycles (calendrical calculations) and the anomalies. Stellar portents were seens as good or bad omens, as all over the world. At the latest by the time of the Han dynasty a systematic theory emerged that all stellar irregularities are sings that the rulers mandate of heaven is in danger, and when it is withdrawn a new dynasty will emerge in correspondence with the cycle of the five elements (retroactively applied for the dynasties of the past as well). This theory gave a strong incentive to turn the anomalies, like solar eclipses, into predictable and periodical events and it also raised the prestigue and influence of the astrological bureau in imperial times.

The Zhou had already legitimized their ascension by claiming that the decadence of the last Shang kings resulted in the loss of the mandate of heaven. Pankenier (1999) argued that at the time of this event there was a planetary conjunction in the Vermilion Bird constellation and the famous omen of a vermilion bird descending upon the altar of the Zhou with a scepter in its mouth is a metaphor of the astronomical situation.

Later texts present anomalies as luminous omens as well so our knowledge about the evolution of these beliefs are still vague and its dangerous to assume too much about Warring States period beliefs based on more abundant Han sources, as Puett (2002) has shown.

Therefore we will examine the recently excavated text “Jing Jian Nei Zhi” from the Chu bamboo slips collection (published in *Shanghai Bowuguan Cang Zhanguo Chu Zhushu, Vol. 5*, Shanghai: Shanghai Guji Chubanshe, 2005.) dated to the late Warring States period. In the text Bao Shuya and Xi Peng explains to the inquiring Duke Huan of Qi that the cause of the solar eclipse is bad government which they explicate. The political ideology presented in the text is also interesting: it shows elements of legism, what is rare among astrological treatises, which usualy advocate more conservative philosophies.

ENGENDERING EMOTIONS: WOMEN’S MELANCHOLY IN 16th-17th CENTURY CHINESE MEDICINE

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Among the human emotions depression would be counted as a primary one, said to have troubled numerous people in the past and the present. In early Chinese medicine, the term *yu* (depression) primarily refers to the repression and stagnation of environmental *qi* and heat. It is later employed to interpret the stagnation of bodily *qi* and Blood, owing to the holistic analogy between nature as macrocosm and the body as microcosm. The largely body-oriented approach to the depressive disorders remained dominant before the 15th century. In the 16th-17th century, however, certain physicians seem to have paid more attention to emotions in etiology and diagnostics. They believed that “stagnation” of emotions always leads to *qi* congestion of the body, therefore results in various other diseases. It is in this context that a rather sophisticated typology of depression was developed. Furthermore, some of the depressive disorders are attributed to women only. Zhang Jiebin (1563-1640), for example, categorized the depressive disorders into three types, i.e. “depression of anger”, “depression of pensiveness”, and “depression of sorrow”. It is said that spinsters, widows and those who have “accumulated suspicions and complaints” are prone to suffer from “depression of pensiveness”.

It is therefore my attempt to answer the questions as below: why do Chinese doctors seem to have focused more on the role of emotions in health and sickness in the 16th-17th century? What is the rationale underlying the medical arguments that women are rather vulnerable to peculiar emotional disturbance? How are spinsters, widows and nuns interpreted as those who are prone to fall ill of depression of pensiveness and even sexual madness? By examining medical theories and practices, I will firstly introduce the medical views of depression throughout the ages. Secondly, my focus will shift to the 16th-17th century when women’s emotional disorders, in particular depression, became more “visible”. Last but not least, I will discuss in what contexts spinsters, widows and nuns were scandalized as potential patients of depressive disorders. In so doing my paper is aimed at contributing a better understanding to women’s emotions and depression as a whole in 16th-17th century China.

ELECTION OF MEMBERS OF THE SECOND RESEARCH COUNCIL OF ACADEMIA SINICA AND ITS IMPACT IN 1940

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The election of members of the Second Research Council of Academia Sinica, which was held by the academy’s First Research Council during the Anti-Japanese War, was a large-scale activity for electing academic elite independently by Chinese academic world in the first half of the 20th century China. Mainly based on the investigation of archives, this paper expounds the whole story of the election and analyses its impact. The academy’s First Research Council enacted a quite strict electoral procedure that was in line with the thought of democracy and freedom on the basis of the *Regulations of the Research Council of Academia Sinica* drew up mainly by V. K. Ting before the election. Furthermore, the sufficient preparatory work for the election was carried out by the Preparation Committee of the Election of Members of the Second Research Council. These efforts laid a good foundation for the election to goes smoothly. Almost 560 scholars in 21 national universities and colleges and 3 election committees attented the primary

election to elect the candidates of members of the Second Research Council. According to the electoral procedure and qualifications of members of the Research Council of Academia Sinica, the academy's First Research Council examined the candidates' qualifications and held the final elction. Although the electoral procedure had some shortcomings, the election made a immediate impact on the success of the first election of members of Academia Sinica in 1948. It served as a link between past and future in the historical process that Academia Sinica, the supreme national academy of repubican China, accomplished its academic system.

Key words: Academia Sinica, First Research Council, election of members of Research Council, Academician System, scientific institutionalization

DEVELOPMENT OF BOTANY IN REPUBLICAN CHINA (1912-1949) – A BIBLIOMETRICS ANALYSIS

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The Republican China (1912-1949) was a key era for modern sciences to be transplanted to China. Botany is one of the science branches that grew very fast in this period. Here we assessed the development of botany in Republican China by doing a statistical analysis on the publications. We categorized the 9285 publications recorded in "Bibliography of Chinese Botany" into two groups based on the languages they used, since botanists in Republican China almost always published their original research work in western languages and reviews or popular science articles in Chinese.

As to the 7686 Chinese publications and the 1599 western language ones, we calculated their annual growth, and found a Price growth curve between the year 1915 and 1937 by doing non-liner regression analysis, which indicated the development of modern botany in China during that era was congruous with the common growth pattern of sciences, only with a deviation brought by World War II. This is contradictory to the common impression of Republican China—a country torn by warlordism with a weak central government incapable of guiding and supporting scientific activities thus prohibited the development of science.

Journals that published Chinese botanical literatures summed up to 1077 and over two thousand authors had contributed to these publications. We indentified the key journals and authors of that period based on Bradford's law and Lotka's law and evaluated their contributions.

At last, we discussed the relationship between social affairs and botanical researches with the cases of Tung oil and Pyrethrum. The former one indicated that the war might stimulate certain field of research while total research activities were largely inhibited. The latter one showed the effect of a political movement to scientific activities.

This is a preliminary analysis in order to familiarize the readers with the development of botany in Republican China by showing some statistical data of the botanical publications at that time. Further studies based on these data would provide a better understanding on the history of botany for that era.

AN ANALYSIS ON THE DEBATE OF THE CONCEPT OF "MASS-ENERGY"

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The appearing of the concept of "mass-energy" has its exceptional background. It involves not only of the comprehension of a scientific conception, but also of the philosophical standpoint. In the middle of the 50's, 20th century, the Soviet Union's scholars were launching an attack on the "physical idealism", and similarly, Chinese scientists were involved in the campaign of "the intellectuals' ideological remodeling". This campaign requested that scientists most abandoned all kinds of idealism and comprehensive the scientific conception from the viewpoint of materialism. In this case, QIAN Xue-sen, the Chinese famous scientist, was to reconcile the conflicting between "idealism" and "materialism" by advanced a new concept, "mass-energy". This case also demonstrates how a scientist's philosophical thought permeated into his comprehension of a scientific conception.

Key word: *mass-energy, mass-energy relation, idealism*

'GOOD FORTUNE OR ENVIRONMENTAL HARMONY?'

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This paper considers the development of the theory of the traditional Chinese art/science of fengshui through the examination of various classical texts. A comparison is made in this consideration between the environmentally harmonious aspects of the theory and the promise of 'longevity, the receiving of favours, becoming an official and imperial prosperity' in relation to 'good and evil spirits and good and ill fortune' (Twenty-four Difficult Problems). The discussion is then tied to the environmental history of China, specifically in terms of the logic of short term advantage and the ethics of chance.

SOVIET EXPERTS AND CHINESE AIR FORCE EDUCATION (1949-1960)

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After the establishment of the People's Republic of China, there was only one old aviation school, which can not satisfy the demand of development and large-scale training of air force. In July 1949, the CPC delegation headed by Liu Shaoqi secretly visited the Soviet, and held talks with the Government of the Soviet Union on buying the airplanes and weapons, and requested the Soviet Union to send experts to help China set up aviation schools. With the help of Soviet experts, a new group of aviation schools and other kinds of air force colleges were founded.

According to the existing complete file in the Air Force Archives, the total number of all the Soviet experts having worked in the air force from 1949-1960, is 8826, of which there were 243 in the administrative organizations, 1181 in the colleges and schools, 597 (44 groups) as short-term technical assistance, 6805 as organic forces (including division, regiment and company). The main part of the organic forces were soldiers who could not be called experts in the strict sense. So in addition to this part, the number of Soviet experts in the air force colleges and schools is the largest in the whole air force in this decade.

Soviet experts had worked almost in all kinds of air force colleges and schools including the aviation schools, command and technological colleges and schools and so on. According to the detailed list of Soviet experts in the air force in this decade, a simple statistics can be made and it can be summarized that Soviet experts served at any level, type and profession of work. In terms of their duty, they served as from chief principal consultant, department consultant, director consultant, to the general teacher; from the director of pilot, the flight captain, flight instructor to technician or even typist, etc. From the perspective of their profession, they had worked in aviation school, command school, technological or engineering college, etc. There were not only aircrew experts but also ground service experts in aviation schools; there were not only campaign command experts but also tactics experts in the command colleges or schools; their professional fields were extensive in the technological and engineering college. Soviet experts had taken participation in the construction and development of chinese air force education in all-round way and in every field.

During the course of their working in air force colleges and schools, Soviet experts had not only helped China set up a relatively perfect system of administrative organizations, but also teach knowledge, technology, research methods and training experience. Air Force College of PLA was the first integrated air force college of new China. Before the establishment of this college, the director of department had held a talk with the chief consultant Allabin. In this talk Allabin suggested how many and which kinds of experts should be retained after the establishment of the college and introduced the administrative system of the Air Force Red Flag in Soviet Union. It can be seen from the *Chart of Administrative Organization* that the administration organizations were very similar between the Air Force Red Flag of Soviet Union and Air Force College of PLA: Firstly, Dean was responsible for the whole college, there was only one director in each college. Secondly, there had divisions which were subordinated directly to the college. Every subdecanal was responsible for each division and was in charge of different type of work. Thirdly, there had the professoriate which also was subordinated directly to the college. Fourthly, there had further training department or section in the two colleges.

There had also similarities in the distribution of the departments and the professional fields in the two air force colleges. The piloting department, command department and logistic department were set up in the Air Force Red Flag according to the mission on training the piloting cadres, command cadres and logistic cadres. The setup of the professoriate directly subordinated to the college met the need of the same or the like courses that all the students must study. This arrangement can help to save teaching resources and make teachers concentrate on some given courses and research fields of their own. The piloting department, logistic department were also set up in the Air Force College according to different training mission. In addition, basic department and further department were set up in the college according to the different length of schooling. However, each professoriate had not very well cooperated with each other according teaching task. Soviet experts considered it not optimization teaching principle that the course *missile air to air* was taught by shooting professoriate and the course *missile ground to air* was taught by bombing professoriate, they suggested it should be responsible for the missile professoriate to teach the same or the like courses such as the above two courses. The Air Force College adjusted curriculum and training plan in order to optimization teaching principles according to the suggestion from Soviet experts.

At the beginning of the establishment of aviation schools, teaching and training programs were almost stipulated by Soviet experts . The first, second, third and fourth training outline in the Air Force College were also worked out under the guidance of Soviet experts and referred to that of the Air Force Red Flag. Soviet experts had not only helped China formulate teaching outline, checkup teaching materials and take on heavy teaching task, but also study out the detailed training program.

In a word, The number of Soviet experts working in air force colleges and schools was so great, their distribution was so wide, and the aid from them was also very generous in the whole air force field. Chinese air force education system was established on the basis of assimilating in Soviet's experience and on the reference to the model of Soviet military education at its earlier times. Soviet experts had made their great efforts and most contributions on the education in Chinese air force colleges and schools, they had exerted a great and profound influence on the air force college and school education.

THE STUDY OF RELATION BETWEEN SCIENCE AND PUBLIC IN CHINA WESTLAKE EXPO 1929

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There were many successful fairs in China before 1929, and Westlake Expo in 1929 is one of the earliest international Expos. Aimed to promote post-war economy in Zhejiang province that locates the beautiful Westlake, the objective of the Westlake Expo 1929 was to promote home products, reward industry and develop culture. This Expo was named Westlake for its famous reputation of Westlake as a beautiful lake having a long historical standing. Its exhibition building composed of eight museums, two exhibit rooms and three special showrooms showed the exhibits related to science, technology, humanity, society, art and culture and so on. And besides, media essential for any fairs played a very important role all through the Expo. Expo 1929 is a successful one, and, just like other international Expos such as Expo of 1851 in Great Britain, its parts of the items was continued to display in the new founded Westlake Museum.

This paper will analyze the relation between society, public and science namely science popularization in China, involving backgrounds, process, contents of this Expo 1929 and public reaction to it. It is doubtless that Expo 1929 was significant especially for the science and culture. Using Chinese words, it is important for the science popularizing related to science, public and society. Generally speaking, fairs themselves are meetings of popularization aimed to show to public. The first Expo 1929 oriented to promote home products introduced another form of science popularization, audiences came to knew about the advanced science, technology and related products at home and abroad at that time.

Regular Session T07
The Middle Ages (Western and Byzantine) and Renaissance

FAITH OR KNOWLEDGE? NORMATIVE RELATIONS BETWEEN RELIGION AND SCIENCE IN TWO BYZANTINE TEXTS

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The question of the relationship of religion and particularly her institutional representative, Church, with sciences in Byzantium was crucial from the first days of the new state. In this paper we will examine the relationship between Church and science as seen through two scientific texts for higher education. The texts are the *Ευσύνοπτον σύνταγμα* (1008), the oldest teaching manual rescued from the Byzantine era, and the *Σύνταγμα των τεσσάρων μαθημάτων* by George Pachymeres (c. 1300), written during the era called Palaiologian Renaissance. These two texts about the sciences of quadrivium (arithmetic, geometry, astronomy, music) describe, among others, the relationship which a Christian must have with the faith and the science. Pivotal is the effort of both authors (the unknown of 1008 and Pachymeres) for the legitimization of sciences and the scientific education for the proof that it is not contradicting to Christian faith and the changes which we can see in their perceptions about this difficult relationship.

EXPLANATIONS OF THE PLAGUE IN THE LATE MIDDLE AGES

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The Black Death of the mid-fourteenth century gave rise to a new genre of medieval scientific literature, the short plague tract which contained descriptive and prescriptive material about this most dangerous and most stubbornly recurring epidemic of pre-modern Europe. Hundreds of different texts of this genre had circulated until the sixteenth century and beyond. Some of these texts (or some of their exemplars) were intended for medical practitioners, some – surrounded by sermons, legends and other praedicabilia in the manuscripts – were utilized by preachers, and quite many were translated in the vernaculars for the use of artisans, merchants and other townspeople who were able to read. Especially in this later capacity, and assisted by the printing press, the plague tract became one of the most popular book types of the early modern book market.

The main research question the paper will attempt to answer is how the emergence and recurrence of plague epidemics is explained in plague tracts between the Black Death and the end of the Middle Ages. Explanations of the plague and of other diseases given by medieval doctors are usually regarded as entirely speculative, authority-driven and unempirical. There are several problems with this view. Even if such explanations were obsessed with opinions of past masters, the variety of such opinions would still raise the question of why a given master or line of traditions was chosen and not a different one. And, especially in the case of the plague, there is also the problem of compatibility between natural scientific (or natural philosophical) explanations and theological interpretations of illness, as well as the related issue of what practical measures were to be taken against the devastation unleashed by it. The political necessity of doing something, and the high number of infected persons made the (in)efficiency of measures taken much more visible, and urged the writers of plague tracts to lay more stress on empirical foundations and applicability. References to personal experience became the part and parcel of this genre.

Accordingly, the paper will conceptualize the problem of explaining the plague on three levels. Firstly, on the level of explanations in natural philosophy which were employed in various selections and combinations in the tracts. Secondly, on the level of the relationship between the religious interpretation of epidemics as God’s punishment (or at least as something with a divine purpose) and the naturalistic explanations. Finally, on the level of the interdependence of theory and practice. The outcome of the analysis will be a typology of explanations placed in historical context, and an attempt to identify trends of historical change in how medieval doctors tried to illuminate the causes of the most devastating epidemics of their times.

LITERATURE AND ASTRONOMY IN SACROBOSCO'S *TRACTATUS DE SPHAERA* AND *COMPUTUS ECCLESIASTICUS*

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Johannes de Sacrobosco's *Tractatus de Sphaera*, written about 1230, was one of the most popular astronomical textbooks ever written. The main sources of Sacrobosco's work were Ptolemy, Aristotle and Alfraganus, but other influences are also noticeable. Besides astronomical authors, Sacrobosco also cited several Roman poets – Virgil, Lucan, Ovid. In another of his works, the *Computus Ecclesiasticus* or *De Anni Ratione*, Sacrobosco algo cited Roman poets several times. This paper analyzes and discusses this feature of Sacrobosco's work, trying to understand the reasons behind the use of literary citations in an astronomical textbook.

It is possible to find literary quotations in several Medieval scientific books, besides Sacrobosco's. Macrobius' *Commentarii in Somnium Scipionis*, for instance, contains some of the citations used by Sacrobosco. Guillaume de Conches, in his book *Dragmaticon philosophiae,* also used literary quotations from Roman poets. However, other Medieval astronomical works (such as Campanus of Novara's *Tractatus de Sphaera*) contained no literary quotation; and Sacrobosco's works are peculiarly abundant of those citations.

Why did Sacrobosco introduce so many poetical citations? This paper analyzes several hypotheses: he could cite the Roman poets (1) as authorities for the ideas he is presenting; (2) because the quotations help to understand the astronomical ideas; (3) to embelish his work; (4) to show his erudition. However, the analysis of Sacrobosco's books and their comparison with other Medieval works leads us to reject those hypotheses.

After rejecting several hypotheses, this paper claims that Sacrobosco's main reason for the introduction of poetical citations was helping university students to understand the astronomical knowledge implicit in the literary works. It also claims that Campanus of Novara's *Tractatus de Sphaera* did not contain literary quotations because it was written by a physician who did not teach astronomy at an university.

ON THE SEMIOTIC PROCESSES THAT ENABLED BOMBELLI'S *L'ALGEBRA*

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Rafael Bombelli is credited with the first use of roots of negative numbers for solving a real problem (*L'algebra,* 1572). He is not the first to set rules for the use of roots of negatives, but is the first to manipulate them beyond these basic rules.

A discussion of the history of negative numbers and their roots is not sufficient to understand Bombelli's achievement. To understand this feat one must consider the Italian algebraic scene that has been evolving from the abbacists (arithmetic teachers for the children of Italian merchants) to the Renaissance. Such analysis exposes two opposing but concurrent processes: one is a division of numbers and quantities according to their *natura*, and the other is the undoing of this division by algebraic practices.

In my talk I will survey some seemingly 'minor' details of the algebraic practices of Bombelli and his predecessors. I will show that Italian algebraists often used numbers as if their values were different from their 'nominal' values, and relate this practice to economic practice. I will then show how such practices undermined the division of mathematical entities according to their *natura*, how they promoted the use of unknowns and of what we could anachronistically approximate by the term 'parameters', and how they enabled the acceptance of new entities such as roots of negatives. I will also show how Bombelli's multiple and original interpretations of geometry (which prefigure Cartesian technique in the contexts of homogeneity and the use of unit intervals) undermined the division of quantities according to their *natura* and promoted the acceptance of new algebraic and arithmetic constructs.

So far the achievements of early European algebra were explained by changes in epistemology (Heefer, Radford), in rhetoric (Cifoletti, Heefer), in intellectual trends (Rose) and in social practice (Høyrup). But the ways, in which mathematical technical practice immanently carried these epistemological, rhetorical, social and intellectual changes and supported their acceptance and replication, have not been properly studied. I propose to fill this gap by describing how algebraic an geometric practices facilitated Bombelli's breakthrough.

This research has implications on understanding the history and pedagogy of mathematics. If we recognize the role of the non-univocal use of signs in enabling mathematical theories and practices, we can better understand the course of mathematical history, and perhaps even teach mathematics in more accessible ways.

Comment: this paper is on the seam line between T07 and T08.1

CHILD HEALTH DURING THE MEDIEVAL AGES IN ISLAMIC WORLD

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Muslim physicians, during the Medieval Ages, have played a considerable role in the field of Child Health.

Rhazes (al-Razi), who was born near to Tehran and died in 925, was a famous physician and writer, whose medical writings greatly influenced the Arabic world as well as Western Europe. Al-Razi talked about the management of the newborn until the walking age. In this regard we can find the concepts of Rhazes and all other physicians before him regarding issues which are necessary to be carried out for every newborn baby. He says that after delivery the umbilical cord should be cut off for a distance of four fingers breadth, and ligated by using a wool string, then a bandage dipped by oil applied on. All of his body should be washed, with a necessity of dropping inside his eyes, and the nose orifices should be cleaned. Then Rhazes talked about the newborn bathing, dressing and sleeping, mentioning to some herbal drugs used for these purposes.

Avicenna (ibn-Sina), who died in 1038 is considered one of the most celebrated physicians during the Medieval Ages. Al-Qanunn Fit-tib (or Code of Laws in Medicine) represents the most important work of Avicenna, and as William Osler described it, the most famous medical textbook ever written. Avicenna talks about milk feeding, the characters of the good wet nurse and weakling. In this regard Avicenna stresses on the necessity of doing all efforts to keep the newborn on his mother milk-feeding as possible, because it is in its essence like his feeding during the embryonic stage. Related to weakling, Avicenna says that it should be gradually, and should be given first light foot such as light meet with soup. Then he stressed on the necessity of not enforcing the baby to sit or stand before he could perform that by him self.

Albucasis (al-Zahrawi) lived in Spain (al-Andalus), and died there in 1013. He is considered one of the most celebrated surgeons during the Medieval Ages. Albucasis talked about pediatric diseases and their treatments. Among these diseases are: gum tumors, aphtha, xophthalmous, thrush, ear pain and discharge, difficult breathing, cough, common cold, throat tumors, diarrhea, vomiting, hiccup, abdominal cramp, rectal prolapse, tenismus, worms, crying, sleeping disorders, bad dreams, bed wetting, convulsions, measles, smallpox and some congenital deformities with the surgical treatment.

The aim of this study is to highlight child health as viewed by some Muslim physicians during the Medieval Ages, and to present their contribution in this field of medicine.

BYZANTINE ASTROLABES AND THE CONTRUCTION OF GREEK AUTHORITY IN 16th-CENTURY EUROPE

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Despite a rich tradition of texts on the origins, construction, and use of the astrolabe— a tradition that extends from Johannes Philopponus' sixth-century text *Περὶ τῆς τοῦ ἀστρολάβου χρήσεως καὶ κατασκευῆς* , to Nicephorus Gregoras' fourteenth-century treatise, *Περὶ κατασκευῆς καὶ γενέσεως ἀστρολάβου* —remarkably few Byzantine astrolabes survive. The scarcity of instruments, however, did not deter sixteenth-century European instrument makers and authors from referring to a tradition of astrolabes in Byzantium. Indeed, Byzantine authors became required authorities in the Latin manuals on the astrolabes that poured from the presses during the sixteenth century. Gregoras, who is more commonly known for his *Ἱστορία Ῥωμαϊκη*, quickly became one of the most widely cited of the Byzantine authors. In this paper I first survey the various Byzantine authors whom Latin instrument makers regularly cited, cataloging where and in what contexts these later authors relied on their Greek predecessors. I then argue that Gregoras became an authority through the Latin redaction published by Giorgio Valla in 1498. Finally, I want to gesture to how these citations to Byzantine authors formed part of a larger effort to construct an image of Byzantine authority, distinct from both Arabic and classical Greek traditions.

Prior to the publication of Valla's Latin redaction *Nicephorus de astrolabo* in 1498, there are few if any citations to Gregoras's treatise on the astrolabe. Shortly after its appearance as the fifth tract in Valla's compendium, which included other Byzantine and Greek authors, Gregoras's text quickly became a standard authority amongst scholars in 16th-century Europe. Such disparate authors as Johannes Schöner and Johannes Stöffler in the early part of the century to Edward Sherburne in the late 17th century regularly cited Gregoras at various places in their own manuals. Looking at the contexts in which 16th-century authors cite Gregoras and the claims they ascribe to him, this portion of my paper argues that they do not appear to have read Gregoras's text. Instead, their familiarity with the Byzantine scholar seems to have been mediated through Valla's excerpt.

Finally, I want to conclude by relocating these citations to Gregoras back into the 16th-century context in which European scholars were trying to construct a distinct Byzantine intellectual tradition. Looking closely at the works of northern European and German scholars, I will highlight the differences they posited between Gregoras's work and his classical and Arabic antecedents. These differences help us recover the intellectual and cultural importance of Byzantium in the sixteenth century.

MATHEMATICS AND VENETIAN NAVAL ARCHITECTURE: AN ANALYSIS OF THE GEOMETRICAL METHODS IN SHIP DESIGN USED FROM THE 14th TO THE 17th CENTURY

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In the Late Middle Ages, shipbuilding was mostly an empirical practice depending on the shipwrights' skill, which developed from acquired experience communicated orally from masters to apprentices, and fathers to sons. However, during this period practical shipbuilding knowledge began to be recorded in texts, and no longer limited to the tradition of oral transmission. Literary evidence suggests that, at least starting from the 14th century, shipwrights used a number of geometrical methods to ensure control over the final shape of a ship's hull with a fair degree of precision. Although it is assumed that shipwrights were generally uneducated craftsmen, the geometrical methods used in ship design involved a profound understanding of mathematical notions, such as algorithms and triangular numbers.

This paper aims to explain the geometrical methods used in ship design during the Medieval and Renaissance periods in the Arsenal of Venice. By presenting several written sources, such as the unpublished *Libro di Navigar* (mid-14th century), we attempt to demonstrate that shipbuilding was a complex craft dictated by geometric rules, which, during the Renaissance, found similar applications in the principles of architectural design and perspective in painting.

THE *CISTERNA FULCRONICA* : WHAT CAN WE LEARN FROM A THE 16th CENTURY OCCITAN TREATISE OF ARITHMETICS ?

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The *Cisterna Fulcronica* (the Cistern of Fulconis), written in the tongue (a variety of Occitan) then prevailing in Nice, was published in 1562.

This Treatise on Commercial Arithmetics is remarkable among similar other works in Occitan language previously published for its focus on pedagogy rather than for its contribution to mathematical theories.

Its author, Juan-Francès Fulconis details his aims and helps his readers from all walks of life, whether merchants or artisans with a wealth of comments .

In doing so, he offers an insight on the social and economical life in this Mediterranean city, that was a stake in the hard struggle between the King François I of France and Charles V, the Holy Roman Emperor.

Fulconis also gives his sources and provides us with an interesting account of the circulation of mathematical ideas between Occitania and its neighbours.

We shall focus on the following three points : the pedagogy of Arithmetics, the sources of the book, and its socioeconomic background.

SCIENCE AND TRANSLATION IN THE 15th CENTURY EUROPE THE LATIN TEXTS ON THE *SEXAGENARIUM* BY JOHANNES BONIE AND CHRISTIANUS DE PROLIANUS

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There still many open questions on the manuscripts devoted to the sine quadrant. In particular, those texts translated or adapted from Arabic into Latin have not received much attention until recently. Such set of manuscripts is of great importance because they could help us to complete our knowledge of the history of trigonometric instruments.

In 15th century two scholars translated Arabic material on the sine quadrant into Latin: Johannes Bonie (Valencia, Spain) and Christianus de Prolianus (Naples, Italy). Johannes Bonie was active during the second half of the 15th century. He produced the first *exempla* of Latin texts and as well as the only extant roman text treating the theory and practice of the *Sexagenarium-Xixante*. Christianus de Prolianus was born in Balvano (Italy) in the first half of the 15th century. He was a celebrated astrologer in the Naples Spanish court. Antonello Petrucci, *secretario personal* of Fernando I de Nịpoles introducted him in this creative atmosphere composed by a select group of poets and scholars.

BnF miscellaneous Latin manuscript 10263 contains a text by Prolianus calling the sine quadrant *Sexagenarium*, Latin translation from the arabic *al-sittūnī.* This Arabic term has been used to name an instrument located at Oxford that has a sine quadrant on one of its sides and an *equatorium* on the other one. Prolianus explains in twenty five *canons* the applications of the sine quadrant as a complementary instrument in the back of the astrolabe. I will present in this paper the work done in collaboration with M. Aguiar Aguilar in the influence of Arabic sources in some Latin texts dealing with the sine quadrant.

MAGIC AND TECHNOLOGY IN EARLY ITALIAN RENAISSANCE: AUTOMATA IN BOIARDO'S "ORLANDO INNAMORATO"

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Matteo Maria Boiardo (1441-1494) was an Italian poet, who lived at Este's court in Ferrara at the end of the XV century; his unfinished masterpiece *Orlando Innamorato* is an epic poem and tells the story of the famous paladin Orlando, who falls in love with the beautiful Chinese princess Angelica.

In this poem, the author, by blending many different classical and Medieval literary sources (mostly Arthurian and Carolingian cycles), waves a 'wonderful' setting for his aristocratic audience, who enjoys his work: history, legends and myths are mixed together to build a virtually never-ending plot, always subjected to luck whims and to magic.

In one episode of the poem, the main character Orlando enters an underground cave, enchanted by Morgana, where he makes an astonishing discovery: gold-made automata studded with precious stones, are attending to their king's banquet in a huge room and they are acting like a real court. The scene is completed by an automaton-archer defending the king's treasure.

Even though Boiardo's goal is to impress and entertain his audience and to give a moral message against greed, he describes so accurately the automata behaviour that it is possible to model it with modern analysis tools.

It is interesting to remark that, although we can find Medieval literary sources for this episode, strictly connected with the theme of magic, Leonardo da Vinci's Atlantic codex and other notebooks of his date back to more or less the same years; in these works there are detailed drawings for a mechanical knight, perfectly dressed in armor, capable to perform different movements similar to human ones.

This paper will analyze Boiardo's text and its possibile historical or literary sources and present an abstract model of the described automata. Then, in order to draw a more general picture of early Renaissance mechanics, mainly automata technology, a comparison between Boiardo's and da Vinci's work is proposed.

M. M. Boiardo, Orlando innamorato sonetti e canzoni, a cura di Aldo Scaglione, Torino, UTET, 1951

G. Federici Vescovini, Medioevo magico. La magia tra religione e scienza nei secoli XIII e XIV, Torino, UTET, 2008

M. Taddei, I robot di Leonardo. La meccanica e i nuovi automi nei codici svelati. Milano, Leonardo3, 2007

FROM ABULCASIS TO GUY DE CHAULIAC – THE HISTORY OF THE SURGERY IN EUROPE IN THE MIDDLE AGES

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The Middle Ages is the one of the most interesting periods of the medicine, because a lot of great ideas were born then and these ideas advanced the development of the medicine so much.

Abulcasis was a moor doctor in Cordoba (Spain) who cured his patients and wrote medical books in the 10^{th} century. His collection "Altasrif" had tree parts. These books contained the modern surgical methods of this period. In the first we can read about the cauterization, the second contains all conditions amenable to surgical management other than fractures and dislocations and in the third book we can see some pictures about the instruments with them he cured the fractures and dislocations. Cause of his birth a lot of ideas were from the Arabic Period.

In the whole Middle Ages the most doctors and surgeons studied from this books that were translated into a lot of languages. These manuscripts contained the illustrations of the surgical instruments too. For example the members of the Salernitan Surgery, Theodoric, William of Salicet, Lanfranc, Jean Yperman and Henri de Mondeville read the excellent book of Abulcasis.

Also Guy de Chauliac who lived in the end of this period in Avignon (France) learned a lot of methods from Abulcasis. He studied medicine in the best universities of Europe and he became a very famous doctor who cured the pope too. He was good at medical practice, surgery and dentistry. Between his odontological instruments can we meet the razors, the iron scrapers, the lancets, the drills etc. With this huge knowledge he wrote his book "La Grande Chirurgie" with that he became the father of the modern surgery.

Thanks to the investigator doctors of the Middle Ages the surgery and other parts of the medicine developed and in the classical period the surgeons and barbers could cure their patients with more effective instruments.

THE SENSE OF HEARING AND THE RECONSIDERATION OF THE PRACTICAL SCIENCES IN ROGER BACON (1220-1292)

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Bacon construed hearing and sight as operating in inherently different ways. He assumed that light and colour were made of a stream of *species* resembling their agents and moving in straight lines, while sound was a series of circular movements in the air. Species cannot represent sound, since Bacon identified sound with quantity while excluding quantities from the range of information that *species* provide. In this way, Bacon excluded sound, hearing and language from the web of the necessary natural causes operating through the mechanism of the multiplication of species.

Following Aristotle, Bacon divided both the sciences and the human mind into speculative and practical parts. He described the speculative intellect as providing theoretical knowledge by receiving the species of things, while the practical intellect was assigned with the application of that knowledge to individual, material cases for the purpose of performing works. Bacon identified the practical intellect with the will, and claimed that it was the only truly rational part of the intellect, since rationality is only possible where there is free will and deliberation. He drew the line between nature and reason at the juncture where the intellect is no longer a passive receiver, whether by performing moral decisions, by imposing words or by actively experiencing the world.

Hearing, since it does not share the species-mechanism for transmitting information, cannot contribute to speculative knowledge. The strength of hearing was reserved by Bacon to the sphere of the practical intellect, yielding *prudetia* rather than *scienta*. *Prudentia* was a state of grasping the truth which involves action aimed at achieving ends. Aristotle defined prudence as "virtue" of the part of reason which "admits of being otherwise" and linked it with temperance and deliberation.

It would seem that since hearing does not contribute to *scientia*, and since Bacon was overwhelmingly occupied with vision and the ways it can achieve certified knowledge, that he would disregard hearing as far as knowledge is concerned, yet that was not the case. In Bacon's hands, the order of the speculative and practical, universal and particular was reversed. Now it was the practical and particular which received precedence. While for Aristotle the most important science was metaphysics, Bacon crowned ethics the noblest science of all. Practical truth should prevail, according to Bacon, over theoretical truth. The end of speculative knowledge lies in its practical application to the enhancement of human life. The intellect must ultimately be subordinated to the will.

The high rank and autonomy which the will receives in Bacon's semiotics cannot be over-emphasized. The only criterion for determining a word's significate is the speaker's will and intention. In the exact same way as he took the deterministic and necessary character of *species* to its extreme, he takes the autonomy of the human will – and along with that the prestige of hearing and the practical sciences – to the opposite extreme.

HOROSCOPES AS BIOGRAPHIES IN THE RENAISSANCE

Dóra Bobory

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The constant debate about the legitimacy of the most popular divinatory art, astrology, did not diminish its appeal to solvent customers in early modern Europe. Even if one accepts the tenets of astrology, the inexactness of the calculation method raises the question of how reliable the results really were and how much the astrologer may have invented of the events he foretold. The doubt is even more pressing when the horoscope is made retrospectively, after the death of the person in question. In an article on Cardano's horoscope of Petrarch, I proposed that the Italian astrologer complemented his calculations with field research, using the available biographies on the poet laureate, and he used the biographical data to prove himself right. It is well known that Cardano wrote and rewrote his own biography taking his many horoscopes as a starting point, and organised its chapters in topical units customary in nativity charts. In order to legitimize later interventions in horoscopes they had cast earlier, astrologers would freely use, and often abuse, what they called 'rectification,' correction of the data or their analysis thereof. In my paper, I propose to bring further examples to reinforce this theory, other nativity charts Cardano cast for deceased Renaissance celebrities, such as Giovanni Pico della Mirandola or Marsilio Ficino. If these speculations are correct, horoscopes cast by Renaissance astrologers may serve, albeit with reservations, as hitherto unexplored sources of biographical information.

THE LATE MEDIEVAL SALT MINING AND THE TECHNICAL QUESTIONS OF SALT TRANSPORT IN HUNGARY

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In the territory of the late medieval Hungarian Kingdom salt was mined in Transylvania and Máramaros. The mining of the mineral and its trade was a royal monopoly and it provided a respectable benefit for the treasure. Matthias Corvinus could count on 80-100 hundred forints every year that amounted to 12-14 % of his income.

The mining happened in bell-shaped pits. Its technology was similar to the technology that we know from information from the 18-19th century. On the basis of the description of Hans Dernschwam from 1528 we can say that some pits went down great depth because there was one in Torda with a bottom of 140 meter depth. In the case of such a depth the water usually raised problems, that is, why the mining had to be finished after a while. In such a case they established a mining place at a new place. The salt was cut in cubes. First they cut out bigger pieces then these pieces were cut into smaller ones. On the basis of an Italian description originated from the 1460s we can form an idea of the weight of the cubes. According to this source they cut out pieces of weight of 3 cantaro to 10-12 pounds, consequently we can talk about cubes of 3-5 kilograms. At the end of the 15th century or at the beginning of the 16th century the size of the cubes has changed. The size of the salt cubes was changing according to the mining places and it also depended on the way of transportation by ship or wagon. Those pieces that were transported by wagon were bigger than the ones that were taken by ship in the inland of the country. The salt transporting vessels from Transylvania were sent on the high water in spring. On Maros smaller ships ran while on Szamos surprisingly big conveyances were used. We can imagine ships with little plunging. The wagons transporting salt were bigger than the average.

Regular Session T08-01
Mathematics and Mechanics in the Classical Period (1543-1800)

THE PROBLEM OF PARALLELS IN ITS SOCIAL CONTEXT: THE POLITICAL, RELIGIOUS AND EDUCATIONAL CIRCUMSTANCES OF THE HUNGARIAN KINGDOM AT THE END OF THE 18th CENTURY

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The presentation examines the history of the problem of parallels in its social context at the turn of the 18th and the 19th century. The aim on the one hand is to show that there was not at all a general scientific interest in the problem of parallels at that time, and on the other hand to present that the problem seriously changed its status within a special mathematical community. Not exclusively the well-known evidences of the history of mathematics, but some further statistical data can show that behind the mathematical interest there was a kind of philosophical-metaphysical interest due to the ideas of Immanuel Kant. Therefore, the problem of parallels seems to be a kind of Kantian problem at the end of the 18th century. Since the Kantianism is closely related to the German Protestant area, so is the problem. The regional distribution of the publications dealing with the problems of parallels also supports the thesis: while the mathematical problem was neglected on the level of the whole mathematical community, at the same time the German Protestant scientific and intellectual sphere appreciated it prominently.

This phenomenon can be seen in a more contrastive way when the religious and political faults of the Hungarian Kingdom at the turn of 18th and the 19th century are examined from this point of view. The close examination of these faults can shed light on how closely the spreading of Kantianism is related to the Protestant regions of the Hungarian Kingdom. Because of the complex political and religious circumstances of the Hungarian Kingdom, the Protestants had no higher forms to learn in that area, and due to this they were forced to peregrinate to the foreign Protestant schools and universities. The examination of the peregrinating process can show that the lack of the higher educational forms was exactly the reason why they got into *that* German Protestant intellectual milieu where the problem of parallels was a real mathematical and philosophical question under discussion. Thus, the religious and political faults of the Hungarian Kingdom, supported by the educational peculiarity of her can reveal that the mathematical problem of the parallels is embedded in the Protestant community.

THE PROBLEM OF CONFLICT AND EXCHANGE OF KNOWLEDGE: THE CASE OF THE REVOLUTION IN BALLISTICS IN 18TH CENTURY EUROPE

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According to Steelle [2006], we should reconsider our assessment of the development of ballistics in 18th Century Europe. The traditional tendency has been to treat this development as arising from a conflict between Newtonian and Leibnizian camps, which leads to an overemphasis on the theoretical and formal differences between these groups. This type of analysis is certainly valid when we consider the polemic around the priority of infinitesimal analysis in the end of 17th Century and the philosophical debate known as the Leibniz-Clark controversy. There are, however, other cases in which this confrontational model does not provide an adequate explanation of the development of physico-mathematical sciences in the middle of 18th Century. Hence in this study, I introduce the concept of ``exchange'' and invert the usual account of the relationship between experimentation and mathematical theory, in order to explain the development of ballistics research in this era.

It is well know that the British engineer and mathematician Benjamin Robins (1707-1751) made a key contribution to ballistics research with his work *New Principles of Gunnery* (1742). In this book, for the first time, we find a natural philosopher distinguishing between inner and exterior ballistics by Newtonian mathematical methods. Robins' innovative device, the Ballistic Pendulum, is also famous because through this invention we are able to determine the initial velocity of a canon ball at the nozzle of the canon. The book also presents a number of problems requiring solutions. To fully determine a ballistic orbit, one must consider a non-linear partial differential equation. Robins' mathematical skills, however, were not sufficient to handle this problem.

Robins' work was further developed by Leonhard Euler (1707-1783), the greatest mathematician of the 18th Century and one of Leibniz school, who produced an expanded German version of the book: *Neue Grundsätze der Artillerie* (1745). As soon as he took up his new post in Berlin, in 1741, he began to insist on the importance of Robins' work to Frederick the Great (1712-1786). Indeed, Euler did not produce a simple translation of Robins' text. After close examination of the contents, he soon changed his approach to an analytical one, which was critically lacking in the original work. He made full use of methods of approximation when he treated certain typical differential equations.

In my research, Euler's innovations will be explained more precisely. At the same time, Robins' original contribution to the experimental knowledge of gunnery will be treated by a consideration of my concept of exchange.

Ref. [Steele 2006]: Steele, B. D. `Rational Mechanics as Enlightenment Engineering' In *Gunpowder, Explosives and the State,* ed. by Buchanan, B.J. Ashgate 2006, pp. 281-302.

DO NOT LUMP EVERYTHING TOGETHER THE FAILURE OF THE PHILOSOPHICAL MODEL, THE SUCCESS OF THE MATHEMATICAL ONE IN MECHANICS IN THE CLASSICAL PERIOD

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The Scientific Revolution did not give birth to a new Philosophy of Nature, but rather to the dominance of a *non-philosophical* model of analysing motion, that was successful, because it produced scientific results, proved *both geometrically and experimentally*, while the philosophical model appeared inconclusive. I propose a comparison between two couples of solutions to basic problems in Physics: (1) the range of projectles' launching and (2) the intensity of gravity force. I will compare (1) Tartaglia's *philosophical* solution (*Nova scientia*, II) and Galilei's *mathematical* one (*Discorsi e dimostrazioni matematiche*, IV) to the problem of how to obtain the highest output, when a projectile is shoot, by the same motive force, then (2) Descartes' *philosophical* concept of "gravity" (*Principia philosophiae*, II) and Newton's *mathematical* one (*Philosophiae naturalis principia mathematica*, I). Thus it will become clear that the success of Galilei and Newton's theories was due *uniquely* to the mathematical model they referred to: in fact, Galilei explained *mathematically* why Tartaglia's solution, confirmed *only* experimentally, was correct; Newton derived *mathematically* Kepler's first law of planetary motion (confirmed experimentally, too), a law that Descartes could not derive *in any way* from his "vortex-theory".

"JOHN THEOPHILUS DESAGULIERS: A NEWTONIAN BETWEEN THE PATRONAGE AND THE MARKET RELATIONS"

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A very wide process of dissemination of Sir Isaac Newton's Mechanical and Experimental Philosophy had taken place in eighteenth-century England, creating an atmosphere of fascination regarding the application possibilities of this new kind of knowledge to the necessities of productive life and the people's general welfare. The activities of many independent or itinerant lecturers, who traveled around the country, were fundamental to the spread of Newtonian Philosophy and the emergence of an ideal of Applied Science. These courses of 10, 12 or 16 lectures, with the presentation of many subjects and experiments, were performed to a very diversified and growing clientele which included not only a specialized audience formed by manufacturers, engineers and mechanics, but also *dilletante* gentlemen and ladies who had as the only objective the knowledge of basic principles arising from the Newton's *Principia* and *Opticks*, according to the independent and itinerant lecturers' interpretations.

The focus of the present paper is the intellectual trajectory of John Theophilus Desaguliers who was the Curator or "Official Experimenter" of the Royal Society of London and became a pioneer in the divulgation of Newtonianism and the most respected English independent lecturer of Mechanical and Experimental Philosophy in the first half of the eighteenth century.

His personal trajectory reflected, in some sense, the crossroad of Modern Science and many learned people who were advocating or divulgating it, being in the middle of a transition process from an aristocratic society, based on nobility values and patronage relations, to a new society established on the production and consumption of material and cultural goods which adopted more and more the nature of merchandises. One of the foundations of the emerging mercantile and capitalist society consisted in the full autonomy or freedom of producers and service renders in offering their "products" to the consumers, also autonomous and free, interested in buying them. Nevertheless, the outmatch of the old social order would still take a long time and its consolidation would occur only in the mid-nineteenth century, with the support of Experimental and Applied Science defended previously by Desaguliers, which was in the basis of England's transformation into the first industrial power of Earth.

THE EARLY YEARS OF GRESHAM COLLEGE, LONDON

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The Gresham Chair of Geometry is the oldest mathematics professorship in England, being founded in 1596, after Sir Thomas Gresham left instructions in his will for the founding of a college at which free lectures in seven subjects would be given to interested members of the general public. Four hundred years on, this is still the case.

This talk outlines the first one hundred years of the College and describes the geometry professors during this period, including Henry Briggs (co-inventor of logarithms), Isaac Barrow (first Lucasian Professor in Cambridge) and Robert Hooke. It also outlines the founding of the Royal Society, which was intimately associated with Gresham College and was based there, for its first fifty years.

L'ÉQUILIBRE DES SONS: LA MUSIQUE ET LES MÉCANIQUES CHEZ MARIN MERSENNE

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En 1627 Marin Mersenne publie le *Traité de l'harmonie universelle*, livre qui inaugure un projet dont les déploiements peuvent êtré detectés dans des oeuvres postérieures, particulièrement *Les Préludes de l'harmonie universelle* et *Les Questions harmoniques*, les deux de 1634, et le traité *Harmonie Universelle*, publié em 1636. La métaphore presentée dans le onzième théorème du premier livre du *Traité de l'harmonie universelle* dans lequel Mersenne déclare que les sciences empruntent quelque chose les unes aux autres, tout comme les parties de l' univers sont solidaires dans une certaine mesure, indique un aspect qu'approche les textes indiqués ci-dessus. En effet, dans tous les textes, on trouve à différentes circonstances, des rapprochements entre la musique et les autres sciences, comme par exemple l'arithmétique, la géometrie, l'optique, la morale, la médecine et la mécanique. C'est justement par l'intermédiaire de la musique que Mersenne souligne l'intégration entre ces différentes sciences. Dans ce contexte, le rapprochement entre la musique et les mécaniques est un sujet qui mérite attention. Il semble qu'il n'est pas anodin que Mersenne ait publié en 1634 la traduction du livre *Le Mecaniche*, de Galileu Galilei et, en 1636, le *Traité de Mechanique*, de Gilles Personne de Roberval, à la fin du troisième livre de L' *Harmonie Universelle*.

Compte tenu de ceci, cette présentation a pour but de traiter la relation entre la musique et les mécaniques à partir des éléments présents dans les théorèmes IX, X et XI du second livre du *Traité de l'harmonie universelle*, qui vise à établir quelques parallèles entre la musique et d'autres sciences. En constituant un bloc thématique, les trois théorèmes sont de bons exemples de ce que l'auteur affirme dans la métaphore indiquée précédemment. Le premier théorème enquête sur la ressemblance entre les consonances, les lignes, les figures et les solides géometriques. Le deuxième, établit une relation entre les sons produits par des cordes de même longueur avec les poids disposés dans une balance, en tenant compte des distances par rapport au centre de celle-ci. Enfin, le troisième théorème détermine et explique les principes des mécaniques. Je crois que par le biais de l'articulation entre ces trois théorèmes nous pouvons comprendre ce que Mersenne appelle "l'équilibre des sons" tout en prenant en compte les éléments provenant des mécaniques.

THE CONCEPT OF SPEED BY DESCARTES

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We may often encounter contradictions when interpreting Descartes' physical terms and entities on the footing of either present-day or Newtonian physics. One of the most typical examples of this practice is the use of the concept of speed in *Principles of Philosophy*. How could one discuss the concept of speed when Cartesian physics admits only extension as the single real property of bodies, and neither distance (the path of a point body) nor time (a point or period of time) can be interpreted in its conceptual framework? Is Cartesian physics really inconsistent and lacks elaboration? How can we explain that moving bodies are indeed able to change their direction of movement (determination) without changing their speed and thereby their quantity of motion? Could surface as an influencing factor or the assumption of some kind of friction be eliminated?

In my presentation I partly argue that speed can be interpreted as the size of the *part of space travelled* by an extended body rather than by one-dimensional *motion*. Apart from the fact that this interpretation is in perfect harmony with the theses of *Principles of Philosophy* I also show that it resolves its paradoxes.

I also argue that in Descartes' physics the speed of a body can only be interpreted relative to another body in motion, and speed essentially means only the difference between degrees of properties (faster or slower). If either of these bodies is in continuous motion that allows for grasping time, the part of space travelled thereby (as extension) will be indefinitely divisible, hence will time be arbitrarily small and continuous. It is this motion (and the time linked to it) that we can compare with the motion of other bodies and consequently interpret speed in this way and not as a sequence of momentary states.

PEDRO GIANNINI (FL. 1773-1800)

Juan Navarro-Loidi

I.B.D. « Bilintx » U.B.I San Sebastián, Spain

Pedro Giannini was a Tuscan mathematician, disciple of Vicenzo Riccati, who taught in Spain most of his life. In 1774 the Count Gazola, head of Carlos III's artillery, recruited him for the position of teacher of mathematics and chief of studies of the "Gentlemen Cadet's Military College of the Royal Artillery of Segovia". Giannini occupied that situation from 1777 up to 1803. This College of Segovia was an institution created in Spain during the Enlightenment to update the teaching of the artillery. It was important in that epoch, and it is still active as Academy of Artillery.

Giannini was a rigorous geometer, who knew well the considerable advances made in mathematics during the 17th and 18th centuries. His main task was as a professor. He printed a *Mathematical Course* (1779-1803, 4 v.) that was used in his classes. In this book elementary geometry, trigonometry, conics, arithmetic, algebra, equations, curves defined with equations, and differential and integral calculus are studied. Its last volume is about statics, hydrostatics and mechanics. He published also a practical book entitled *Practices of Geometry and Trigonometry* (Segovia, 1784) that was used for a long time in the Academy of Artillery. He wrote, equally, several research works on the cycloid, the cissoid, Apollonius' determinate sections and on several problems of mechanics that were put in print in two volumes *Opuscula Mathematica* (Parma, 1773) and *Opúsculos Matemáticos* (Segovia, 1780).

During the Enlightenment the Spanish mathematicians were related mostly with France or Great Britain, not with Italy, and they wrote very few research works. In that sense Giannini was an original personage. However he was not a very recognized author. He was not well connected. He worked in Segovia, far from the Court, and he had a reserved character. It didn't help to his renown neither to teach in a military institution, without belonging himself to the army

JACOPO RICCATI'S RESEARCH ON DIFFERENTIAL EQUATIONS

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Jacopo Riccati (1676-1754), a Veneto nobleman with a high skill in mathematics, was one of the few Italian mathematicians of his time who enjoyed an international reputation. Riccati played a prominent role in the diffusion of the Leibnizian calculus in Italy and his ideas influenced for a long time Italian mathematics.

Largely self-taught as a mathematician, by 1695 he begun studying Cartesian algebra and Newton's *Principia* and learned Leibniz calculus in the period between 1706 and 1709. He was frequently in touch with Nicolaus I, Nicolaus II and Daniel Bernoulli who shared with him an active interest in integral calculus and differential equation. Riccati's studies on differential equations led him to the discovery both of general solution methods and of the celebrated non linear first order differential equation $dy=ax^m\,dx + cy^2\,x^n\,dx$ currently named after him.

An extensive treatment of his results can be found in the interesting treatise *Della separazione delle indeterminate nelle equazioni differenziali del primo grado e della riduzione delle equazioni differenziali del secondo grado e d'altri gradi ulteriori* written around 1723 for his students Ludovico da Riva and Giuseppe Suzzi and published with *Annotazioni* [Notes] of his son Vincenzo in the first volume of the *Opere del conte Jacopo Riccati*. In this treatise in addition to expounding the techniques of other scholars, he presented in detail his personal methods, the most important of which are the method of *dimezzata separazione* [partial separation] and the method of "undetermined coefficients and exponents". The first one was conceived by Riccati in 1714, communicated to Leibniz through B. Zendrini and L. Bourguet, and then published in 1715 in the *Giornale de' Letterati d'Italia* in the framework of the controversy between Riccati and the two Bernoulli, Johann and Nicolaus I, on Jacob Hermann's solution of the inverse problem of central forces. The same method was also used to solve a famous problem posed by Hermann in the *Acta Eruditorum* of 1719. The method of undetermined coefficients and exponents, perfected in 1717, was the artifice which Riccati, as he explicitly acknowledged, used in the most difficult situations. With this method he studied the motion of the cycloidal pendulum in a resisting medium and the class of differential equations which represents this kind of problems. Riccati, dealing with this problem in the spring of 1717, exchanged with Nicolaus I Bernoulli a number of letters in which for the first time he introduced the Riccati differential equation. This correspondence started the search of the cases of integrability by separation of variables of Riccati equation, which involved also Nicolaus II, Daniel Bernoulli and later other skilful mathematicians. Riccati's solution uses an adaptation of the method of undetermined coefficients and exponents and was inserted in the treatise by his son Vincenzo.

JOHANN BERNOULLI'S RESEARCH ON MECHANICS

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Johann Bernoulli (1667-1748) is a well-known and highly appreciated mathematicien. However, his research on mechanics have been little studied. Partly because his mechanics has been regarded as an inconsistent aggregation of Cartesian, Newtonian and Leibnizian physics; applying calculus to mehcanics as a Newtonian, advocating living force (*vis viva*) as a Lebnizian and adopting vortex theory as a Cartesian.

The "vis viva controversy" began in the 1680s between Cartesians and Leibnizians; Cartesians defended the importance of momentum, while Leibnizians defended living force as the basis of mechanics. In the 1720s, various Newtonians entered the dispute and sided with the crucial role of momentum. Since then, historians believed that 18th century natural philosophers regarded living force as incompatible with and opposed to Newtonian mechanics, and Johann Bernoulli has been regarded as a "passionate defender" of living force doctrine. Central to his researches on mechanics was an attempt, according to many scholars, to show the superiority of the living force doctrine over the Newtonian principles of motion.

Reexamining carefully Johann Bernoulli's theory on vibrating string (1728) and his paper on mechanics (1735), the author discovers misinterpretations in these views of Johann Bernoull's mechanics. While both the paper of 1728 and 1735 have been considered to be based solely on the conservation of the living force, the author shows that each paper offered two solutions for one problem; the solution based on living force theory and the solution based on acceleration law. In these papers, Johann Bernoulli uses the conservation of living force. In addition, he also uses the acceleration law derived from Newton's *Principia*. Johann Bernoulli does not claim the superiority of the living force in these papers. Rather, he develops two solutions in each paper for examining the characteristics, structures and relations of the two solutions.

The author suggests that Johann Bernoulli did not regard these two solutions (conservation of *vis viva* and acceleration law) to exclude each other, but he was aware of the relations (although insufficiently) between them. This analysis aims at offering a comprehensive view of Johann Bernoulli's mature research on mechanics. It also provides an alternative view for looking at the prehistory of law of conservation of energy in the eighteenth century.

CHARLES BOSSUT, AN OUTSTANDING FRENCH MECHANIC AND MATHEMATICIAN OF THE XVIII CENTURY

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The paper focuses on the study of famous French scientist of XVIII Century, member of Paris Academy of Sciences and Institute of France, Charles Bossut's (1730-1814) life and creative work.

J. d'Alembert and his famous treatise "Dynamics" made a great influence on the formation of Bossut as a scientist and on his applied and theoretical work.

As soon as Bossut was appointed as Professor of Mathematics in Engineering School of Mezieres, he started to teach, later he continued teaching at Hydrodynamics Chair of a Military school in Louvre and at Polytechnic School. Teaching works on different aspects of mathematics, dynamics, statics and hydrodynamics prevail in the scientist's publications. The latter sphere causes a considerable interest in Bossut's mind, though the subject of the study is still just the experimental part. Experiments on moving in liquid bodies resistance definition made by the scientist along with d'Alembert and Condorcet are well-known.

In the period from 1763 to 1778 Charles Bossut published a major series of works intended for educational purposes, though having their own scientific value as well. In particular, "The most advantageous construction of dykes" was recognized not only in France but also in other European countries, as well as the studies on equilibrium vault calculation. "Elementary treatise on mechanics" was translated into Russian, and for many years has been used as a textbook on Mechanics in Russian universities.

Charles Bossut's final period of scientific work became a kind of resume: previous generations' theoretical experience collecting and generalizing with the following integration of knowledge. In 1802 and 1810 Bossut published his great works on history of mathematics, that covered the period from Ancient Times to the end of the XVIII century.

MATHEMATICAL EDUCATION IN WALACHIA, MOLDAVIA AND TRANSYLVANIA IN THE 18th CENTURY. EUROPEAN MOBILITY OF HIGHLY CULTIVATED PEOPLE

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Nowadays we live the globalization epoch, many times accentuating its economic side. The old ages lived globalization in a very sense under the cultural aspects. In the Romanian Principalities, as anywhere in the world, the mathematical education presented two specific features: a practical side, often linked by the measurement of lands, and its joining in philosophy. The humanists' role was very important in the mathematical education too.

The historical conditions delayed the educational process. The situation was unchanged from the begging of the first millennium, so as George Sorton wrote: "Roman mathematics remained always on a very low level; they were essentially restricted to the need of accounting and surveying". The first school where mathematics were taught to young people was "Scola Latina" at Cotnari, founded in 1562 by the prince Despot, a friend of the German humanist Philipp Melanchton. The sequel of the educational process was intensified in a significant measure in the 18th century. Some examples illustrate the development of mathematical education, under the flow of cultural values from the West Europe to the Romanian Countries. One academy was founded in Iassy at 1640, another in Bucharest at 1679. In Transylvania, beginning with 1581 many universities were founded and suppressed by religious causes. The education in Romanian language begins in 1754 at Blaj.

About the professors who taught mathematical knowledge in the Romanian Countries, some examples will illustrate the proposed theme.

In Walachia and Moldavia we find professors of Greek origin with studies in European cultural centers, as Padova, Bologna, Paris, Vienna, Constantinopole, Halle. We name some of them: *Sevastos Kyminitis*, *Ioan Comnen, Manase Eliad*, *Nicolae Cercel*, *Nichifor Teotochis*, *Hrisanthos Notaras*. Especially the last was a prominent humanist and had an important role in the cultural life in the Romanian Countries. In 1716 he published at Paris "Introductio ad geographiam et spheram", inscribed to the prince of Walachia, the first work with scientific character in Walachia and Moldavia.

The mathematical books were translated especial from German language into Greek, Latin and later into the Romanian language. The oldest manuscript in the Romanian language containing mathematics belongs to Matei Millo Spatharus, whose origin was in France. In Transylvania the first books with mathematical knowledge were written in Latin. "Elementa mathematica" is published at Cluj, author Maximilian Höll, who had studies in Cluj and Viena. In the Romanian language a little arithmetic (151 pages) was published in 1777 at Vienna, author being the school-master Johan von Felbiger.

With the beginning of the 19th century the Romanian school comes in a new era, especial by the development of the education, inclusive of mathematical education. All these were possible due to a knowledge accumulation, realized by scientific exchanges and absorption of cultural values.

THE DECIMALIZATION OF TRADITIONAL ORAL NUMERATION SYSTEMS ACROSS LANGUAGES AND CULTURE: A DIACHRONIC AND SYNCHRONIC OVERVIEW.

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In the entire world, across space and time, a large number of oral, non-decimal, numeration systems were transformed into decimal systems in different ways (pure mathematical change of base systems, limited or extended borrowing of foreign terms) for different uses (trading, local use in the city, general imposed use seen as the way to modernity) and by different actors (colonizers, local intellectuals, religious authority, education administrators or mundane village people within the influence of city life.

Different examples of decimalization, taken from languages in which the different stages of transformation can be historically dated, will be considered in order to establish a typology of these transformations.

These oral numeration systems belong to West Africa, to America (Meso-America and North-America), Asia (tibeto-burmese languages) and even Europe.

In a quite different sphere, the scholar one, numerous mathematicians have argued during centuries for a official change from the decimal system. A lot of them were in favor of a duodecimal base, some in favor of a four-base, of a sixteen-base.

Arguments used by the mathematicians across time to change the numeration system from decimal to another base will be opposed to those of authority figure in non-hegemonic countries willing to "civilize " or to get "civilized" by adopting a decimal numeration system.

Regular Session T08-02
Physics and Astronomy in the Classical Period (1543-1800)

THE ASTRONOMICAL OBSERVATIONS, HYPOTHESIS AND DEMONSTRATIONS IN *CHONGZHEN LISHU* – A CASE STUDY OF THE MOON'S THEORY

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Chongzhen Lishu was a literature of the Ming Dynasty introducing the European classical astronomy. Some content of Ptolemy's *Almagest* was introduced into China for the first time. It thinks that the lunar observation data and the theory of the ancient Greek in *Yuelilizhi* were distilled from the Ptolemy's *Almagest.* It concludes that Ptolemy's astronomy brought the huge impact and influence to the Chinese astronomy in the late Ming dynasty. It is found that there were some disadvantages in the astronomical observation of the ancient China.

1. The reason and the principle and the basic rule to solved problems were firstly emphasized in *Yuelilizhi*. But there weren't any traditions and habits doing it in the Chinese astronomy. And the Chinese scholars defined Moon's motions by the geometrical model from the Ptolemy's astronomy.

2. The method of the choice of the lunar eclipses is divided into two steps in *Yuelilizhi*. The first one is two eclipses to be chose are same. The second method is that the distance of the moon away from the centre of the earth are same in two eclipses. The related word is the lease common multiple. In order to calculate the lease common multiple, The compilers textual research the records of eclipse observation in historical books of astronomy of 21 dynasties. There were only records about the years, months and days, but weren't the time of day, minutes and the degree and minutes of the longitude of the moon and the sun in the most of them. It thinks that Ptolemy's two hypothesis reflected two method s of the choice of the eclipses were cited in *Yuelilizhi*.

3. Ptolemy's method founded on the observation and the hypothesis, and his demonstration based on the Euclid's *Element* were spread into China in the late Ming times, especially the testify of equivalence about the epicycle and eccentric. There were some related figures and texts in *Yuelilizhi.* It was named in *Yuelilizhi*.

TYCHO BRAHE AND KEPLER IN PRAGUE: MULTIFOLD REFLECTIONS ON ASTRONOMY

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The collaboration between Tycho Brahe and Johannes Kepler which took place at Prague in the very first years of 17th century indicates a significant moment for the evolution of ideas in Astronomy.

The second half of the 16th century had been marked by the introduction of the Copernican system but it had not been accepted by the majority of the leading figures of Astronomy of the era. Kepler was a young enthusiastic Copernican but his theoretical figures had to be evaluated by the observational data which Tycho Brahe and his assistants had collected intensively for many years by observing the heavens.

Though Tycho was not a follower of Copernican Astronomy, his collaboration with Kepler would lead Astronomy to its new era.

The outcomes of their collaboration did not only confirm the wisdom of Kepler's theoretical predictions but also they vindicated the ability of Tycho Brahe to achieve outstandingly accurate measurements.

On the other hand, the conclusions that derived from the meeting of these two different personalities formulated a major attack to the traditional Aristotelian interpretation of the heavenly motions which had been already affected since 1543 and contributed significantly for the acceptance of the Copernican system from the scholars of the 17th century.

Our goal focuses on the trace of these multifold reflections on Astronomy that derived from the meeting of 'the prince among the astronomers' and the young obscure astronomer in Prague.

NOTES ON JOHANNES KEPLER'S BOOK ' HARMONICE MUNDI''

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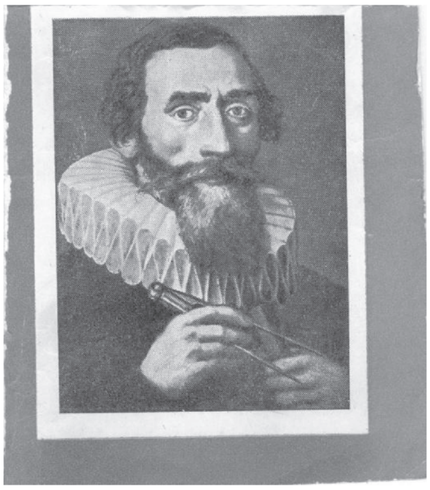
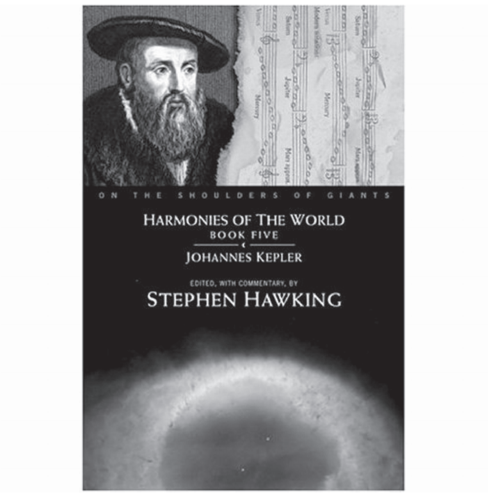
This year 2009 is the International Year of Astronomy dedicated in particular, to 400th anniversary of Kepler's work *Astronomia nova*. In this connection, various astronomy- and space related events (for example, a launch of Kepler's Mission spacecraft searching for habitable planets) are planned for the spring 2009 [1]. The idea of this presentation is a tribute to Johannes Kepler's life, one of greatest minds, a physicist, astronomer, philosopher and, in particular to his work *'The Harmony of the World''* [2]. This book was planned in 1599 by Kepler as a sequel to the *Mysterium cosmographicum* [2] but was delayed until 1619 since Kepler interrupted his work temporarily to study laws of planetary motion published for the first time in the *Astronomia nova* (1609).

In this presentation we briefly analyze from the view point of mathematics and the musical harmonies the selected chapters from Kepler's *Harmonics Mundi* –

Book III. On the origin of the harmonic proportions, and on the nature and difference of those things which are concerned with melody.

Book V. Harmonies of the World [3]





References

1. http://kepler.nasa.gov/
2. The Harmony of the World by Johannes Kepler. (Translated into English with an Introduction and Notes by E.J.Aiton, A.M.Duncan and J.V.Field). Copyright 1997 by the American Philosophical Society. Memoirs of the American Philosophical Society.
3. Harmonies of the World by Johannes Kepler with comments of Stephen Hawking.

ASTRONOMY AND OPTICS : THE DEVELOPMENT OF THE OPTICS OF MOVING BODIES.

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Studying history of optics, it can be shown that there are many interactions between astronomy and optics. For example, existence of a finite speed of light was shown on the 17th when Rømer compared the duration of Io's orbits towards Jupiter ; existence of a finite speed of light is also important when a star is observed whith a telescope, as James Bradley (1693-1762) had shown in 1728 by the observation of -Draconis and the discovery of stellar aberration. Works about connections between astronomy and optics, called optics of moving bodies, had been developped from the 17th, and concern the question of heliocentric system, stellar aberration, and, of course, speed of light. I will speak about the question of heliocentric system, then controversies about the existence or not of a speed of light and consequences for astronomical observations taking into account particular properties of light, and finally I will show how astronomical observations could confirm at the same time heliocentric system and existence of a finite speed of light. I will then highlight the results obtained by James Bradley through a comparative study between his and the French approach to the same phenomenon.

GEORG MARKGRAF IN DUTCH BRAZIL: HIS PIONEERING ASTRONOMICAL ACTIVITIES IN THE NEW WORLD

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Brazil's Northeast region was for a while under Dutch occupation during the 17th century. The Republic of the United Provinces of the Netherlands was then experiencing a golden age in arts and sciences. From 1638 through 1643, Georg Markgraf was a naturalist and the cosmographer to the court of Johan Maurits of Nassau, the colonial governor of Dutch Brazil, himself a humanist and lover of science.

Markgraf's work on Brazilian natural history was soon published in *Historia Naturalis Brasiliae* (1648). But his astronomical work did not have the same fate. Only fragments were published in *De Indiae utriusque* (1658). Later his observations were cited in *Annales Célestes du dix-septième siècle* by Pingré (1901). In 1979 J. D. North published *Georg Markgraf, an astronomer in the New World*.

Since the information on Markgraf's astronomical activities is still fragmentary and fuzzy, we thoroughly scrutinized the 114 pages in Latin of the astronomical notes of the Manuscripts of Paris (including transcription, translation, calculations and cross-checking references with other documents). The most important subsidiary document was the Manuscripts of Leiden (422 digital files) which, among other things, allowed the recognition of Markgraf's calligraphy and a comparison of notes referring to the same events and to the observations made in Leiden and then in Recife.

The present work deals with the observatory and its instruments (a 3D drawing was prepared); the periodization of the astronomical activities; the observation of eclipses; the meridian observation of stars; the meridian and extra-meridian observation of the Sun; and the planetary observations. The celestial positions in horizontal coordinates were quantitatively analyzed to obtain a statistical estimate of the observational and instrumental errors and to determine the latitude of the observatory. Because the stellar nomenclature was unsettled, especially for the southern sky, Markgraf invented some designations. This is the subject of a separate work. The lack of records of celestial rarities (comets and supernovae) is explainable, but not of the sunspots.

The scientific achievement is appraised under the light of Markgraf's own research plan, published in *Historia Naturalis*. He fell short of his aim. He had little time left for astronomical activities and Nassau's stay in Brazil was abbreviated. Markgraf could not even continue his career in Europe since he died prematurely in Angola. With the end of Dutch Brazil in 1654, this effort ended up as an isolated chapter of the Brazilian history of astronomy. But it occurred in a privileged moment of the history of astronomy (the transition from the kinematic astronomy of Kepler to Newton's dynamic one), so its historical recovery has worth. Moreover, until proof to the contrary, it is the first documented astronomical activity carried out in the New World and in the southern hemisphere in an established observatory (mimicking that one from Leiden University) endowed of a telescope, inspired yet by the first whiffs of modern science.

ISAAC NEWTON: THE EXOTERIC AND ESOTERIC KNOWLEDGE OF THE *PRINCIPIA*

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Philosophiae Naturalis Principia Mathematica was original published in 1687 and it has never been out of print since. It is the most remarkable book in the history of science and its originality and the power of thought have no equal. A. Rupert Hall claimed "No other approached its authority in vindicating the mechanistic view of nature." Although from a modern perspective this is the end result of the theory in the *Principia* it is in fact a misconception of Newton's philosophy behind the *Principia.* Newton was repelled by the concept of a mechanistic view of nature which had been promulgated by Descartes in *Principia Philosophiae* published in 1644. For Newton, a clock-universe that has been wound up and left to run had no room for God – this was inconceivable.

In the *Principia* he noted small variations in the orbits of Jupiter and Saturn. Also in *Opticks,* published in 1703, he claimed that Comets could not keep their orbs. Newton concluded that the designer of the universe, God, had to intervene to occasionally 'repair' and 'restore' the balance of the universe. God was not only the First Cause but he continually sustained the universe – God was a necessary presence. This view of the purpose of God is supported by Newton's unpublished papers, particularly in his writings on prophecy. He conceived the *Principia* as the exoteric knowledge of nature while the prophets held the esoteric knowledge of nature. The prophets could only be interpreted through hieroglyphs understood through the framework of the architecture of Solomon's Temple. Newton studied the architecture of the Temple, in detail; he believed that to understand the structure of the Temple was to understand the prophets and thus the mind of God. This paper examines Newton's association of the *Principia* and the architecture of the Temple of Solomon as the esoteric knowledge of nature.

TRANSFORMATION OF PROPOSITION VII IN BOOK I OF NEWTON'S PRINCIPIA WITH SPECIAL REFERENCE TO THE ADJOINING FIGURES

Takeshi Sugimoto

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Newton's Principia is a difficult book for modern readers. One of the reasons is loss of knowledge on Apollonius's Conics: this will be solved elsewhere in the near future. The original text is written in Latin, which is another hurdle. Translation of scientific documents needs special care to every words, equations and figures. One of the symbolic errors in the figures of Principia is found in the one adjoining Proposition VII in Book I. Scrutiny of the figures in different editions and translations leads us to two findings. One is transformation of the figures made by Newton himself: this revision results in extensive use of this proposition in proofs for other propositions. Another is a mere but serious error made by an editor and a draughtsman engaged in an American edition of Principia in 1934. This error contaminates to several modern editions of Principia in Japanese (1971 & 1979) and English (1999).

Proposition VII Problem II is such a problem as follows: let a body revolve in the circumference of a circle; it is required to find the law of the centripetal force tending toward some given point in the circumference. Newton's original figures are reproduced in figure 1 below. Figures in the first (1687) and second (1713) editions show semicircles. Newton's intension is hidden in the unpublished scholium (1684): …after the body reaches the centre *S*, it will no longer return to its orbit, but it will depart along the tangent. Therefore a semicircle is chosen. The revision from the first edition to the second edition is to move the centre *S* from the circumference into the inside of a circle. If so, the orbit has to be an entire circle. We speculate Newton realised that fact and added the lower half of the orbit in the third edition (1726).

The so-called Jesuits' editions of Principia (1739-42) are thorough annotation of the third edition including lots of quotes from Apollonius's Conics. Strangely enough the annotators use the figure of the second edition, *i.e.*, a semicircle. As we check capitalisation and punctuation, their text is taken from the third edition. The error in the figure is transmitted to the second Glasgow reissue of the Jesuits' editions (1833).

This scrutiny leads us to another special concern in Japan. The acclaimed Japanese translation from Latin is found to be translated from the American edition (1934).

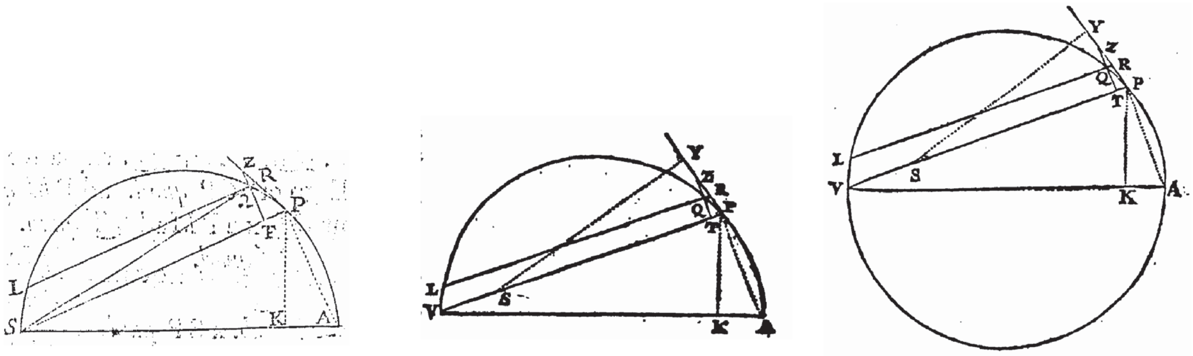

Figure 1. The figures for Proposition VII: 1st Ed.(left), 2nd Ed.(centre) and 3rd Ed.(right).

STARS, BIRTHS, AND KINGS: ASTROPHYSICS AND MYTHMAKING IN SEVENTEENTH-CENTURY ENGLAND

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As many historians have noted, a bright noon-day star allegedly appeared on May 29, 1630, the day the future Charles II of Great Britain was born. Evidence for this event has traditionally been drawn from the large corpus of Restoration propaganda that accompanied Charles II's return to the throne in 1660. This paper will explore the accuracy of these birth claims, as well as the broader historical context of the 'star-king' birth narrative. In doing so, it will highlight the complex relationship between astronomical phenomena and political propaganda in the Interregnum/Restoration period. Finally, it will consider the 'birth-star' event itself and evaluate the viable astronomical explanations for its cause. Using current, cutting-edge astrophysics, a radical new re-interpretation of this event will be put forward, one with important ramifications for astronomical research.

ANALOGIES OF SOUND AND LIGHT IN THE SCIENTIFIC WRITINGS OF ATHANASIUS KIRCHER

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The Jesuit Athanasius Kircher produced his exorbitant oeuvre of philological, historical, scientific and philosophical writings during the better part of the 17th century. Like many of his contemporaries, he had a somewhat different idea of what science is, and how it proceeds, than most of us today. One of the most prominent aspects of early modern thought that we find fault with is the role of analogy. It was at its height in alchemical and hermetic writings, and contained the belief that the elements of the macrocosm have their counterparts in the microcosm, and can be influenced by manipulation of those. Understood in this way analogical thinking seems to have no part in 'true' science.

Penelope Gouk has shown how the early modern science of sound developed in England in a web of science, music, and magic. In sound, this 'occult' quality that cannot be seen, sympathy as resonance actually works. Eberhard Knobloch has written about Kircher's combinatorics, and noted the role of analogical thinking for his world view. Melanie Wald has made an in-depth study of his *Musurgia Universalis*, the opus featuring most of his writings on sound, and stressed its interconnectedness with his other writings and the metaphysical significance it lends to music as the science of sound. What I want to do in this paper is not to retell the story of Kircher's convoluted writings overburdened with esoteric meanings. Rather, I want to explore how a specific set of analogies guides his reasoning about sound. Analogies in Kircher are not just about understanding esoteric meanings of scientific facts, they are, at least sometimes, about finding those facts in the first place and understanding their *scientific* content. On the one hand, he describes consonance as equal to light as a reflection of the universal harmony of creation, on the other, he explicitly states that sound is a *simia*, an 'ape' of light, and that knowledge secured about light can be transferred to sound under certain conditions. This latter statement is both informed by his belief in the harmonically ordered cosmos, and correct according to modern science.

The use of the analogy of sound with light is not limited to Kircher, and has been used extensively in writings both on optics and acoustics from Kepler to Newton and beyond. Newton even tried to explain properties of colours in the terms of musical intervals. Looking more closely at the relationships between the two sciences might teach us more about how early modern science developed.

THE STATUS OF THE MILKY WAY IN WILLIAM HERSCHEL'S WORK AND HOW DID SCIENCE HISTORIANS OF THE NINETEENTH CENTURY FOCUS THE QUESTION.

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According to Agnes Mary Clerke, who wrote popular books on the history of eighteenth century astronomy, the telescope has provided the means by which results were secured in that period. She believed that William Herschel's telescopes were the first examples of giant optical devices in the eighteenth century, extending the boundaries of the visible universe. Gazing the sky with his telescopes, Herschel produced, for example, his Catalogue of One Thousand new Nebulae and Clusters of Stars, published in 1786. Supposing that stars were nearly equally scattered and knowing the angular diameter of a determined field of view in which he knew the number of stars, Herschel wanted to determine empirically the length of the visual ray. In 1784 he presented a model for the appearance of the milky way, which, he believed, was a stratum of stars of various sizes.

Herschel's observations of the sky also raised questions about the nebulae, such as what they would be, what different types there were and whether they could be other milky ways like our own, composed of many individual stars. But how did the scientific community of the eighteenth century deal with issues like the shape of the milky way or the nature of nebulae? Historians took these questions to the next century, but, how did they focus it? Did they emphasize the same aspects that eighteenth century astronomers did? Was it an issue of importance to the astronomers? Was the cosmological scene in the eighteenth century devoted to answering questions about the nature of the nebulae or the milky way, such as whether it could be resolved into stars and why did it present itself to us in the observed shape?

In our work we analyze the period concerning the construction of a model for the milky way in William Herschel's works of 1784 and 1785, the relevance of the subject to Herschel as well as the impact of his results in his contemporary scientific community. Another point we analyze is the nebulae issue in Herschel's works and how his conclusions led to the vision supported by Agnes Mary Clerke, in her popular books, that the question of the milky way and the existence of other worlds was completely solved. Finally we investigate how the subject of the milky way spread in the nineteenth century through the work of historians, such as William Wheeler and Auguste Comte.

Regular Session T08-05
Biological and Medical Sciences in the Classical Period (1543-1800)

HOW ALDROVANDI READ, *AND LOOKED AT*, HIS LYCOSTHENES: READING PRACTICES, IMAGES, AND THE PERSISTENCE OF KNOWLEDGE IN SIXTEENTH-CENTURY NATURAL HISTORY.

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How did knowledge circulate between the texts by naturalists in the sixteenth and early seventeenth centuries? The ongoing discussions on the effects that the use of humanist reading and note taking practices, notably commonplacing, had on the composition of these texts have transformed the way we think about the history of natural history and other early modern scientific activities that relied on such technologies. This paper builds on this research. Yet it also widens the perspective with regard to the use of images. The ways in which the eminent Bolognese natural historian Ulisse Aldrovandi (1522-1605) processed knowledge are demonstrated by a small sample of both textual and pictorial information on preternatural phenomena he found in earlier publications.

Aldrovandi is an excellent case in point. His note taking practices or, more generally, his use of reading and writing technologies, was not idiosyncratic. The ways in which Aldrovandi dealt with images display striking similarities to those of other naturalist and non-naturalist authors at the time as well. An analysis of these practices can help us understand why knowledge could 'travel' so easily from work by one author to that of another, as will be shown. Furthermore, the paper tries to carve out parallels between these two fields in Aldrovandi: the verbal and the pictorial representation of natural historical phenomena.

THE MEDICAL LIBRARY OF THE SECRETARY OF THE KING OF SWEDEN: HENRIK MATSSON HUGGUT (CA. 1540?-1617): AUTHORS FROM THE ANTIQUITY TO THE RENAISSANCE.

Terhi Kiiskinen

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Henrik Matsson Huggut, a royal secretary, was one of the leading elected officials of John III of Sweden. His property was confiscated by John's rival, Duke Carl, in 1601 and the inventory shows that he owned a remarkable and precious library. There are more than two hundred and fifty titles representing the different fields of learning, and the works containing several volumes make the number even bigger. The collection resembles the libraries of Eric XIV and John III of Sweden in its main features. The sons of Gustav Vasa brought the Northern Renaissance in Sweden and were interested, besides theology, law and history, also in the natural sciences and medicine as well as the arts and literature.

The Huggut collection housed ca. thirty medical and medically related works. The scope of my presentation is this part of the collection. The fields of the works comprise among other things the humoral pathology of Antiquity and the Arab doctors, astrological medicine, theory of signatures, natural magic, Paracelsism, the art of distillation, medical botany, and the anatomy, physiology, pathology and epidemiology of early modern times. All in all the medical works of the Huggut collection show that at the end of the 16th century at least the top of the Swedish Empire was well informed about the newest and most actual currents of medicine. The Huggut collection was very precious, which shows willingness to make financial sacrifices for the sake of medical books and interest in the development of medicine. The collection contained also literature, which represents the top of medical research and treatment as well as the whole field of the medicine of those times.

MIDWIVES MODELLING MANNEQUINS: OBSTETRICAL MACHINERY AND MEDICAL KNOWLEDGE IN THE FRENCH ENLIGHTENMENT

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This paper will take the anatomical "machinery" crafted by both female and male obstetrical practitioners as a starting point from which to examine the place occupied by artificial models of the human body in mid-eighteenth century French medical culture. Known alternately as "phantoms," "doll-machines," and "mannequins," hand-made representations of the gravid body were both described in popular and learned treatises and marketed as pedagogical tools. It will be argued that such models were emblematic of Enlightenment medical thinking given their aim to both correct old prejudices and create new knowledge. In the first, these models were positively viewed for their conceptual ability to stand-in for Nature. As examples of the way things "objectively" were, these models proposed to overcome through education the popular and "occult" beliefs that shrouded in mystery practices surrounding the birthing process and resigned to "fate" the life chances of both mother and infant. Secondly, the materiality of these models promised to open up the vast recesses of the female body for all to see, taxonomise, and memorise in a bid to understand and manipulate the latest in birthing techniques. While the makers and marketers of these obstetrical mannequins championed their utility, and reinforced their application in stamping out waywardness and ignorance, sceptics pointed to their deficiencies and the new types of prejudices they seemed to create. As objects testifying to both medical theory and practice, these models occupy an important place in the histories of both objectivity and medical pedagogy. Within the larger context of the increasing role of the "man-midwife," and the female midwife's response, the contested aims and uses of these "machines" tells us something about both the conceptual and material themes that concerned medical practitioners, and the complex interaction of intellectual and cultural forces that shape the movement of material objects through scientific networks.

ANATOMY AND ITS ARTEFACTS: VISUALISING THE BODY IN THE EIGHTEENTH CENTURY

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This paper will explore the fashioning of anatomical modelling as a medical practice by focusing on the socio-cultural setting in which models were defined as a reliable source of medical knowledge. In the course of the eighteenth century, anatomical models promised to provide accurate insights into the inner body. Colored, three-dimensional and soft/moist-looking, they played an important part among the visual and material practices that characterized eighteenth-century medical representations of the body. Models also offered a means to overcome traditional shortcomings related to the physical deterioration, bed smells and the risks of contamination that characterised the messy setting of anatomical dissections, and were thus regarded as potential replacements of the natural body.

Created at the intersection between medical demonstration, artistic anatomy, religious imagery and curious display, eighteenth-century anatomical models captured the interest of several European courts and were included among the sightseeing attractions that made the lour of the Grand Tour. They were also turned into part of local heritage, and stimulated a sense of collective pride and identity. As such, models lay at the centre of a composite world of social interaction, and opened up the way to new forms of authorship related to the expertise of wax-modellers. For example, they granted fame and authority women like Marie Marguerite Bihéron (1719–1795) in Paris and Anna Morandi Manzolini (1714–1774) in Bologna. This paper will explore the social life of eighteenth-century anatomical models by focusing on the role of anatomical models in the context of the re-assessment of the notions of evidence and credibility supporting claims about the body.

INSTRUMENTAL USE OF EXPERIMENTAL PHYSICS IN MEDICINE AT THE ROYAL COLLEGE OF SURGERY OF BARCELONA (1760-1843)

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Science Communication Observatory (OCC). Universitat Pompeu Fabra de Barcelona, Spain

From 1764 the rules of the Spanish Royal Colleges of Surgery favored the celebration of scientific meetings where periodically dissertations were debated in a public session. That should be considered as new practice of scientific knowledge transmission and privileged scenario in which professional legitimation could be obtained in front of all members of the College Board by peer reviewing process.

Since chemistry and experimental physics were included in the academic programs of the Spanish colleges of surgery these kind of knowledge were considered a crucial tool to debate and to understand the unexplained processes that happened in the human body in healthy as well as in illness condition. Moreover, experimental physics application to healing arts was associated with the development of expertise managing and maintenance of electric machines devices.

Taking the Royal College of Surgery of Barcelona (1760-1843) as a case study, this communication aims to do a first approach about the uses of experimental physics applied to medicine as an emergent discipline capable to control diseases, together with cultural and social analyses of public discourses when several strategies of popularization of science had being implemented in the enlightened society at the end of eighteenth century in Spain.

GIOVANNI BORELLI (1608-79) ON ANIMAL MOVEMENT

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Giovanni Borelli, born in Naples in 1608, was a mathematician, physicist, astronomer and physiologist. Although Borelli also published on mathematics, astronomy and mechanics, he is best known for his work on animal motion, i.e. *De motu animalium* (1680-81).

The subject matter of Borelli's treatise on animal movement was unoriginal. Already Aristotle wrote a treatise with the same name. There exist two full-length medieval commentaries on Aristotle's work, written by Michael of Ephesus and Albertus Magnus. A number of shorter commentaries were written by several other medieval philosophers. The first modern studies in this field were published in the early 17th century. Fabricius of Aquapendente (1537-1619) published several works on the subject in the 1610s. William Harvey (1578-1657) wrote an unfinished manuscript called *De motu locali animalium*.

In my paper, I shall examine and compare Borelli's forms of explanation with those of his predecessors. Before Borelli, the movement of animals was often conceptualised with the help of social metaphors. Already Aristotle stated: “the animal organism must be conceived after the similitude of a well-governed commonwealth” (Aristotle, *Movement of Animals*, 703a 29-30). Harvey compared the animal body with an army, a state administration, a musical theatre, a construction company and a crew of a ship. In turn, Borelli conceptualised the animal body with the help of simple machines: “the operations of animals are carried out using instruments and mechanical means such as scales, levers, pulleys, winding-drums, nails, spirals, and so on” (Borelli, *De motu animalium*, Vol 1, p. 2).

Since Borelli's aim was to describe the movement of animals in a mechanical manner, he can be regarded as representing mechanical philosophy. However, unlike Descartes, Borelli is not prepared to regard animals as mere machines. Borelli is only prepared to say that an automaton has “a slight similarity” with animals since both are moved by natural faculties, and both are self-moving organic bodies making use of the laws of mechanics (Borelli, *De motu animalium*, vol. 2, p. 226). However, I still argue that Borelli can be called a “proper” mechanical philosopher.

Regular Session T08-06
Technology and Engineering in the Classical Period (1543-1800)

TECHNOLOGY AND ENGINEERING IN THE COUNCIL HOUSE TOWER OF MEDIEVAL BRASOV

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Transilvania University of Brasov, Romania

In time the HUMANS have learnt that they are dependant or an irreversible “flow” of the phenomena that give their existence a perishable status, a “ transient” character; therefore it is the HUMANS that strove for a rational understanding of time by measuring its “flow”.

The design of a time measuring “machine” was, without any doubt, the strangest invention to have ever been made. The time was captured in the clock and, serving as a substitute for nature, the HUMAN being kept it under control. Not long after the 13th century the tower clocks came out and subsequently the clockmakers guilds were developed all around Europe.

Around 1450 tower clocks were assembled on the external walls of the towers.

After series of continuous improvements brought around 1675 increased the precision to measure time, subsequently it was TIME itself to be measured.

The paper presents briefly some evolutionary aspects of distinct time measuring techniques through the development of HUMAN society, while emphasizing the way the passing of time is marked in historical Brasov by the tower clocks of the main architectural and cult buildings that existed or still exist here.

The paper reveals specific data by making reference to the evolution of the **Council House Tower Clock** since its origin and up to present days, undertaking various historical sources.

A special is held by the original aspects relevant to the present tower clock as regards its structure and evolution beginning with 1877 and up to present days, illustrating it together with its component parts.

Also, the paper herein takes a close approach to the hour bell (the bell striking the hour) incorporated in the Council House Tower of Brasov. The first hour bell, dating back to 1520, broke down after the great fire in 1689. In 1690 it was cast a new bell that still exists nowadays. For this bell there were made determinations as regards the analytical equations of the curves of the exterior and interior profile, as well as its thickness in longitudinal section.

The calculations were based on specific measurements as well as on graphical and graphical – analytical methods (respective time), as well as on the constructive diagram created by Knabbe – Nystrom method.

By comparing these classic methods of calculus there were created the conditions of a computer – aided calculation attempting to determine the variation functions of the curves of the exterior and interior profile of the bell on the basis of correlation and regression method. Following the determinations regarding the analytical equations of the curves of the exterior and interior profile of the hour bell there can be determined, both graphically and mathematically, the bell’s volume (the active part).

In the particular case of the hour bell in the Council House Tower of Brasov, this bell emits the sound FA sharp of lower octave with harmonic in DO sharp.

PORT ENGINEERING IN THE 17th CENTURY CONSTRUCTION INNOVATIONS AND LATER DEVELOPMENTS

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University of Genoa (Italy)

Over the centuries the port of Genoa, in the Mediterranean, has always been an important focal point for international maritime traffic. Having first begun as a natural landing place (Figure 1) situated at the eastern end of the stretch of coast included between the two headlands that delimit the Gulf of Genoa, it then became an artificial port starting from the 11th century presenting, in the first configuration, a wharf (*molo vecchio*) rooted on the eastern headland (Carignano headland) and built, mainly, of masonry covered by a face of squared stones as was done ashore for normal walls (Figure 2). The mole improved the protection of the berthing from the heavy seas coming from one of the two sectors of the main offshore winds (south-easterly heavy sea, *Scirocco*) which stressed the environ and led to an increase of the possibility of berthing for ships of larger sizes given that the mole, in the last stretch towards the head, had its foundations on a depth of about 12-15 metres.

The lack of protection of the port from the heavy seas coming from the other sector of offshore wind (south-westerly heavy sea; *Libeccio*) made the harbour basin particularly vulnerable as a consequence of the severe wave motion which could occur in it at the time of the aforesaid heavy seas (Figure 3). Already towards the mid-sixteenth century the urgency of having adequate protection had been pointed out, but only downstream of disastrous wave events that followed one another at limited time intervals (the years 1592, 1613, 1630, 1636) was the decision taken to proceed with the building of a mole (*molo nuovo*), rooted on the western headland (headland of the lighthouse or *Lanterna)*, which among other, besides guaranteeing the safety of berthing, encouraged the commercial attractiveness of the port (Figure 4) .

After a heated debate on the choice of the typology to be adopted for the new defence work, the appointment was entrusted in 1638 to Ansaldo De Mari, a Genoese man from an aristocratic family and "*ingegno elettissimo*[1] (highly superior talent)" already designer of the town walls. The financing for the realisation of this work was ensured by the *Banco di S. Giorgio*, an important Genoese bank [2].

In order to understand the importance of the technical solution proposed by De Mari better, it is worth remembering that at the start of the 17th century the theoretical knowledge of the different aspects of maritime engineering was very poor and could not supply theoretical support for the design of works in the sea. In particular, the behaviour of the dynamic action on maritime structures activated by the interaction with the wave motion was not known even at the qualitative level and, consequently, the proportioning of such structures, which were usually built of walls situated on emerging mounds of rocks of different size (such as for instance, the moles of Palermo, Naples, Leghorn and Malaga, as well as the *molo vecchio*, old mole, of Genoa recalled previously), was carried out on the basis of the personal sensitivity of the designer, not corroborated by external objective criteria.

De Mari set himself the objective of rationalising the design of the *molo nuovo* envisaging first of all the development presented, along the vertical direction, by the dynamic action exerted by the wave motion on a maritime structure of any typology whatsoever, then establishing, on the basis of the aforesaid development, the specific typology to be adopted, and finally proportioning, in a coherent way, the structure thus identified.

In detail De Mari, from an observation of the localisation of the damage provoked by severe heavy seas on the emerging mounds, formulated his own hypothesis of the course of the distribution of the dynamic action of wave motion which would seem to be mainly concentrated around the still water level (especially but not exclusively for waves in breaking conditions or near to such conditions), to then rapidly decrease proceeding toward the bottom.

Making reference to such a trend, De Mari proposed an appropriate typology of breakwater, on the one hand aimed at minimising the aforesaid damage and on the other suitable to lead to a competitive structure even with regard to the cost. The typology suggested envisaged the defence work subdivided into two parts respectively made up of a breakwater basement and a masonry structure or breakwater trunk of concrete (pozzolanic underwater) resting on it with a face of squared stones (Figure 5).

(Oversized abstract. Please contact the author for the full text)

ACOUSTIQUE PHYSIQUE ET PROCÉDÉS TECHNIQUES AUX XVIIÈME ET XVIIIÈME SIÈCLES

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Généralement on considère la sphère musicale comme le domaine de développement exclusif de la technologie acoustique, à travers la lutherie et l'organologie. Pourtant, depuis l'Antiquité jusqu'au XVIIème siècle, si le phénomène sonore est peu observé et peu expliqué, on utilise, parfois sans les comprendre, les propriétés particulières de la propagation des sons dans des domaines autres que musicaux.

A partir de la fin de la Renaissance, plusieurs usages sociaux font appel aux techniques acoustiques, notamment celles qui permettent l'amplification des sons, ou plutôt les techniques qui contournent la loi physique de l'atténuation des sons avec la distance. On trouve ces usages dans des domaines aussi divers que l'architecture, notamment celle des lieux scéniques ou des édifices religieux, la médecine de l'audition, la communication en mer ou encore la transmission discrète de la parole.

Déjà, aux confins de la Science Expérimentale naissante, la Magie Naturelle évoque des procédés sonores merveilleux, on les découvre chez Giambattista della Porta et plus tard dans les ouvrages abondamment illustrés d'Athanase Kircher. Marin Mersenne propose plusieurs applications à partir de la mesure de la vitesse du son. Les architectes font appel aux savants pour construire des voûtes dont les courbures permettent des conversations discrètes. A partir d'une obscure invention venue d'Espagne, on imagine des cornets acoustiques, et même des 'fauteuils pour les sourds'. Vers 1670, l'anglais Morland invente le porte-voix, suivi par de nombreux autres savants européens qui en cherchent la forme la plus efficace. A la fin du XVIIIème siècle, on utilise fréquemment des tuyaux dans les maisons pour communiquer d'une pièce à l'autre.

Tout au long de ces histoires d'inventions, se dégage une constante préoccupation, observer et comprendre le phénomène sonore pour inventer des usages nouveaux. A partir de ces procédés empiriques, dont on ne comprend pas toujours le fonctionnement, s'enrichit en retour une science acoustique nouvelle qui invente, à partir de l'expérience et de l'observation, une mathématisation de la propagation des ondes sonores dans l'air.

EULER MEETS DUTCH WINDMILLS: AN INTERSECTION BETWEEN MATHEMATICS AND EXPERIMENTAL PHILOSOPHY IN THE 18th CENTURY

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Windmills were one of the principal sources of power during the 18th century. They attracted the attention of many practitioners and theorists of the time. Even Leonhard Euler (1707–1783), one of history's most prominent mathematicians, was no exception. This paper examines Euler's theoretical study of windmills as an intersection between mathematics and experimental philosophy in the 18th century.

Euler addressed this subject for the first time in a paper published in 1754, in which he attempted to determine the maximal output of different power sources, including windmills. His entire argument was based on the so-called impact theory, the standard approach of the time for problems related to fluid resistance.

Four years later, Euler revised his theory in response to a report of experiments performed in the Netherlands. A professor at Leiden University, Johan Lulofs (1711–1768), the successor of famous natural philosopher Willem Jacob 's Gravesande, communicated this report to him. Lulofs was also active as the superintendent of rivers in the province of Holland, and he had much interest in improving windmills for land drainage.

Lulofs pointed out in his letter to Euler that the formula that Euler had derived gave considerably less output than those that were recorded in experiments with full-scale Dutch windmills. Lulofs reported that when the wind's speed was about 30 feet/s, a windmill could raise 1500 feet^3/min of water to a height of 4 feet. Euler's formula, applied to a mill with the same specifications as the mills used in the Dutch studies, gave a volume of 757 feet^3/min, almost half of what had been recorded. In his own treatise on this subject, Lulofs discussed this issue in detail and suggested rarefaction of the air after the sails as a cause of the discrepancy. In fact, Lulofs' results left much to be desired; in particular, his information about wind speed was unreliable. However, his measurement with full-scale windmills was a remarkable experiment at that time. The fact that Euler, after a few years, responded to it with a 70-page memoir indicates its impact.

Euler made a real effort to solve this problem. He revised the impact theory's formula by introducing a new term to represent the effect of backflow. He investigated the optimum distribution of twist on a sail. By so doing, Euler managed to explain away the discrepancy Lulofs had found. Although he still argued in terms of the impact theory, Euler's achievement shows the highest sophistication of the age. Lulofs, on the other hand, realized the defects in his data and found a new interest in measuring wind speed. This episode illustrates empirical challenges' role in the scientific activities before the advent of precise measurements and mathematical physics.

WOLFGANG VON KEMPELEN – A MASTER OF ENGINEERING IN THE AGE OF ENLIGHTENMENT

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Wolfgang von Kempelen was an outstanding personality in the history of the Austro-Hungarian administration during the Age of Enlightenment. Born into an aspiring middle- class family in Pressburg (later to become known as Bratislava), well-educated, respectful, diligent, polylinguistic, and of modest behaviour, he attained a high position as a civil servant in the Austro-Hungarian administration. The Austrian emperors entrusted him with various tasks in different places throughout the empire and, vice-versa, Kempelen also knew how to take advantage of the opportunities this presented to advance his own career.

The subject addressed by most authors in relation to Wolfgang von Kempelen is what is commonly referred to as 'the Turk' (a chess-playing automaton), which for years stimulated – and still stimulates – the fantasy of anyone hearing about it. Yet Wolfgang von Kempelen is assigned a permanent place in science history thanks to his speaking machine and the book he wrote on philology, linguistic technology and phonetics, entitled "*Mechanismus der menschlichen Sprache nebst Beschreibung einer sprechenden Maschine*" ('The Mechanism of Human Speech') and published in 1791.

Since, however, very little was known about his other achievements and the rest of his life, legends about him began to spread. The few available outlines of his life are incomplete and contain incorrect information. My research work on the personality of Wolfgang von Kempelen concentrated on the material which is to be found in the archives in Vienna, Budapest and Bratislava. Surprisingly enough, it emerged that there is a huge amount of accessible information about him.

The goal of the present lecture is to present a survey of Kempelen's technical skills and technical developments (excluding the chess-automaton and the speaking machine), most of which have remained unknown to the public until now.

Wolfgang von Kempelen consituted a new type of enlightened official, one who was immensely creative: he wrote poetry and theatre plays, he drew and he knew how to etch; he also developed water pumping equipment and an apparatus for lifting heavy loads, and designed an adjustable bed for the Austrian Empress Maria Theresia and a printing apparatus for the blind Viennese pianist Maria Theresia Paradis; furthermore, he developed a steam engine and a fire engine, pans for salt-works, a cutting machine for tobacco, and much more. Last but not least, he was interested in chemistry and brewing beer. Kempelen always had an open mind for technical innovations, although he was also willing to bear the hardships of being an entrepreneur.

Regular Session T09-01
Mathematics in the Contemporary Period (1800-)

KOLMOGOROV PROGRAM ON FOUNDATIONS OF MATHEMATICS

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Beginning with devising the Russell paradox (1902) and the proof of Gödel incompleteness theorems (1931) many scientists have been sure that the proof of consistency of foundations of mathematics as a whole was impossible. And no nuances are considered. It is supposed without reserve, that foundations of mathematics and its sections can be introduced and investigated by the axiomatic way mainly (according to Frege, Hilbert, etc).

Meanwhile Russian mathematician Andrey Kolmogorov (1903–1987) during preparation of his well-known work [1] "On the principle of excluded middle" (Tertium Non Datur) (1925) formulated the Program on foundations of CM (Classical Mathematics in its integrity) and noticed, in particular, that the tool of a theories (of the first-order theories of modern mathematics) can be introduced not according to Frege (i.e. axiomatically, as it is basically done today), but in a new fashion: for example, set-theoretically on the basis of the naive (unformalized) set theory. Kolmogorov assumed to use set-theoretic construction of theories, in particular, for the proof of consistency of some of most interesting of them. He noted that his reduction of 1925 (see [1]) allows one, by using a set-theoretical generality, to considerably simplify constructions and proofs, making them more easily understandable and popular. And it was Kolmogorov who paid attention to derivations rules, the two floors (premises and conclusion) of which may underlie simplifications. It is important to choose for each theory the suitable axioms from all logically equivalent deduced formulas.

Kolmogorov's program on foundations of mathematics assumes that at formalization of CM it is necessary to consider two well-known components of CM – computing (algorithmic) and deductive (logical) and simultaneously to reflect without restrictions two Cantorian principles of set theory – unrestricted comprehension and unrestricted logic. All derivations of CM are constructed by application of these two Cantorian principles.

Results of the present work can and should be introduced into educational process – it is advisable to teach the foundations of modern mathematics not only axiomatically by Frege and Hilbert, but also set-theoretically by Kolmogorov.

References

[1] Kolmogorov, A.N., On the principle "Tertium non datur" // Matematicheskiy Sbornik, 1925, Vol. 32, ¹ 4, pp. 646–667. Translated into English as "On the principle of excluded middle" in "Van Heijenoort J. From Frege to Gödel. A Source Book in Mathematical Logic, 1879–1931. – Cambridge, MA: Harvard Univ. Press, 1967, pp. 414–437.

KAZIMIERZ ŻORAWSKI, HIS WORK AND THE CREATION OF THE CRACOW MATHEMATICAL SCHOOL

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Before the Polish Mathematical School was created in the XXth century, its germs had appeared at two important historical Polish universities in Lwów and Kraków, at the end of the XIXth century. However, the Polish state did not exist at that time. Kraków with its Jagiellonian Universtity contributed more to the development of mathematics on the Polish lands. Kazimierz Żorawski was a major influence on the development of mathematics in Cracow. He arrived in Cracow in May 1895, and was the first mathematician of great stature who worked at the Jagiellonian University for centuries, not counting Franciszek Mertens who taught at the university from 1865 to 1884.

Kazimierz Żorawski prepared his Ph.D. thesis, on the problems of invariance of differential forms, under the supervision of Sophus Lie and defended it in Leipzig in 1891. Lie himself wrote about the thesis:

Among the Leipzig theses we should mention a beautiful work by Żorawski about invariants of isometries […] Żorawski with great skill carried out difficult and complicated calculations necessary to solve the problem.

His interests included integral invariants, differential equations and their applications in differential geometry. His results were quoted by Felix Klein in his *Vorlesungen über die Entwicklung der Mathematik im 19. Jahrhundert.*

Unfortunately, many Żorawski's brilliant achievements remained unnoticed and were rediscovered by mathematicians from other countries. The main reason being that they were published only in Polish. The Author himself, being very modest, did not care much about emphasizing and spreading his own achievements.

We will review Żorawski's most important results, in particular those in geometry, published, forgotten and then rediscovered. We will pay attention to the significance of his activities in Cracow and their influence on the development of the Cracow center and of mathematics in Poland

QUATERNION ENGAGEMENTS AND TERRAINS OF KNOWLEDGE (1858-1880): A COMPARATIVE SOCIAL HISTORY OF PETER GUTHRIE TAIT AND WILLIAM KINGDON CLIFFORD

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Historical studies of quaternion mathematics have usually placed Sir William Rowan Hamilton's "discovery" of quaternions within the context of the history of modern vector analysis. Exemplary of this technique is the seminal study *A History of Vector Analysis* by Michael Crowe (1967), in which Hamilton's development of quaternions is seen as an important precursor to the eventual development of contemporary vector calculus. Within Crowe's account, the reader also finds the story of two transitional figures: Peter Guthrie Tait and William Kingdon Clifford – the central figures in this paper. Tait is described as a propagator of Hamiltonian methods – someone who wrote about them more succinctly than did Hamilton, and someone who applied them to various topical problems in dynamics. Meanwhile, Clifford is described as a secondary, minor figure – a transitional character whose development of bi-quaternions figures not at all in Crowe's historiography.

This paper will seek to redress those categorizations by effectively stopping the clock at 1880, before the "modern" conception of vector analysis had emerged. Following a brief account of the state of British mathematics and science in the first half of the century (1800-1850), this author focuses on the motivations behind Tait and Clifford's respective engagements with and uses of quaternion mathematics in the second half of the 19th-century. Using the analytical metaphor of "terrains of knowledge" (which is inspired, in part, by the Wittgensteinian metaphor of language games and by more recent sociological research on scientific boundaries), I aim to describe the environments – philosophical, institutional, political, and religious – within which Tait and Clifford worked. By describing the "terrains of knowledge" through which each actor navigated at the time that he worked to shape quaternion mathematics, the historian is better placed to explain why Tait and Clifford – two actors who lived in a similar time, in a similar place, and who engaged with similar conceptual artifacts (i.e. "quaternions") – operated in such divergent ways.

In the case of Tait, the crucial "terrains of knowledge" to consider in identifying his conceptual environment include: Cambridge mathematics in the 1850s; the institutionalized mathematical tradition at the University of Edinburgh; Industrial Scotland and its lucrative "science of energy;" and Presbyterian politics and its sectarian divisiveness. In Clifford's case, the salient terrains of knowledge to consider include: Cambridge mathematics in the 1860s; Darwinism and its social-philosophical offspring; the emergence of new geometries in Europe and Britain; and the University College London and its educational philosophy.

When combined, these "terrains of knowledge" constitute the varied intellectual environment within which each actor engaged with quaternion mathematics and within which each actor found the resources to justify and legitimate his respective views.

ONE OR MORE DEFINITIONS OF NUMBER IN GOTTLOB FREGE'S PAPERS?

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The main philosophical problem, which Frege investigated, was the question: "What is a number?" He maintained that the above question is a common problem for mathematicians and philosophers. Frege dealt with this subject for forty years of his life and during that time he worked out four ways of defining a number.

In his first book, *Begriffsschrift* (1878) and in an article written in the same year *Applications of "Conceptual Notation,"* the number was connected with succession of elements in sequence. In a similar way, the number was defined by Ludwig Wittgenstein in *Tractatus Logico-Philosophicus*. Furthermore Bertrand Russell in *Principia Mathematica* referred to Frege's definition of ancestral.

In his second book, *Die Grundlagen der Arithmetik* (1884), the number was defined by the relation of equinumerosity between concepts. There, Frege did not use his conceptual notation. He hoped that in this way, his conception would be better understood by the readers of the book, but unfortunately it did not happen.

In the first part of his last book, *Grundgesetze der Arithmetik* (1893), the number was also defined by the relation of equinumerosity between concepts. In contrast to the second book, Frege used his conceptual notation. Unfortunately, in the logical system presented, an antinomy was found.

The three above conceptions of the number underlay logicism, it means the view, that arithmetic of the natural number is derivable from logic. Twenty years after discovering of the antinomy in his logical system, Frege maintained that arithmetic has to be based not on logic but on geometry. He only drew an outline of this idea and died before his working was completed.

THE EMERGENCE OF FRACTIONAL CALCULUS

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The fractional calculus is a field of the mathematical analysis that it has revealed of great importance in the modeling of problems of the physics, the economy and the engineering.

The first indications of the fractional calculus appear toward final of the XVII century to the around of some comments of L'Hospital regarding the value of n in the notation $\frac{d^n y}{dx^n}$ invented by Leibniz, who gives the possibility of considering derived of order ½.

In the following years other mathematicians had approach to the calculation of derivatives of arbitrary order of diverse functions, as it becomes evident in the works of Leonar Euler (1738), Laplace (1812), S. F. Lacroix (1820), Jean Baptiste Joseph Fourier (1822).

However, it is starting from Niels Henrik Abel (1823) and Liouville (1832) that is considered the proper history of the fractional calculus. Of the works of Liouville, grateful as the real creator of the fractional calculus, and Riemann (1837) we have one of the main denitions of fractional integral.

The fractional calculus continued evolving to the margin of the integer calculus through the competition of some mathematicians as: A.K. Grünwald (1867-1872), A. V. Letnikov (1868-1872), H. Laurent (1884), J. Hadamard (1892), O. Heaviside (1892-1912), H. Weyl (1917), H. T. Davis (1924-1936), D. V. Widder (1941) and M. Riesz (1949).

The main objective of the report is to analyze the emergence of the fractional calculus in agreement with the enunciated developments before.

FROM A MEASURE THEORY TO A THEORY OF MEASURES

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The idea of this talk is to describe how Carathéodory developed what can be rightfully named a theory of measures from the ideas set out initially in the late 19th and early 20th Centuries by Jordan, Borel and Lebesgue (among others) even though this was not the envisaged goal of these authors.

The three French authors we have mentioned all developed a measure as an auxiliary tool in their research, it is quite clear that none of them intended to study the measure they had created on its own; their goal was to facilitate and improve either integration theory or complex variable theory. However, it was the manner in which Borel and Lebesgue presented their measures that would eventually lead to Carathéodory's approach and it is our claim that it is at this moment that an object called a "measure" was introduced as such in mathematics. In other words, it was the axiomatic approach followed by Lebesgue (and Borel) that allowed Carathéodory's "formal theory of measurability" and eventually led to measure theory (as a theory whose objects are measures) as known today.

THE RIESZ BROTHERS'S CORRESPONDENCE

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The Riesz brothers, Frigyes Riesz (1880-1956) and Marcel Riesz (1886-1969) were world famous mathematicians in the 20th century. Frigyes Riesz was one of the founders of functional analysis; the famous Riesz-Fischer theorem is familiar to every mathematician. Marcel Riesz's main research topic was also mathematical analysis, and he founded a Swedish mathematical school devoted to the theory of partial differential equations. They were not only excellent scholars, but also founders of mathematical schools. Frigyes Riesz taught at universities in Hungary (Kolozsvár, Szeged and Budapest), and Marcel Riesz at universities in Sweden (Stockholm and Lund).

In 2002, the granddaughter of Marcel Riesz gave the academic legacy of Marcel Riesz to the Department of Mathematics at the University of Lund. László Filep (1941-2004), a Hungarian historian of mathematics, put this legacy in order in 2003. During his time in Sweden, Filep examined the letters of Hungarian mathematicians, and realized that probably the most interesting correspondence in the legacy was that between the two Riesz brothers. He planned to publish the Riesz brothers's correspondence in a book, but unfortunately Filep died a year later. In our project we carry on with his work at the Institute for History of Hungarian Sciences.

Marcel Riesz's academic legacy is quite interesting. He kept in contact with many mathematicians. In our work we focused mainly on the Hungarian correspondence, but we should mention that Prof. Jaak Peetre is currently working on the Swedish correspondence side. Frigyes Riesz's academic legacy is in Budapest. In his legacy we can find letters by Marcel Riesz. We would like to publish a book about the most important letters from a historical and mathematical point of view in the near future.

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THE BAIRE CLASS AND THE THEORY OF FUNCTIONS

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The objective of the conference is to show that the discontinuous functions begin to surface like a significant field with the theoretical developments of René Baire, established in his thesis doctoral of 1899. In this document Baire defines a hierarchy of functions designated the "Baire class". From Baire, we know that the continuous functions conforman only a first level of the universe of functions, since while the set of the continuous functions has the potencia of the continuous, the set of all the functions has a potencia greater. Through the exposition will show the way in that Baire uses the punctual convergence of sucesiones of functions in the perspective of the theory of set of Cantor and in the line of developments of Weierstrass, Darboux and Borel. The origin of the developments of Baire have relation with his interpretation of the famous false teorema of Cauchy, as which "sum arbitrary of continuous functions is continuous". For this Baire analysed the characteristics of the discontinuous functions, obtained of convergent series of continuous functions.

LA « MÉMÓIRE SUR LES MÉTHODES GÉNÉRALES D'INTEGRÁTION » DE JOAQUIM GOMES DE SOUZA (1829-1864).

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On June 1855 Joaquim Gomes de Souza submitted to Académie des Sciences his "Mémoire sur les méthodes générales d'integrátion". A committee consisting of M.M. Bienaumé, Lamé and Liouville was set up to report on the work, but Souzinha never got the appraisal of the paper. This mémoire and others works submitted to Académie and to the Royal Society were posthumously published as Mélanges du Calcul Intégral, by Brockhaus of Leipzig, in 1889, as expense of Brazilian govern. Souzinha was born in Itapecuru-mirim, Maranhão state, Brazil. In June of 1848 he received the degree of Bachelor on Physics and Mathematical Science by the Royal Military Academy of Rio de Janeiro, and in October of this year he get his doctorate in Mathematics with the dissertation "O modo de indagar novos astros sem o auxílio das observações diretas" (Way of investigating new stars without aid of the direct observations). It was the first doctorate granted in Brazil. He died in 1863.

In this memory he determines the function $\varphi(x)$ that solves the equation

$$\int_{\alpha}^{\beta} f(x,\theta)\varphi(x+\theta)\,d\theta = F(x)$$

He uses the development of infinite series without worry about its convergence.

LES COMMENCEMENTS DE LA SCIENCE STATISTIQUE À L´ESPAGNE ET PORTUGAL

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Au Portugal la première institution officielle de statistique commence à fonctionner en 1841 et s´appellerait « Section de Statistique et Topographie », à l´Espagne il faudrait encore attendre quinze ans, jusqu´à 1856 avec la création de la « Commission Générale de Statistique du Royaume ».

Le XIXième siècle est d´une grande importance pour la Statistique mondiale, en spéciale en Europe où il y a déjà en fonctionnement des sociétés professionnelles (London à 1835, Paris à 1860, …) Le ISI (International Statistique Institut) est fondé à London en 1885, à l´occasion du 50 anniversaire de la création de la Royal Statistical Society. Il établit la consolidation des réunions internationales de Statistique, que dans le nombre de neuf, avaient été organisées sous le protectorat de Monsieur Quetelet. La première réunion internationale à Madrid (Espagne) est en 1931, du 15 au 20 septembre. Au Portugal on devrait attendre jusqu´au le suivant siècle.

L´ Institut National de Statistique portugais est né à Lisbonne, en 1935, tandis qu'en Espagne se fait à Madrid, en 1945. C´est nécessaire d'y inclure la parenthèse espagnole de la guerre civile 1936-1939 et les premières années de l´après-guerre.

Dans l´histoire de la science l'Espagne et le Portugal vont toujours de la main, et en particulier dans la science statistique, avec un parallélisme étonnant dans les créations des diverses institutions nationales qui vont réguler la science statistique dans les deux pays. Dans cette communication on présentera les premiers apports espagnols et portugais à la Science Statistique et on démontrera que les deux pays ont toujours suivi des chemins pareils.

LE PÈRE DE LA RECHERCHE OPÉRATIONNELLE EN ESPAGNE : SIXTO RÍOS GARCÍA

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Sixto Ríos García a été considéré dans tout le monde scientifique comme le père espagnol de la Recherche Opérationnelle depuis la fin du XXième siècle. Ses réalisations sont connues dans tout le monde scientifique et son travail est reconnu autant en Espagne que dans toute la communauté internationale.

Sa vie a été un référant dans la formation des rechercheurs de son époque et dans la création des centres de recherche statistique, comme la première École de Statistique en Espagne et l´Institut de Statistique et de Recherche Opérationnelle du « Consejo Superior de Investigaciones Científicas » (CSIC) de Espagne et d´autres institutions pareilles à l´Amérique.

Le professeur Ríos a écrit plus de trente livres et plus de deux cents articles publiés dans divers magazines scientifiques internationaux. Il a laissé de nombreux élèves qui sont aujourd´hui directeurs de départements universitaires dans toute la géographie espagnole et aussi internationale.

Sixto Ríos est né à Pelahustán (Toledo- Espagne), le 4 janvier 1913, dans une Espagne rurale. Il commence ses études universitaires à Madrid et fait le doctorat avec le professeur Julio Rey Pastor, juste avant la guerre civile espagnole. Il a occupé la chair de Statistique Mathématique depuis le 5 juin 1948 jusqu´à sa retraite. Cette chair était unique en Espagne à cette époque-là.

Ses travaux et ses recherches seront après la guerre et la reconnaissance arrivera avec des prix espagnols et internationaux. Par exemple, il est nommé Académicien de Nombre de la Royal Académie de Sciences de Madrid en 1959, il reçoit le prix « Francisco Franco » de recherche en sciences accordé par le CSIC espagnol en 1975, et le prix « National de Recherche Mathématique » du roi Juan Carlos I d´Espagne en 1977. La Royal Society désigne Sixto Ríos Honorary Fellow en 1978.

Malgré sa retraite Sixto Ríos a continué ses recherches jusqu´à sa mort qui se produit le 8 Juillet 2008 à Madrid. Nous voulons le faire un petit hommage dans cette occasion pour l´histoire scientifique de l´Espagne et ainsi reconnaître ses mérites.

LA MIXITÉ DU PHILOSOPHIQUE ET DU MATHÉMATIQUE AU DÉBUT DU 19ÈME SIÈCLE: J.-B.-E. DU BOURGUET ET SES *TRAITÉS DE CALCUL DIFFÉRENTIEL ET INTÉGRAL* (1810).

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Les avancées mathématiques en France à la fin du $18^{ème}$ et au début du $19^{ème}$ siècle étaient encore souvent inscrites dans une vision philosophique. En témoignent les motivations revendiquées et argumentées des auteurs d’ouvrages d’analyse de rejeter l’infiniment petit (Lagrange, Arbogast, Lacroix, etc.). En témoignent aussi les nombreux articles parus à partir de 1810 dans les *Annales* de Gergonne qui relevaient de ce que ce dernier appelait la « philosophie mathématique » : la connexion avec la philosophie s’y exprimait dans toutes les branches des mathématiques. En témoignent enfin les ouvrages affichant strictement leur volonté de débattre sur les questions philosophiques sous-jacentes à des choix didactiques ou conceptuels : Carnot et sa *Métaphysique du calcul infinitésimal*, Wronski et son *Introduction à la philosophie des mathématiques et technie de l’algorithmie* ou sa *Réfutation de la théorie des fonctions analytiques de Lagrange*, etc.

Cette mixité du mathématique et du philosophique a trouvé une de ses plus belles expressions dans un ouvrage aujourd’hui méconnu : les *Traités de calcul différentiel et de calcul intégral* de J.-B.-E. Du Bourguet, parus en 1808. Après avoir situé ce document dans le contexte décrit ci-dessus, nous en proposerons une étude complétée par un rappel sur les articles de Du Bourguet parus dans les *Annales* de Gergonne.

Nous terminerons notre exposé par des compléments sur sa biographie qui ont été portés récemment à notre connaissance et qui nous éclairent sur un autre aspect de l’histoire des sciences : une sociologie des réseaux à une époque donnée, ici celui des militaires à la fois enseignants et scientifiques dans la période postrévolutionnaire.

Mots-clés : mathématiques / philosophie / calcul différentiel / Annales de Gergonne / Du Bourguet / Dubourguet

IS SCIENCE DISCOVERING NATURE OR "VICE VERSA"?

Jasna Fempl Madjarevic

Mathematical Society, Belgrade

From the *Sectio Aurea* to the Set Theory, throughout the centuries, mathematical models and other branches of science have been used to interpret various beautiful shapes & forms, bodies and curves in nature which, in turn have been objects of numerous mathematical researches and discoveries. Regular hexagon, for instance, is used to interpret snowflakes, bee-hive cells, etc. The snail's home follows a logarithmic spiral shape which has its own equation!

Ashes and lava form volcanic cones, space bodies are spheres, crystals in nature offer countless possibilities for serious research of regular polyhedrons and invoke admiration.

Man has never succeeded in taming nature although nature is not the only one to blame for worldwide catastrophes. On the other hand, whatever the science manages to build is prone to "destruction"

It is the modern age of the Internet that gives full relevance to the question initiated by the title - has the nature with its spider webs inspired builders of the world wide web to discover the ideal way of communication? The question of mutual pervasion of science and nature seems to be unavoidable.

Man - scientist should keep discovering and learning from nature. In turn, the nature "promises" to be more generous leaving the question of who the nature's programmer is eternally open. Is the nature all about chaos and coincidence or must there be some ultimate software running it ever so precisely? Honestly: who stands behind the magnificent world of nature?

VÁCLAV ŠIMERKA-MATHEMATICIAN, TEACHER, PRIEST

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Václav Šimerka was born 20th December 1819, died 26th December 1887. He studied theology and in 1845 was ordained a priest. Some years later he passed the state exam in mathematics and physics. Fro 1852 to 1862 he taught mathematics, physics and Czech language at the secondary school in Èeské Budìjovice. In 1862 he stopped teaching and become a parson.

Šimerka published several papers in mathematics, mostly in Journal for cultivation of Mathematics and physics. He specialized in algebra and number theory (congruence, arithmetic progression and so on.) He is although author of the book "Algebra or general reckoning", this book was approved as a text-book for secondary schools. The appendix of this book (later was published separately) deals with calculus, it was the first Czech book that dealt with advanced mathematics.

In 1871 he published paper "The power of conviction", in which Šimerka tried answer this question: "How can the conviction be expressed by numbers. ?" In this paper Šimerka tried to solve some philosophical problems through mathematics, especially through the probability. These extensive and interesting treatise was appreciated by Masaryk (philosopher and later the first President of Czechoslovakia). On the other hand this paper had not substantial influence although was published in Germany, too.

Šimerka¨s mathematical work was not epochal, but he has significant position among Czech mathematicians in the middle of 19th century. He was although good teacher, member of various association.

DES PONTS ENTRE L'EST ET L'OUEST : VARIATIONS AUSTRO-HONGROISES, PÉTERSBOURGEOISES ET KÖNIGSBOURGEOISES

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Dans cet exposé, nous nous intéressons à la circulation des textes mathématiques entre l'Europe de l'est et de l'ouest au XIX^e^ siècle. Grâce à deux épisodes précis concernant la géométrie non-euclidienne et les débuts de la topologie, nous mettons en lumière grâce à des documents en partie inédits le rôle joué par des journaux et des hommes.

Variations pétersbourgeoises et königsbourgeoises

Le célèbre problème des ponts posés par Euler, en latin, dans les *Commentaires de l'Académie des sciences de Saint Pétersbourg* en 1736 a été traduit pour la première fois en français par Émile Coupy en 1851 dans les *Nouvelles annales de mathématiques* [NAM, I, 10 (1851), 106-119]. À la suite de Coupy annonçant ses intentions: « Ce problème intéressant, d'une solution fort ingénieuse, n'a été traduit que je sache, dans aucun recueil français, et se trouve enfoui maintenant dans une volumineuse collection à la portée seulement des personnes qui habitent la capitale. », nous nous questionnerons sur le problème de l'accès aux sources et le rôle des traductions aux services du plus grand nombre grâce à des supports comme les *Nouvelles annales*.

Variations austro-hongroises

En 1832, le jeune mathématicien hongrois János Bolyai publie à Vienne, en appendice d'un ouvrage de son père, un traité de géométrie non-euclidienne ayant pour titre *Science absolue de l'espace*. Trois avant, en 1829, le jeune Lobatchevski avait publié un texte sur ce sujet dans le *Messager de Kazan*, un texte rejeté par Ostrogradski à l'Académie des sciences de St Petersbourg. Pour que les idées de Bolyai et Lobatchevki passe à l'ouest, il faudra du temps.

Presque une génération plus tard en 1853, Riemann s'empare du sujet et se consacre aux hypothèses qui servent de fondement à la géométrie. Jules Guillaume Hoüel (1823-1886) est un des rares connaisseurs de ce qui se passe à l'est. Il offre plusieurs traductions d'importance au *Journal de Liouville*. Des traductions de Dirichlet notamment. Des traductions qui inspirent les mathématiciens italiens qui à ce moment là ont le vent en poupe. C'est dans un journal italien – les *Annali* – que Hoüel traduit Riemann. Toujours en Italie, en 1867 et 1868, dans un journal réservé aux étudiants des universités –le *Giornale di matematiche* paraissent enfin en français les traductions, par Hoüel de Lobyai et Lobatchevki. Malgré les résistances, il finit par publier en France à la fin des années soixante Lobatchevski, Bolyai et Riemann. Pas dans une prestigieuse publication, les *Comptes Rendus de l'académie des sciences de Paris*, ou le *Journal de Liouville*, mais dans les *Mémoires de l'Académie des Sciences Physiques et Naturelles de* .. Bordeaux, où il enseigne.

Au-delà des considérations techniques, nous nous questionnerons sur les modes de transformations des textes mathématiques (les traductions), sur les acteurs de ces transformations (les traducteurs) et les supports de ces transformations (les journaux).

Mots-clés : géométrie non-euclidienne, Bolyai, Riemann, Höuel, *Journal de Liouville*, Königsberg, Coupy, *Nouvelles annales de mathématiques*, *Mémoires de l'Académie des Sciences Physiques et Naturelles de Bordeaux*.

Regular Session T09-02
Physics and Astronomy in the Contemporary Period (1800-)

THOMSON VERSUS CLAUSIUS: WHAT IS THE SHARE OF EACH ONE IN THE CREATION OF THE 2nd LAW OF THERMODYNAMICS?

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When the laws of thermodynamics come into play, many names are remembered. However, two of them share the merit of formulating the second law, these are: Rudolf Clausius (1822-1888) and William Thomson (1824-1907). The central aim of this communication is to review the secondary literature about the formulation of the 2nd law comparing them with the analysis of the primary sources, that is the original papers by Thomson and by Clausius in the period 1848-1851 (Thomson, 1848, 1849, 1851; Clausius, 1851). As secondary literature we have taken (Dias, 1996; Dias et al, 1995; Klein, 1974; Morus, 2008; and Smith, 1977, 2003).

Despite the more recent literature, our conclusion is that the most comprehensive and balanced analysis remains that written thirty years ago by Smith (1977). Although some authors give the merit of formulating the second law to only one of the authors, either Clausius or Thomson, for instance Morus concentrated his analysis only on Thomson's contribution, we claim that this development was indeed a co-creation of these two authors.

In his 1849 article, Thomson noted a contradiction between the principles of Carnot and Joule, raising the question of a possible choice between the two principles. Some authors point out that suggesting such a choice was Thomson's "mistake" (Klein, 1974; Dias et al, 1995). However, we believe that his contribution in this direction was of great importance, opening the way to Clausius (1850) achieve the reconciliation necessary to eliminate the choice "either-or" proposed by Thomson. Once known the solution proposed by Clausius, Thomson published his 1951 article suggesting two proposals about the changes between heat and work, now known as the 1st and 2nd laws of thermodynamics. As Smith (1977) argues: "[…] Clausius read Thomson's paper of 1849 on Carnot's theory and responded to it in 1850. We also know that Thomson was aware of Clausius' paper of 1850 when he published his 'Dynamical Theory of Heat' in 1851" (p. 232). Therefore, it should be noted that Thomson and Clausius walked across independent paths, while in interaction, to formulate the second law. Moreover, the modern statement of the Second Law, both by Thomson and by Clausius, depended on finding a compatibility between the principle of Carnot and of Joule, which suggests that the two formulations, in the process of its creation, strongly interacted to obtain the current understanding of the laws of thermodynamics.

We are grateful for the comments on an earlier draft of this communication provided by Olival Freire Junior.

A HISTORY OF ENTROPY THROUGH VARIOUS METHODS

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We have been studying a history of entropy through various methods.[1)] Our papers were compiled as a book called "A Historical Approach to entropy," in 2002.[2)] In this book R.Clausius's 16 papers (1850~1865) on the mechanical theory of heat were mainly studied through such various methods as text analysis with the help of Clausius's own manuscripts, mathematical equation analysis by the use of our own database, experimental data table analysis and technical term analysis. It was clearly recognized that the results acquired through the traditional text analysis were greatly expanded thanks to the other analyses. In addition to this expansion, new findings came out as a result of these analyses. They were 1. Clausius's pairing treatment of the first and second laws of thermodynamics through the equation analysis, 2. a sort of existence of experimental data distribution in the inter-European academic community which required Clausius to compare his value, 1/A with Joule's J (the equivalent of work for the unit of heat) through the experimental data table analysis, and 3. the wider possibility for non-natives of German to study the mechanical theory of heat through technical term analysis.

We briefly reported the above result at the annual Conference of the British Society for the History of Science in 2003.[3)] In the case of the method of the experimental table analysis: Clausius discussed a number of experimental tables in his papers on thermodynamics although he hardly carried out any experiments. We have collected Clausius's experimental tables to compare them with W. Thomson's because they both adopted some data from V. Regnault, a famous French experimentalist at that time. Through the experimental table analysis, the existence of three related tables by E. Clapeyron(1834), W. Thomson(1849) and R. Clausius(1850) was found out. These three tables include the so-called Carnot's function "C," the function of temperature, which played an important role in the formation of the second law of thermodynamics.

In the case of the technical term analysis: We started to use Clausius's 12th paper on the theory of electricity. Firstly, frequently appeared names of 10 physicists in the paper of 1853 were discussed rather than actual technical terms. These10 physicists are interestingly classified in two groups: 1) Physicists in the field of thermodynamics; S.Carnot, Mariotte & Gay-Lussac, Helmholtz, and W. Thomson, 2) Physicists in the field of electricity; Johann Poggendorff(1796-1877), George Ohm(1787-1854), Benjamin Franklin(1706-1790), Thomas Seebeck(1770-1831), and Jean Peltier(1785-1845), The last two physicists are direct predecessors of the thermoelectric effect (Seebeck effect and Peltier effect). W.Thomson(Kelvin) also belongs to the group of predecessors.

At this Congress, we would like to report our recent progress along the above lie. Particularly, through the two methods, namely, through the experimental data table analysis and through the technical term analysis where such typical technical terms as Verwandlung (transformation), Disgregation, Arberit (work) and Werk(action) will be considered as well as those of the 12th paper

1. Eri Yagi, "Studies on the history of thermodynamics through a database", BSHM Newsletter,39, pp.8-9,1999.
2. Eri Yagi, A Historical Approach to Entropy, Collected Papers of Eri Yagi and her Coworkers, at the Occasion of her Retirement, International Publishing Institute, Tokyo, 186pp. 2002.
   Supplement of the Collected Papers of Eri Yagi and her Coworkers, A Database from R. Clausius's Abhandlungen I- XVI, Eri YAGI Institute for History of Science, Kawagoe, Japan, 72pp. 2002.
3. Eri Yagi, "Various methods to study the mechanical theory of heat," Abstract: BSHS Annual Conference, York, 2003.

LA RÉCEPTION FRANÇAISE DE LA THÉORIE CINÉTIQUE DES GAZ

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Au début du XIX^{e} siècle la physique française a connu son âge d'or. Concernant la chaleur deux théories ont été proposées: le calorique (Laplace-Poisson) et la théorie ondulatoire de la chaleur (Ampère). La question de la transition des vielles théories à la théorie cinétique a reçu très peu d'attention. M. J. Nye, S. Brush et D. Pestre suggèrent que l'intérêt actif pour la théorie cinétique des gaz commençait avec la génération de Perrin, Langevin et Borel. Ils ont noté la marginalité de la théorie cinétique des gaz en France au XIX^{e} siècle et souligné quelques caractéristiques supposées de la physique française dans la seconde moitié du siècle : isolement, positivisme, anti-atomisme.

D'après la théorie ondulatoire les molécules sont composées par des atomes centres-de-force vibrant autour d'une position fixe et communiquant leur mouvement à travers des ondulations se propageant dans l'éther. Dans cette conception la chaleur rayonnante s'expliquait naturellement comme un mode de vibration de l'éther. Mais pour la théorie cinétique des gaz qui lui fit bientôt concurrence, le problème de l'éther était une source d'anomalies. Clausius s'abstint de condamner la conception vibratoire, même si sa théorie cinétique était supérieure dans le cas des gaz. L'année-même où il publie son premier mémoire sur la théorie cinétique des gaz, en 1857, il expose les deux hypothèses, la théorie vibratoire étant mise en relief. La majorité des Français s'intéressant à la nature de la chaleur, opticiens et/ou adeptes de la tradition de mécanique physique partageaient l'ontologie moléculaire de Laplace, Navier, Poisson et Ampère. En 1872 Joseph Boussinesq proposait encore une théorie des gaz inspirée des idées d'Ampère, comme alternative à la théorie de Clausius. Son mémoire ne devient compréhensible qu'en l'inscrivant dans la tradition post-aplacienne de mécanique physique dont les domaines (l'élasticité, l'hydrodynamique et l'éther mécanique lumineux) étaient au centre des réussites de la physique mathématique française à son âge d'or. Une des surprises de mon travail (développé dans ma thèse de doctorat "La réception française de la mécanique statistique", dirigée par Olivier Darrigol, Univ. Paris 7, 2008) est la persistance des convictions favorables à la théorie ondulatoire de la chaleur. Vers 1885, la version ampérienne du programme de la physique moléculaire était encore vivante. Elle garantissait encore une vision unificatrice des phénomènes, une cosmovision, partagée par une bonne partie de l'élite des physiciens français.

L'histoire usuelle des théories cinétiques de la chaleur est trop linéaire: elle sélectionne les travaux qui fondent la conception moderne (Clausius, Maxwell, Boltzmann et leurs proches) et ignore tout de qui s'en écarte.Il y a eu, dans toute la seconde moitié du XIX^{e}, plusieurs conceptions cinétiques de la chaleur. Cette situation peut être comparée à la multiplicité des théories mécaniques contemporaines de l'éther optique. Dans les années 1870-1890, on constate l'intérêt des Français pour des mémoires de Clausius n'appartenant pas à la théorie cinétique des gaz. Certains de ces mémoires concernent la réduction mécaniste du deuxième principe par analogie avec les systèmes périodiques; d'autres concernent le théorème du viriel. Contrairement aux clichés concernant l'absence d'une physique théorique française ou la dominance totale des approches empiriques et phénoménologiques, je constate que, pendant tout le XIX^{e} siècle, la plupart des physiciens français étaient favorables aux vues mécanistes.

THE RELATIONSHIP BETWEEN GIBBS' THEORY OF THERMODYNAMICS AND THAT OF STATISTICAL MECHANICS

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The aim of this paper is to investigate how Gibbs' theory of thermodynamics (TD) influenced on his formulation of statistical mechanics (SM). Although it is well-known that J. W. Gibbs (1839—1903) founded both modern TD and SM, few studies have examined the relationship between these two kinds of works. In this paper, the following points will be clarified: First, Gibbs sophisticated TD in order to explain chemical properties of matter. Second, Gibbs derived several equations analogous to the fundamental equations of TD from his theory of SM. Finally, Gibbs claimed that some ensembles have properties corresponding to the ones of systems in thermodynamic equilibrium. These points indicate that Gibbs had an idea that the chemical properties of matter can be derived from his theory of SM.

In his articles on TD (1873—1878), Gibbs characterized the equilibrium state of system with two variational principles called "criteria of equilibrium," which are equivalent to each other, and derived the fundamental equations, which contain all the thermodynamic information of the system. With these two tools, he showed that equilibrium must fulfill the condition that the temperature, pressure, and chemical potentials are constant throughout the whole system. He then explained several chemical properties of matter such as osmotic pressure with the conditions, therefore his theory of TD can be regarded as a theory of chemical properties of matter.

When he wrote *Elementary Principles in Statistical Mechanics* (1902), Gibbs tried to derive that kind of TD from the Hamiltonian analytical mechanics. He defined ensemble of systems, and introduced canonical or grand canonical ensembles as ensembles satisfying a condition "statistical equilibrium" that the distribution of ensemble remains constant. He deduced some equations in the ensembles, and then pointed out that there is a formal analogy between the equations in the ensembles and the fundamental equations in his theory of TD. On this analogy, he claimed the correspondence between quantities in the ensembles and ones in TD such as temperature, entropy, chemical potential.

Further, Gibbs showed that a canonical ensemble has a property corresponding to one of the criteria of equilibrium in his theory of TD. Also, he claimed that two grand canonical ensembles would form a film corresponding to a semi-permeable film in TD, and suggested that the statistical equilibrium between the two ensembles would be established when some conditions corresponding to the ones of equilibrium in his theory of TD were satisfied. Gibbs was aware that his theory of SM was incomplete because it could not derive the formation of all the phenomena explained in his theory of TD. However, he tried to derive his theory of TD as a theory of chemical properties of matter from SM, and when we examine his system of SM, we have to look at his theory of TD at the same time.

ON HERTZ´S PRINCIPLES OF MECHANICS

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Hertz's Principles of Mechanics was published posthumously in 1894. Great physicists of that time wrote on it between 1894 and 1902: Helmholtz, Fitzgerald, Poincaré, Mach, Boltzmann, Lorentz, among others. Reiff 1900, Ehrenfest 1904, Brill 1909 and Paulus 1916 developed some applications of Hertz's mechanics. The critical topic that Hertz's mechanics is too difficult in applications, led physicists to withdraw it from physics (Helmholtz 1894, Mach 1897, Boltzmann 1900, Duhem 1903, Winkelmann 1929, Lindsay and Margenau 1947, Sommerfeld 1948, Päsler 1968). According to Coelho 1996, this criticism has its roots in a misunderstanding of Hertz's philosophy presented in the introduction to the book. Whereas, according to Hertz, a physical theory is a picture ("Bild") constructed by us, physicists understood his mechanics as a common theory, which tells us what the reality is.

In the History of Science, there have been some studies on certain issues, such as mass, space and time, force or "Bild" (Kleinpeter 1898, , Jammer 1957, 1961, d'Agostino 1990, Hentschel 1998, Lützen 1999, Hamilton 2002, Nordmann 2002, Guzzardi 2005, Poser 2007, among others) and on the whole work i.e. involving the philosophical, mathematical and physical parts of Hertz's book (Coelho 1995, Lützen 2005). Some criticism on Hertz's mechanics and also on his philosophy can, however, be overcome, if both are considered in conjunction with each other.

An outline of how to understand the physical part, as a picture ("Bild") and the philosophy, thanks to examples drawn from mechanics, will be presented in this paper, as well as how this enables us to overcome the difficulties referred to by physicists and historians of science.

HERTZ´S EXPERIMENTS ON ELECTROMAGNETIC WAVES FROM MODERN RETROSPECTIVE: SERIOUS INDICATIONS ON INCOMPLETE APPROACH

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The 19th century electrodynamics became the battle-field of paramount importance to test existing conceptions of propagation of electromagnetic (EM) actions. There are no doubts that Hertz's contribution was decisive in that historical choice. He was the first physicist who observed EM waves in air travelling with the velocity of light according to Maxwell's theory. Since then it is generally believed that on the classical level the question of the general meaning, understanding and testing of the basic behavior of EM phenomena (as far as to the propagation is concerned) had been definitely and positively resolved.

In this work we expose several reasons why Hertz's experimental approach cannot be considered as conclusive at many points as it is generally implied by physicists and historians of science. In particular, we found it to be of interest to consider how the modern view on scientific method might have influenced on Hertz´s methodology and conclusions, had it been available at the time of his famous experiments on propagation of EM waves in air [1].

According to this analysis, the general enthusiasm for Hertz's experiments at the end of the 19th century as well as the unconditional acceptance with which their conclusions were received might seen somewhat unjustified in modern retrospective and, especially, in view of very recent experimental data obtained by the authors [2] that in many aspects replicated Hertz's original approach but filled the gap left by Hertz due to incompleteness of his methodology aggravated by the low level of the 19th century laboratory equipment.

References

[1] R. Smirnov-Rueda, "*On Essential Incompleteness of Hertz´s Experiments on Propagation of Electromagnetic Interactions*", Foundations of Physics, **35** (2005), 1-31

[2] A.L. Kholmetskii, O.V. Missevitch and R. Smirnov-Rueda, "*Measurement of Propagation Velocity of Bound Electromagnetic Fields in Near Zone*", Journal of Applied Physics, **102** (2007), 013529

INTERACTION OF EXPERIMENTAL PROGRAMS: THE DEVELOPMENT OF EXPERIMENTAL RESEARCH ON THERMAL RADIATION IN GERMANY AT THE END OF THE 19th CENTURY

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This paper analyses the development of experimental research on thermal radiation in Germany at the end of the 19th century from the viewpoint of 'experimental programs'. The concept of 'experimental program' indicates a set of experimentations. Experimentalists aim their research at some direction, and according to that direction, they select and develop some instruments, then make a kind of instrumental configuration for the intended experiment. If some problems appear, they adjust their instruments and instrumental configurations or try other instruments to measure and experiment. This continues until they achieve the aim of their experiments.

There were three main experimental programs in the radiation research in the 1890s. The first experimental program was led by Friedrich Paschen(1865-1947) in Hannover, searching for the energy distribution law through his spectroscopic radiation measurements. The second experimental program was led by Otto Lummer(1860-1925) and his collaborators in Berlin, improving the standards of light or heat on the service of the PTR. The third experimental program was led by Heinrich Rubens(1865-1922) and his collaborators in Berlin, making an examination of Maxwell's electromagnetic theory in the range of infrared wavelengths.

These three experimental programs interacted through the intersection of the aims of programs, the development of instruments and the investigation into the instrumental configurations in the research on thermal radiation at the end of the 19th century. The interaction between spectroscopic, standard-oriented and electromagnetic experimental programs provided the radiation experiments with the different precision instruments, the various configurations of instruments and the measurements on spectral radiation covering a wide range of wavelengths and temperatures.

PIAZZI SMYTH'S MAPPING OF THE SOLAR SPECTRUM IN LISBON, SINTRA AND MADEIRA: ANALYSIS OF RESULTS AND INSTRUMENTS

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In the 2nd half of the 19th century the impact of spectroscopy span across several sciences like chemistry, physics and astronomy. One of the most eclectic scientists of that time was Charles Piazzi Smyth (1819-1900) who was appointed Astronomer Royal for Scotland, based at the Calton Hill Observatory in Edinburgh and professor of Astronomy in the University of Edinburgh. He is mostly known for his contributions to astrophysics and photography. His successful research on solar and terrestrial spectra with an emphasis on visual representation was a major achievement. He also developed spectroscopic techniques to use in weather forecast.

During the years 1877 to 1881 Piazzi Smyth made several scientific voyages to Portugal, namely Lisbon, Sintra and Madeira to carry out spectroscopic and meteorological research. The scientific results were detailed and published in the Edinburgh Philosophical Transactions.

An account of his expeditions and scientific results was also contained in the books, Madeira Spectroscopic (1882) and Madeira Meteorologic (1882).

In this paper we will discuss the experiments and instruments he used to observe record and map the solar spectrum in continental Portugal and in Madeira in the years 1877 -1881 and how his research work contributed to the development of spectroscopy, photography and astronomy. We will also look into the relations he established with Portuguese scientific institutions, namely the Astronomical Observatory of Ajuda.

References:

PIAZZI SMYTH, C. (1877). Optical Spectroscopy of the Red End of the Solar Spectrum at a High Altitude in the Sky – Parte III – Observations at Lisbon*, The Astronomer Register*, Vol 179, pp. 281-293.

PIAZZI SMYTH, C.(1882). *Madeira Spectroscopic*, W. & A. K. Johnston. Edinburg.

PIAZZI SMYTH, C. (1882). *Madeira Meteorologic*, David Douglas, Edinburgh.

HERSCHEL, A. S. (1900).Some Notes on the Late Prof. Piazzi Smyth's Work in Spectroscopy, *Nature*, Vol. 62, pp. 161-165.

HENTSCHEL, K. (2002). *Mapping the Spectrum,* Oxford University Press, New York

PAST AS PREDICTION: VICTORIAN SCIENTISTS ON ANCIENT ECLIPSES AND THE POWER OF SCIENCE

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Greek historical accounts of ancient eclipses (such as those of Thales and Agathocles) were an important, if peculiar, focus of scientific attention in the nineteenth century. Victorian-era astronomers tried to correct the classical histories with scientific methods, then used those histories as data with which to calibrate their lunar theories, then rejected the histories of having any relevance to science at all. The specific dating of these eclipses – apparently a simple exercise in celestial mechanics – became bound up with tensions between scientific and humanistic approaches to the past as well as wider social debates over the power and authority of science in general.

The story begins in the early years of the nineteenth century, when the astronomer Francis Baily asserted that modern lunar theory allowed the solution to a millennia-old historical puzzle, the dating of an ancient battle disrupted by an eclipse (the so-called eclipse of Thales). A generation later, Baily's dating was rejected by G..B. Airy, the Astronomer Royal. But Airy's critique of Baily was not based on an incorrect calculation or inadmissible physical assumption. Rather, Airy said that Baily did not understand the Greek histories well enough, and argued that astronomers needed to correct their equations of the moon's motion based on certain readings of the classical texts. This elevated literary knowledge above scientific knowledge, a view that was well accepted by many of his British contemporaries.

However, this hierarchy was rejected in the 1870s by the American astronomer Simon Newcomb. He re-examined the ancient reports of eclipses and loudly rejected them as the basis for lunar theory. Newcomb was a firm believer in a rigorous, standardized "scientific method" and he rejected the reports of the Greek historians based on this: Herodotus did not follow proper methods, and therefore his reports could not be the basis for science. The British biologist T.H. Huxley took a similar approach, declaring that astronomy's precise deterministic calculations made science the sole authority for speaking about the past. Huxley argued that astronomy's ability to create accurate "retrospective prophecy" showed that scientific reasoning was superior to religion (and incidentally, helped support Darwin's theories). Both Newcomb and Huxley declared that prediction (of past and future) showed that the universe ran solely on natural laws, which gave science its persuasive power.

This strange journey of the ancient Greek eclipses through Victorian astronomy reveals how concerns about the social and cultural authority of science impacted concrete matters of evaluating data and solving equations, as well as played a role in wider debates about education, history, and religion.

THE ROAD TO THE WEST GOES SOUTH. INTERNATIONAL EXCHANGE IN ASTRONOMY IN THE EARLY 20th CENTURY

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Two important geographical shifts occurred in the astronomy in the late nineteenth, early twentieth-century. The first shift was to the South. Previously, almost all large observatories were located on the Northern hemisphere, but in this period, the Southern sky started to be studied systematically. The second shift was directed to the West: American astronomers and observatories became more and more prominent members of the astronomical community, in some cases replacing their European counterparts.

In this paper, I will argue that these two developments are connected. I will do so from the perspective of Dutch astronomers, who were both geographically and intellectually located between the Continental and the Anglo-Saxon research traditions. I will show how Southern astronomy (especially, but not exclusively, in South Africa) was instrumental for the establishment of contacts with the American astronomical community, which in turn led to a dynamic exchange of knowledge, instruments and people.

The analysis of the relations between European, Southern and American astronomers will contribute to our understanding of the dynamics of international scientific exchange. It will shed new light on the origins of the modern international astronomical community.

DANJON AND FRENCH ASTRONOMY DURING THE SECOND PART OF THE 20th CENTURY

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After WW I, France was an exhausted country and the first points to take into account were its reconstruction. Nevertheless, science was not completely absent and some works were under development when occurred WW II. Danjon (1990-1967), after WW I, went to Strasbourg Observatory placed under the directorship of Esclangon (1871954); he took over this position, when the last one became director of the Paris Observatory. At Esclangon's retirement, Danjon succeeded him in 1945.

The Observatory had lived, during the years of war, with a low level of activity, more or less limited to determination of time. Most instruments had been - at least for their optical, recording parts and micrometers - placed in safe storage. Among the staff, several men were in detention in Germany, others – mostly the younger ones – somewhere or outside of France. From 1941, some instruments came back into use, allowing to pursue some astronomical research.

After two successive wars, French astronomy had been left, in some way, as it was before WW I, with its main activities in Paris related to astrometry and derived domains, including the development of international cooperation. In Meudon, solar research was still at a high level, following Janssen (1824-1907) and Deslandres (1853-1948), the last one having obtained, under his directorship, that Paris and Meudon become only one institution, named *Observatoire de Paris.*

When in Paris, Danjon took care, not only of this institution, but also of French astronomy in general. Beside his personal research, in the field of the Earth rotation and in the courses at *La Sorbonne*, Danjon developed other activities, such as radioastronomy, celestial mechanics, time and related fields, astrophysics, the very beginnings of space research,... He pushed research for new instrumentation including recent computation capabilities, large telescopes, modern receptors,... Danjon took also care of all what is necessary within a large observatory, as it became, including new buildings in its three sites, recruiting engineers, technicians,... for the years to come after his retirement in1963.

THE AETHER DRAG EXPERIMENT IN THREE DIFFERENT CONTEXTS: FIZEAU (1851), MICHELSON AND MORLEY (1886), AND ZEEMAN (1914)

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Not only the relationship between theory and experimentation is of great interest in the development and history of physics, but also the contexts in which experiments are conceived, realized or repeated may add meaningful insight on the processes by which physics and science in general evolve. The case of Fizeau's aether drag experiment of 1851 and its "repetitions" by Michelson and Morley in 1886 and by Zeeman in 1914 is an example of how the same experiment performs very different heuristic roles in different contexts.

Fizeau originally proposed his experiment to address one of the most fundamental scientific questions of his time, *viz.*: if light is a wave in an all-pervading lightbearing medium – the *luminiferous aether* –, then what happens to the velocity of propagation of light in a *moving* transparent medium such as glass or water? Fizeau's experiment has since then been celebrated as an achievement of ingenuity and experimental expertise. Nonetheless, his results seemed puzzling to Fizeau himself and did not establish unequivocally any aether model, thus failing as a crucial experiment.

Michelson and Morley's "repetition" of Fizeau's experiment 35 years later was interesting mostly due to some advancement in instrumentation. Stepping on Michelson's own novel interferometric designs the authors managed to readdress the questions involving the optics of moving media. Their conclusions did not differ from Fizeau's, but pushed the accuracy of its results further up and gave insight for their famous experiment of 1887.

Michelson and Morley's 1886 setup was retaken by Zeeman from 1914 on as an experimental basis for his own research program. Now there was basically no advancement on the instrumentation, or at least not in the optical part of it, but there had been major modifications in the theoretical framing of the optics of moving transparent bodies with the establishment of the theory of relativity in the very first decade of the century. In particular Zeeman is interested in testing Lorentz's coefficient, a dispersive (*i. e.*, wavelength-dependent) term introduced as a necessary addition to Fresnel's drag coefficient. He concludes for the correctness of the term, fitting in with the new paradigm.

The same experiment was performed in different contexts and for different reasons, yielding different consequences. Hence subtracting the context from an experiment cannot lead to a full understanding of it, even within an internalist view of science.

FRINGE COSMO-(A)-GONIES: FRENCH AND BRITISH "COSMOGONISTS" FACING SCIENTIFIC STANDARDIZATION

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"There are as many cosmogonies as cosmogonists" – that's how historians of astronomy and of the planetary sciences describe the many theories explaining the origin of the solar system that arose between the 1850s and the 1930s. The works of Jaki (1978), Brush (1996), and Kragh (2004 and 2008), for instance, have documented the highly diverse production of hypotheses concerning these inorganic genetic problems during this period. My objective is not to challenge this fact, but rather to examine the reasons of this proliferation. The explanations that have been explicitly or implicitly given for this often only claim to reveal historical sciences' epistemological inability to discriminate between different challenging hypotheses. In this paper, I would like to adopt a different approach, one that considers social, cultural, and political factors.

The development of cosmogony was intimately linked with the process of making different kinds of professional communities, in this case in astronomy and in geology. The proliferation of cosmogonical hypotheses, and the crucial issues of who made them and where they made them, can be understood by recognizing this process of community building and its accompanying work of normalization. In other words, we must analyse how a "good" way of making astronomical or geological sciences was gradually imposed by certain institutions (Académie des Sciences, Observatoire de Paris, Museum in France, System of awards in the Colleges, Royal Astronomical Society in England), that considered (often implicitly) cosmogonical questions as scientifically acceptable or not. I will focus primarily on French cosmogonies between the 1870s and 1920s, a comparison with British case will allow me to highlight the evolution of national specificities.

As I will question the social and institutional spectrum of the actors involved, especially their amateur status, I will show how French and British cosmogonical practices diverged from the 1890s onward. In France we can observe that cosmogonical problems are gradually abandoned by professional astronomers, thus leaving behind a large space for amateur production (important professional astronomers like E. Roche and H. Faye were replaced by a swarm of amateurs like R. du Ligondès, H. Lafouge, E. Turpin, T. Moreux or E. Belot among many others, generally ignored by scientific authorities). However, in England, we continue to find important scientists interested in these questions, publishing their results in professional or popular media (there is no break between George Darwin, Robert Ball, James Jeans and Arthur Eddington). In order to explain the popular proliferation of hypotheses in the French case, I will show how the new norms that rule scientific production in observatories in the 3rd Republic implied a transfer of cosmogonical questions from professionals to amateurs. Highlighting the differences between French and British political and social contexts, especially through the relations between political and religious power, will allow me to explain some local particularities which present themselves in the treatment of cosmogonical problems during this period, like the variety of arguments used in both countries, or the social and political profile of the actors.

The study of French and British "cosmogonists" in their social and political context will be a way to enrich, with a new example, the array of the complex interactions that can exist between groups of actors (not necessarily unified) trying to establish forms of normality in the sciences, and a plurality of other actors, coming from various strata of society, and accepting or resisting those standards.

THE REVIVAL OF THE OSCILLATING UNIVERSE

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Models of the cyclic or oscillating universe go far back in time, and within the context of standard general-relativistic cosmology they were discussed in the interwar period by A. Friedmann, A. Einstein, R.C. Tolman and a few others. Although never generally accepted, the idea stayed alive after World War II, as one possible class of models among others. Surprisingly, from about 2000 it seems to have become quite popular among theoretical cosmologists, if certainly not generally accepted. How could oscillating models survive the discovery in 1998 that the universe is accelerating and topologically flat? Why was the new generation of cyclic-universe models proposed? And why were they seen as appealing in comparison with more standard models of a universe in eternal expansion?

A critical survey of this very recent episode in cosmology may give an insight into the modern history of cosmological thought and show how it connects with, as well as differs from, older and more established works in cosmology. One theme that needs to be considered is how far the new interest in oscillating models reflects emotional desires or other extrascientific motives, such as has previously been the case. Whether in its old or new forms, the cyclic universe is often claimed to be "philosophically appealing," but it is far from obvious what such a claim is supposed to mean.

ABOUT A NEW PERIODISATION OF THE HISTORY OF NEUTRINO AND WEAK INTERACTIONS FROM THE DISCOVERY OF Â$^-$-RADIOACTIVITY UP TO THE SOLUTION OF SOLAR NEUTRINO PUZZLE (SUDBURY,KAMLAND)

In memoriam Pierre Curie and Bruno Pontecorvo

T.TORÓ

Western University of TIMISOARA and SAPIENTIA University, ROMANIA

Thirty years ago Bruno Pontecorvo one of the founder of neutrino-physics and –astrophysics, on the occasion of 50th anniversary of neutrino, in 1980, proposed a periodisation of the half-century history of neutrino physics and astrophysics. Now in 2009, almost 30 years after this periodisation many new important results was obtained in this field (e.g. the direct experimental observation of vector-bosons W^-, W^+, Z^0 at CERN, the neutrino radiation from supernova SN1987A, observation of neutrino oscillation at SUDBURY, Canada, KamLAND, Japan and many others). In our proposed new periodisation we attempt to incorporate these new results up to solutions of solar neutrino puzzle with the mentioned neutrino-oscillation experiment at SUDBURY and KamLAND.

The paper is divided in three parts: the review the main periods (steps) of evolution of neutrino and weak interaction physics, a review the Nobel Prizes in this field and a list of some open questions in the future of neutrino- physics and –astrophysics as well as in weak interaction.

Totally, we have 37 Nobel Prize winners in this domain. This is an impressionable number, perhaps is one of the greatest number of Nobel Prize winners in a relatively narrow but very important field, which the neutrino and weak interactions physics is.

Open questions in physics, astrophysics and cosmology of neutrino as well as in different possible application.

1. The neutrino rest-mass in future direct experiments (KATRIN, Heidelberg-Moscow collaboration etc.)
2. What is the value of the minimal neutrino mass?
3. The neutrino mass from oscillation experiments, cosmic and terrestrial (SUDBURY, KamLAND, OPERA at CERN-GRAN-SASSO and from cosmological data (COBE, WMAP, PLANCK)
4. Dirac neutrino and Majorana neutrino? ââ-decay, new experiments (the distinction between neutrino and antineutrino, Heidelberg – Moscow collaboration, SUPERNEMO and others).
5. Neutrino physics and astrophysics at Ultra High and Extremely High energies (DUMAND, BAIKAL, AMANDA/ICECUBE, NESTOR, ANTARES, NEMO)
6. The problems of cosmological (relic) neutrinos.
7. The possible existence of tachyonic neutrino.
8. The new underground and underwater neutrino experiments in progress (MINOS, OPERA, T2K-Japan, LENA, PYHASALMI-Finland, BOREXINO).
9. The possible role of neutrino in dark matter and dark energy problems.
10. The neutrino factories, muon collider.
11. The possible role of neutrino in SETI .
12. The future of neutrino physics at LHC in Geneva (LHC-b detector and the problem of matter-antimatter asymmetry of the Universe.
13. The future of neutrino geophysics (the possible detection of antineutrino radiation of Earth).
14. The future of "neutrino-radar" (monitoring of antineutrino radiation from nuclear reactors at long distances for the possible control of proliferation of nuclear weapons by IAEA-Vienna.

If these, two last questions (and many others) will be transform in reality a theoretical question, in the future, the neutrinos the most elusive particles in the Universe from an object of research will become a strong instrument in the service of mankind, as the light carrier photon, as the electrical current carrier electron or like the neutron, the key of nuclear energy.

LOOKING THOUGH THE MICROSCOPE IN THE CONTEXT OF VIENNA INDETERMINISM ON A LOCAL WAY TO CONCEPTUALIZE BROWNIAN MOTION

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Albert Einstein's 1905 work on Brownian motion resembled a stroke of genius. Through a critical analysis of Boltzmann's *Lectures on Gas Theory* he concluded that Boltzmann had missed that the random motion of suspended particles in a liquid permits an empirical distinction between phenomenological thermodynamics and the kinetic theory of gases. In subsequent works, but not in the first, Einstein showed that such random motions corresponded to the well-known phenomenon of Brownian motion, which had defied naturalists' attempts at a coherent explanation since its discovery in 1827.

My paper starts out from the observation that in Habsburg Austria there existed a parallel tradition of research into Brownian motion that involved Sigmund Exner and his son Felix, and foremost Marian von Smoluchowski. While the Exners showed by precise experimentation that the commonly given explanations of the phenomenon were wanting, Smoluchowski pursued an independent, both theoretical and experimental line of research that led him to an independent derivation of Einstein's result and a generalization of it. Put against the backdrop of earlier attempts to understand Brownian motion – which in effect had been of little influence on Einstein –, one sees that Felix Exner in 1900 provided precise evidence that the observed velocities of the Brownian particles were irreconcilable with the kinetic theory of gases. Although had already been reached by the botanist Karl von Nägeli, Exner's paper showed with unparalleled precision that one had to make a fundamental choice.

While Boltzmann had tacitly excluded suspensions from his statistical mechanics – an inconsistency that would become Einstein's starting point – von Smoluchowski came to understand that despite the overwhelming intuitive evidence the particle velocities were ill-defined and a mere product of the scale on which a microscope operates. Thus, eight decades of research – the careful Sigmund Exner apart – had assumed to observe a quantity that was not there and had used increasingly sophisticated techniques to picture particle paths that were only an average resulting from the observational scale of the microscope. Finding a new measurable quantity, fluctuations of position, however required a deep change on the conceptual level. I will argue that such a stand was only possible once the indeterminism of the late Boltzmann was integrated into the relative frequency interpretation of probability. For, only within the context of this interpretation does there exist a transitional domain between microscopic randomness and the apparently deterministic macroscopic limit of random micro-phenomena. This synthesis between Boltzmann and Fechner's interpretation was brought to bear by Franz Serafin Exner, Sigmund's brother, who stood in close contacts with von Smoluchowski.

This case study about the interaction between instrumental and philosophical developments also teaches interesting lessons for the philosophy of scientific experimentation. Rather than a sourceof novelty, an experimental tradition might also prove a liability.

JUN ISHIWARA AS A FORERUNNER OF BOSE ON STATISTICS, DE BROGLIE ON PHASE-WAVE, AND EINSTEIN ON QUANTUM CONDITION

Seiya ABIKO

Seirei Christopher University (Prof. Emeritus), JAPAN

Jun Ishiwara (1881-1947) is the first Japanese theoretical physicist that reached international standard. He studied in Europe from 1912 to 1914 under Sommerfeld and Einstein, where he published seven papers on German physics journals. These papers are known to some extent among western researchers. I am taking up here his two papers published in Japan just before and after his studying abroad.

In 1911, Ishiwara was appointed assistant professor at newly built College of Science, Tohoku Imperial University. His paper "Contributions to the Theory of Light-Quantum" was accepted in 1911 and published in 1912 on the inaugural volume of *Sci. Rep. Tohoku Univ.* This paper is 37 pages long in German, but never noticed by foreign researchers. In Part II of this, in order to derive Planck's radiation formula, he presumed not only individual light-quanta ε, but also their complex named "light-molecules." He assumed that the number of degrees of freedom of a light-quantum differed depending on the constitution of light-molecule it belonged to. By maximizing the number of ways for distributing total degrees of freedom of light-quanta to the those of the phase space volume element they belonged to, given by the elementary volume multiplied by $2/h^3$, he obtained, for the ratio of these two numbers, $p = 1\big/\left[\exp(\beta\varepsilon)-1\right] = \sum_{i=1}^{\infty}\exp(-i\beta\varepsilon)$, thus arriving at Planck's radiation formula. He utilized the above series expansion in deducing the number-density of light-molecules composed of i light-quanta. In my view, this Ishiwara's method entails already the essence of Bose statistics. In the place of Bose's phase-space cells, Ishiwara introduced his light-molecules.

De Broglie utilized in 1922 the same term "light-molecule" and the same series expansion of Planck's formula as Ishiwara did in 1911. Examining the fluctuation of each term, de Broglie concluded that fluctuation due to light-molecules correspond to wave-like fluctuation of Planck's formula. This observation led de Broglie, next year, to introduce famous concept of "phase-wave," giving rise to coherence among individual quanta. On the other hand, in order to explain wave-like behavior of radiation, Ishiwara introduced in Part V of 1911 paper, minute electric and magnetic vectors associated to a light-quantum, with their interactions giving rise to light-molecules. His minute vectors seem to me a predecessor of de Broglie's phase-wave.

In his 1915 paper "The Universal Significance of the Quantum of Action," Ishiwara presented for the first time in the world the generalized quantum condition explaining at once Planck's radiation formula and Bohr's theory of atomic constitution. His quantum condition for a system with f degrees of freedom was $(1/f)\sum_{i=1}^{f}\int p_i\,dq_i = h$.

Because of the unnecessary factor $1/f$, his condition led to wrong conclusions. But, if this factor is neglected, his condition is essentially equivalent to $\oint_{c_k}\sum_{i=1}^{f} p_i\,dq_i = n_k h$ (k=1,…, f), which Einstein introduced in 1917 as the quantum condition independent of the choice of coordinates.

COMPTON'S LARGE ELECTRON AS AN EXAMPLE OF HIS CLASSICAL APPROACH TO X RAY SCATTERING

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The persona of Arthur Holly Compton (1892-1962) is connected with his quantum explanation for the X ray scattering by matter, suggesting that X and γ rays are composed by particles with quantized energy and momentum, which led him to win the 1927 Physics Nobel Prize. Such persona suggests Compton as somebody always related to the old quantum mechanics who made contributions to the transition to the new quantum mechanics. In this paper we intend to show a different character, a physicist fully devoted to explain X ray scattering through classical electrodynamics and classical models of the structure of matter. Indeed, what we call Compton effect was a late result, December 1922, of six years working on that classical approach, doing experimental as well theoretical research (Stuewer, 2000). Kevles (1977), writing on the history of American physics, reinforces our claim that Compton was a scientist interested in classical explanations for those phenomena and not a physicist devoted to work out the quantum theory. He argues that "among the authors of the remarkable discoveries was Arthur Holly Compton, who in the early 1920s was pioneering in the field of X-rays". According to Shankland (1973), Compton was interested in X ray physics from 1916, while he was doing his PhD, to the early 1930s when he switched to cosmic rays. Compton's work is an evidence of how the dilemma between wave and particle descriptions of radiation appeared also in X ray works and not only in optics. However, in this paper we intend to focus on the less known classical Compton, fully devoted to X Ray scattering. Our strategy is to present one of his most bold classical conjecture: to explain such scattering with the hypothesis of a large electron instead of the almost point electron early suggested by Thomson. With such model, Compton (1919) stated that he would be able to explain the low values found experimentally for the absorption coefficient as well as the difference observed between the intensity of the incident beam of γ-rays, after scattering, on the incident and emergent side of the plate. His hypothesis was that the electrons had a diameter comparable with the wave-length of the hard γ-rays. Through a detailed mathematical modeling he showed how such hypothesis allowed interference among the several incident rays and such interference could explain the available experimental results. Compton (1919a) considered three models of electrons to determine the absorption coefficient. After he analyzed the agreement of these models with experimental data, he concluded that the flexible ring electron model presented the better agreement with experimental results. Thus, it would be necessary to change the law absorption of high frequency so that it were considered the size and the shape of the electron (*ibid*., 1919b). Assuming the electron would have the model of flexible ring, his radius would therefore be $(1.85 \pm 0.05) \times 10^{-10}$ cm (*ibid*.). Despite his initial success, Compton abandoned his hypothesis of the large electron after getting better experimental results while working at the Cavendish Laboratory (Stuewer, 1975).

We are thankful to Olival Freire by discussions on is paper.

THE FOUNDATIONAL SIDE OF ITALIAN PHYSICS IN THE FIRST HALF OF THE XX CENTURY

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Alongside the recovery of Italy's place in physics in the XXth Century (mainly due to Enrico Fermi Group in Rome and to Bruno Rossi Group in Florence), there was in Italy too as abroad a consistent development of specific reflections, strongly theoretical and foundational in character, due to independent personalities endowed with both physical talent and competence and philosophical deepness. In particular, among the most relevant of them there were Ettore Majorana and Giovanni Gentile jr., son of the important idealist philosopher G. Gentile sr. Though they were rather linked to the Fermi Group, they also had critical attitudes towards them, as they were interested not only in physics in general but also in its links with other sciences and philosophy. Those interests are demonstrated by several foundational and theoretical writings, both of Gentile jr. (including his very important contribution to quantum statistics with a proposal of intermediate statistics or parastatistics, called from him "Gentilian statistics"), and Majorana's great anticipating theoretical writings on quantum field theory, from one side, and his methodological and foundational reflections on the role of statistics in both physical and social sciences, from the other side. On this subject Majorana wrote an important article which was published, after his disappearance, by his great friend Gentile jr. in a collection of essays of Gentile himself, to testify to the great friendship and community of ideas and interests between the two physicists.

Another autonomous personality of physicist, though great friend of Enrico Fermi, was Enrico Persico. He was much more interested than Fermi in methodological and foundational themes, such as the foundation of quantum mechanics (with a particular attention paid to wave mechanics) and the problem of causality in classical and quantum physics (on which he edited a volume of Planck's essays in Italian translation). Persico was also a great teacher who formed generations of physicists, in Florence, in Canada at Laval University, in Turin and in Rome, just for the importance he gave to the foundational side of physics, in order to avoid errors and ambiguities through accurate reflections on concepts and theories. Yet Persico, whose activity went on until 1969, was also able to join together theoretical and operative attitudes as a director of the theoretical section of accelerator physics at the National Laboratories of CNEN (National Committee for Nuclear Energy) in Frascati, near Rome and its State University, to elaborate projects and implementation of a national 1,1 GeV electrosincrotron. So he demonstrated the great fecundity of ideas and foundational reflections even at most applicative and experimental levels. After leaving the Laboratories at the end of the enterprise, Persico went on teaching theoretical physics of accelerators and reactors, so showing the utility of theoretical and foundational reflections not only to build machines but also to make them work.

RESEARCHES AND STUDIES IN MATHEMATICAL NON-CLASSICAL PHYSICS (QUANTUM; RELATIVIST) ACHIEVED IN THE PERIOD CCA. 1900 – CCA. 1939/1940 BY SCIENTISTS FROM CARPATHEAN-DANUBEAN-PONTEAN / ROMANIAN/SPACE

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The main items of this analytical-synthetical exegesis regarding the achievement of the scientists from Carpathean-Danubean-Pontean / Romanian/Space in mathematical non-clasical physics are following:

- The meaning of theoretical non-classical Physics in the period *Fin de Siècle and La Belle Èpoque*: physical, mathematical, experimental, methodological, epistemological et al. aspects.
- Precursor-al facts: the works of the erudite teacher Fàrkas Bolyai (1775-1856), and his genial son, the mathematician János Bolyai (1802 – 1860), creator of one non-Euclidian Geometry (used also later in general Relativistic Theory of Gravitation).
- The *vita et opus* of: Dragomir Hurmuzescu (-, Studies in â radioactivity), Victor Vâlcovici (1885-1970), Alexandru Proca ((1897 – 1955, Theory of mesons), George Vrânceanu (1900-1979, Geometrised non-holonomic unitary model), Ion Plãcinþeanu ((1893-1960, Vectors, tensors, potentials), Remus Rãduleþ (1904-1984, Vectors, tensors, potentials), Augustin Maior (1882- 1963, physicist, engineer, inventor, explaines the multi-telephony), Octav Onicescu (1892-1983) , Ion Ciortea (invariant-ive method), Nicolae Bãrbulescu, Valer Novacu, Serban Tiþeica, Stefania Mãrãcineanu (1882-1944, Radioactivity), Ion Bedreag (Historiography).

Some connections with other researches and *studia* achieved in more recent periods – post second world war - are also considered.

References

1. T. Weszely, *Farkas Bolyai* (Hungarian and Romanian) (Bucharest, 1974).
2. P. Stäckel, *W und J Bolyai, Geometrische Untersuchungen* (Leipzig, 1913).
3. B. Szénássy, *History of Mathematics in Hungary until the 20th Century* (Berlin-Heidelberg-New York, 1992).
4. T Weszely, Farkas Bolyai: Man and mathematician (Romanian), *Gaz. Mat. Publ. Lunara Pentru Tineret* 80 (8) (1975), 291-293
5. A. Maior, Uber Mehrfach-Fernsprechen*, Elektrotech. Zeitsch., 19, 84,* (1907)
6. A. Maior, Sur la télégraphie et la téléphonie multiple avec des courants de haute fréquence*, Révue Gén. Eléctr., vol.10, (1921)*
7. A. Maior, Champ gravifique et magnétisme*, C.R. Acad. Sci., Paris, 231, 607,* (1950)
8. M. F. Rayner-canham, G. W. Rayner: A Devotion to Their Science: Pioneer Women of Radioactivity, 1997.

CONTIRBUTIONS TO ANALYSIS OF LIFE AND WORK OF ANY HUNGARIAN SCIENTISTS FROM FORMER AUSTRO-HUNGARIAN MONARCHY

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Key worlds: history of science, physics, papers, discussions, polemics

The aim of our paper is to study and analyse the life and scientific work of any Hungarian origine university teachers and/or scientific researchers from former Austro-Hungarian Monarchy, also any persons which figures not in any issues of history of sciences, understanding, to introduce these persons in the History of Science.

These persons are the following : **Barnothy**, Eugen ; **Forro** (*Barnothy*), Magda; **Hamos**, von , Ladislaus; **Heindlhofe**r, Kalman; **Jüttner**, Franz (Ferenc); **Ratz**, E; **Selety** (former *Jeyteles* or *Jeitteles*) Franz ; **Szarvassy**, Arthur; **Szasz**, Otto, **Szekely** (de Doba) ,Angelika; **Szivessy** , György (Georg), **Szolnoki**, Imre; **Gaál** , Sándor (Alexander von). We can cite, as exemples, only the work of small persons because of small space into abstract.

Barnothy, Eugen ,Kassa (Chositze) 1904 , Chicago 1996, Diplome of physicist in Budapest .Emigratted with his wife, Barnothy Forro Magdalena, in SU, Lake Forest – Barat College as Professor, founding the Forro Science Corporation. With his wife. Publications and brevets in the ultrasonics and astronomy, member in the American Astronomical Society and others.

Forro – Barnothy Magda: Zsámbok Hungary 1904, Chicago 1993. Emigratted with Barnothy Eugen, in US in Lake Forest, Professor on Barat College and University of Illinois.Diplome on physics on Budapest and Goettingen , degree of doctor in Budapest 1928. Publications, upon 150 pieces, in cosmic rays, physics of atoms, astrophysics and biomagnetism.

Hamos, Ladislaus,von: born 1905.Studies and degree of doczor on Heidelberg and Berlin, in 1930. Studies, papers and inventions in the X-ray spectroscopy, with applications in physics, chimy and technology. He constructed the von Hamos X-Ray spectrograph., obtaining brevet for it in SU..

Jüttner, Franz (Ferenc): Breslau 1878, Breslau ? 1958. Studies, probably in Muenchen. Domain of relativistic theory of gases, many papers were issued into book “ Relativistic Thermodynamics” 1911.Iimportant results in the thermodynamics, relativity and quantenthorie

…and so on…

Székely, Angelika (de Doba): 1891 Olmuetz, diplome on Physics and on , in Graz.. Habilitation degree in 1930 in Graz, being first lady which obtained this scientific degree and obtaining the University Dozent also Associate Professor position 1941/42, among the ladies working on University on Graz. Angelika.

Gaál, Sándor (Alexander, von): Goganvaralja (Gogendorf, Gogan) Transilvania 1885-1972. – Sepsiszentgyörgy Sfintu-Gheorghe Transilvania. Al.v.Gaal was one polyhistor on physics, mathematics and techics.He obtained many very important results in Relativity Theory, Thermodynamics, Cosmic Rays, Logics and Technologies.

N.N. BOGOLIUBOV – THE GREAT SCIENTIST AND HUMANIST OF XX CENTURY

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The birth of exact natural sciences is usually associated with the name of Isaac Newton - a great mathematician and physicists in one person. His approach in unifying physical intuition, the experimental; data and the use of an adequate mathematical formalism was followed in the 18th and 19th centuries by Euler, Poincare’ and others. On the other hand, the subsequent intense developments in physics, mathematics and mechanics in the XX-th century resulted both in the extension of our knowledge about the world and in its differentiation and specialization. The great Russian mathematician and physicist Nikolai Nikolaevich Bogoliubov, whose centenary is widely celebrated this year, is one among few universal genies able to conceive the Nature integrally. This is evident both from his papers and the studies of the institutions he led: N.N. Bogoliubov was the founder of the Laboratory of Theoretical Physics (now bearing his name) of the Joint Institute for Nuclear Research in Dubna, the Institute for Theoretical Physics (bearing now his name) of the Ukrainian Academy of Sciences is Kiev and many others. Bogoliubov initiated (in Moscow, 1972) a series of international congresses on theoretical and mathematical physics (this year in Prague). He was a great renaissance figure – Researcher and Teacher. He created a new branch in sciences: the modern theoretical and mathematical physics, with followers in the whole world. Born in an orthodox priest's family, he remained a deep believer and great humanist throughout his life.

The first 15 years of his carrier, N.N. Bogoliubov was working with his teacher N.M. Krylov on various mathematical problems, in particular those in variational calculus, that resulted in the nonlinear mechanics, continued in Kiev by Yu. Mitropolski. The results of these studies alone could make Bogoliubov's name great, but this was only the beginning. Later on, these results were used in statistical physics

In 1946 N.N. Bogoliubov presented at a Session of the Russian Academy of Sciences his theory of superfluidity. Its printed version, translated to many languages, is one of the most frequently cited papers of the XX-th century. Next, in 1954 he introduced a system of axioms that made possible the construction of the relativistic quantum field theory based on general principles of covariance, unitarity and microcausality. His contribution to the solution of the problems of mathematical physics concerning the relation between mathematics and physics was revolutionary. By solving the problem of divergences in quantum field theory, Bogoliubov paved the way to the modern microscopic theory of matter. In 1965 Bogoliubov with co-authors introduced a new quantum number (color) of elementary particles (quarks), thus founding the modern quantum field theory of elementary particles, later named Quantum ChromoDynamics

PRINCIPLES OF PHYSICAL THEORIES - PAST AND PRESENT

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To describe and explain known data, to predict new phenomena – it was the main goal of physical theories from very beginning of modern physics. It is the main goal of physics theories up to nowadays. However, big changes have arisen in turn of 19th and 20th centuries. Previously, theorists were generalizing isolated empirical data and on this base they were building up physical theories (e.g. classical mechanics, theory of electromagnetic field, thermodynamics and statistical physics). But then quantum mechanics was built by another way. M. Planck derived his law mathematically and only after that he was searching physical fundament for its interpretation. Analogically, A. Einstein introduced his idea of light quantum as solution of theoretical problem. One can say that quantum mechanics as hole was built at first mathematically (its mathematical apparatus was built as first) and at second physical interpretation of this apparatus was searching (probabilistic interpretation of wave function, uncertainty principle, complementarity principle etc.). This tendency is the main characteristics of theoretical physics in present time. This problem will be discussed in detail. In addition, several another principles of physical theories – both in past and in present – will be discussed.

CASIMIR EFFECT, THE SPREAD OF RESEARCH ON IT, AND THE QUANTUM VACUUM ONTOLOGY FROM 1948 TO 1975

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During the twentieth century, the concept of vacuum has undergone an enormous change, which has been promoted by the discovery of many phenomena related to its substantial character. One of these effects is the mutual electromagnetic attraction of neutral bodies due to fluctuations of the quantum vacuum energy, proposed by the Dutch physicist Hendrik B. G. Casimir in 1948 and nowadays known as "Casimir effect". In the following decades, Marcus J. Spaarnay and other experimentalists have shown that Casimir's prediction – and other related effects as well – was in agreement with experiment, and since then the effect has been mentioned as empirical evidence of the reality of the quantum vacuum zero-point energy.

For twenty-seven years – from its proposal to 1974 – there were very few articles on the Casimir effect. At the beginning of this period, the study of the effect was restricted to a small group of physicists and physico-chemists, most of them working in centers focused mainly on technological development, such as *Royal Philips Electronics'* research laboratory in the Netherlands. During the decades of 1960 and 1970, the number of research projects and institutions devoted to the Casimir effect showed but a slight increase. Only from 1975 onward did it rise significantly, owing mainly to Julian Schwinger's important paper on the subject, but also to the general retake of the quantum field theory program following the discovery of the possibility of using perturbative methods in strong interaction theory.

In our work we analyze the 1948-1975 period as concerns the dynamics of the Casimir effect research in the physics international community.

We begin by analyzing the spread of research on the quantum vacuum. We focus on published articles on the subject, on the physics textbooks published during the period, and on the importance of the subject in scientific meetings. A second point we investigate, which is related to the first one, is the reception of the Casimir effect by the scientific community. Here we discuss why some important physicists didn't support it and what criticisms they made. The third and last point we analyze is the mutation of the quantum vacuum ontology. We scrutinize the different concepts of vacuum over the period (virtual particles, fluctuations, zero-point energy etc.), and in what sense there was a consensus on its ontology. As a conclusion, we intend to show that the Casimir effect research was marked by a distinctive kind of scientific stance, which in a sense was technologically pragmatic, yet at the same time achieved an interesting debate on scientific realism. We maintain that the emergence of such an unconventional approach was possible only because of the considerable distance kept by some Casimir effect researchers from universities and their endogenous dynamics.

Regular Session T09-03
Earth Sciences in the Contemporary Period (1800-)

SOCIAL ASPECTS OF NATURAL-SCIENCE WORLD OUTLOOK AND EVOLUTION OF CONCEPTIONS ON THE EARTH AGE

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In ancient time, when a Man debated with the Gods, the crafts, sciences and arts were explosively developed in Europe and the ideas of the practically infinite time (Aristotelian Infinity) have been born.

After the Christianity genesis, the ideas about the World and Man creation that took place, according to the Bible, 7-8 thousand years ago, and negligibility of a Man in the face of God were formed. Such ideas obstructed the scientific and technological progress.

But with the Renaissance origin, when the science and art revival began, it was necessary to discredit the Christian religion in order to accelerate the social development and emancipation of a man from the existing restrictions. In order to disprove the Creation doctrine the ideas about a greater age of the Earth were suggested. So according to Buffon's estimations made in XVIII century, the Earth age counted 75000 years.

But in the end of XVIII century the ideas about infinity of time began to restore. One of the founders of geology science James Getton noted that he didn't see either beginning or the end in the geology. Such ideas were also promoted by the publication of Charles Lyell's famous book about the principles of geology in the first half of the XIX century. But in the second half of XIX century, under the pressure of scientific facts and theories, the Earth age started to decrease gradually in the ideas of such scientists as Lord Kelvin. In 1863, he supposed the Earth age to be 400 million years, but in the end of the century he reduced it down to 24 million years. In the beginning of XX century, the majority of scientists trended toward the opinion of more ancient age of the Earth. Since the second half of the century the hypothetical Earth age counted 4.5 milliard years and it is not practically changed since that time. Perhaps we deal here with the conventionalism – an expedient agreement of the leading scientists in the given scientific field. At present time, there are enough scientific data, which could promote more appropriate ideas about Earth age. Even a simple calculations show that the real Earth age may probably be less than it is declared at the present time (see Table 1).

Table 1. Time needed for filling the World Ocean by solid flow and obtaining the present-day mineralization

	Annual flow, milliard tons	Necessary amount	Time period, million years
Solid flow (Lvovich)	22.4	1.37×10^{18} m^3	153
Ion flow (Lvovich)	2.48	4.79×10^{16} tons	19.3
Ion flow (USSR data)	13.9	4.79×10^{16} tons	3.4

Thus, probably, the Earth age does not exceed 400 million years.

In the last two centuries the struggle between the creationism doctrine and evolutionism takes place. The low Earth age of about several million years calls into doubt the evolutional theory. But the evolutional approach is extremely necessary to the mankind for justification of its right for any nature destructive and dangerous actions.

The Earth age declared at the present time is not scientifically substantiated enough. It is quite completely based on nuclear geochronometric methodology, which is disputable by itself. Firstly, it is not grounded at all the main hypothesis about elements which are the final disintegration products in nuclear geochronology (^{206}Pb, ^{40}Ar, ^{87}Sr) and completely have radiogenic origin. Secondly, it is not proved that during enormous time intervals the interchange with environment didn't occur. Thirdly, the half-life periods measured by the milliard years are questionable in themselves.

TWO CENTURIES OF OIL INDUSTRY OF CHECHEN REPUBLIC

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The history of oil industry of Chechen Republic has a history of almost two centuries and can be divided into five stages.

Stage I (1819-1892) First oil deposits on the territory of Chechen Republic were discovered in 1833. Oil was extracted through oil wells, which were walled simply with wattle and were of not more than two arshin (an *arshin* equals about 28 inches) in depth. During the period from 1833 to 1846 inclusive, about 40 thousands poods (1 pood equals about 17 kilograms) of oil was extracted (a little more than 3 thousand poods a year on average), during the period from 1846 to 1855 inclusive 50 thousands poods was extracted (5 thousand poods a year on average), during the period from 1856 to 1865 inclusive, about 125 thousand poods was extracted (about 12.5 thousand poods a year on average). In 1890, the level of oil extraction reached 370 thousand poods a year.

Stage II(1893-1920) The industrial development of republican oil fields was initiated on October 6, 1893 ã., when the First bore-well gave oil. This gave a new spurt to development of oil industry in the region, with new territories being explored, including the ones researched through foreign investments. By the beginning of 20th century, all open oil fields on the territory of the republic belonged to Belgian, English and French companies.

By 1917, the number of oil bore-holes oil reached 660, and the level of extraction reached 1.7 million tons a year. Russian Revolution and Civil War naturally affected the level of oil industry in the region, and the levels of oil extraction had reduced, by 1919 in Grozny oil fields there were only 36 bore-holes in exploitation.

Stage III (1921-1945) With the end of Civil War, the process of recovery of Grozny Oil Industry was reinitiated, but only by 1925 the level of extraction exceeded that of the pre-war period, and reached more than 2 million tons a year. At that period, a “Grozneft” trust was founded. The industry undergoes a process of massive technical re-equipment. Borehole drilling is done with rotor method, and electric engines are introduced in the oil extraction fields. New oil fields are being explored. In 1931 the level of oil extraction reached 8 million tons a year. Another challenge for Grozny Oil Extraction and Oil Processing Industries came with the Great Patriotic War (World War II). In October 1942, in the result of air bombardments the majority of oil extraction and oil processing objects were ruined, but the oil industry continued its work. During the period of Great Patriotic War the level of extraction did not exceed 1 million tons a year. In 1943, a special resolution was adopted by the State Defense Committee “About Grozny Oil Industry reconstruction activities”.

Stage IV (1946-1991). The process of post-war recovery of Grozny Oil Industry took place in extreme conditions, and the prewar level of oil extraction of 3.3 million tons a year was reached only by 1960. Nevertheless, this period is considered the “golden age” of Grozny Oil Industry. Newest technologies of oil drilling and oil field development were invented and put into practice, and a number of geological explorations and geo-physical researches took place. For the first time in the world, an ultra-deep well was drilled, with a depth of 7502 meters. In 1957, exploration of oil in upper cretaceous deposits was initiated. Large oil deposits were determined in Mesozoic deposits, and more than 20 new oil fields were brought into development. By 1971, the level of extraction reached 22 million tons a year. Such high rates of exploration lasted until 1982. In 1991 the level of extraction went down to about 4 million tons a year. With the collapse of USSR, highly qualified oil industry specialists started leaving the republic, and the process of destruction of the scientific, technical and material base had begun.

Stage V (1992-2007) The period from 1993 to year 2000 represents the darkest pages in the history of oil industry of the Republic. In the result of war actions, all oil extraction objects were destroyed, and 150 fountain wells were in open fire. Losses and thefts of oil during those years exceeded 10 million tons. By year 2000, the rate of oil extraction went down to its lowest figure in the history of the industry – 0.077 million tons. With the end of the active phase of war actions on the territory of the republic, the oil industry had to be rehabilitated practically from its zero point. A huge task was put on the shoulders of “Grozneftegaz” staff, which had to rehabilitate the oil industrial system and its almost completely destroyed infrastructure. As early as in the first years of activity, the rate of oil extraction had reached 700 thousand tons. In 2003 alone, a number of head structures for oil collection, storage and transportation were placed into operation. In 2007, the level of extraction reached about 2 million tons.

On all stages of the history of the industry, a large number of scientific research works was done in geology, geophysics, well-drilling and oil field development. A significant contribution was made by such famous petroleum scientists, as: V.N.Maydebor, A.A.Khutsiev, G.M.Sukharev, A.G.Barminsky, P.P. Zabarinsky, S.S. Itenberg, B.K. Lotiev, M.S. Burshtar, etc.

FORGOTTEN COLONIAL SEISMOLOGY: THE INTRODUCTION OF INSTRUMENTAL SEISMOLOGY IN THE PHILIPPINE ISLANDS (1865-1910)

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Instrumental seismology in the Philippine Islands started at the Manila Observatory, managed by the Jesus Society, after 1865. Its early development shows some characteristic features: It developed much faster than in Spain (the dominating power at that time) and it is the unique example of development of the Italian seismological tradition in the Far East. Otherwise, seismological studies on the colonial Philippine Islands were not reduced to the research done at the Manila Observatary. A second station was installed and other interesting developments (mainly related to the seismological engineering) took place at that time. Extend of the attained development is only comparable, in the far East, with developments of Japanese seismology. When Philippine administration changed from Spanish to American hands, the work done was acknowledged and enhanced and new developments took place. An introductory study, discussion and evaluation of the initial moments of instrumental seismology in Philippines and the related seismological research are presented.

CHANGES IN STATE DIRECTED ASSESSMENT AND THE ROLE OF 'CONCLUSIVE EVIDENCE': THE NYS HS EARTH SCIENCE REGENTS EXAM REPLACES 'POLAR WANDERING' WITH 'PLATE TECTONICS' AS THE ACCEPTED EXPLANATORY THEORY FOR OBSERVED MACRO-CRUSTAL CHANGES.

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When does evidence become 'conclusive' such that the State will dismiss a previous theory and embrace a newer one?

Between the late 1970s and middle 1980's the Board of Regents of the State University of New York changed the High School Earth Science Regents Exam to reflect the Geology community's overwhelming embrace of 'plate tectonics'. Before this time apparent changes in Earth's pole location, as evidenced by a rock's paleo-magnetic orientation, were explained by a theory of 'polar wandering'. Students were tested as to their acceptance of and proficiency in comprehending this explanatory theory by way of the State created and administered Regents Exams. After this time, the Exams dismissed 'polar wandering' to be replaced by 'plate tectonics'. The State had thus accepted with changes in their Exam, that it was the rocks, and not so much the poles, that had moved over geologic time.

GEOTHERMAL HEAT FLOW AS A PROBLEM: THE HISTORY OF OBSERVATIONS AND THEORIES

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The idea that the Earth initially was the small star and as a result it possesses the red-hot core belongs to and was introduced in his "" (1644). Gottfried Leibniz in his "*Protogaea*" (1691) also suggests the idea that the Earth is a cooling star. Buffon (1778) estimated the time interval of the Earth cooling based on the cooling rate of as 75 000 years. The theory of the Earth as a planet which gradually gets cold prevailed the geological thought for a long time. In 1883 the first reliable estimates of the heat flow from the Earth interior were obtained.

In December 1936 V.G.Khlopin, later one of the leading scientists in the Soviet atomic project, made in Moscow a presentation named "*The radioactivity and the thermal regime of the Earth*". V.G.Khlopin data and calculations were used by V.I.Vernadsky in his plenary report at International Geological Congress XVII Session (Moscow, 1937). Two important articles devoted to the thermal regime of planetary bodies were published by the well-known Russian mathematician A.N.Tikhonov also in 1937.

In 1954 at the X General Assembly of IUGG it was concluded that there is no sufficient evidence of systematic difference in heat flows values at different regions. That conclusion contradicted existing different geological models for the continental and ocean floor crust.

In 1962 the soviet radio astronomers V.D.Krotikov and V.S.Troitskii by comparison of Moon's radio-brightness at different wave lengths measured the heat flow from inner layers of the Moon as 0,055 W/m^2, practically equal to that one of the Earth.

The value of the heat flow passing through the surface of the Earth is also important for the scientific interpretation of Kyoto protocol requirements. The annual registered consumption of natural fuels (oil, coal, gas) by the global population and industry constitutes almost ½ of a heat flow power from the Earth's interior.

We still do not know whether the heat flow from the Earth's interior increases or decreases. We do not expect to receive an answer in the nearest future. However, the cooling of the Earth can be interpreted as tendency to lower the heat flow density, thus making the Earth crust to cool. In such case the Mankind activity in managing the greenhouse effect in the planet's atmosphere seems reasonable.

THE TRAILS OF ROMAN SYMONOWICZ' MINERALOGICAL TRAVEL (1803) TO TRANSYLVANIA (ZIEMIA SIEDMIOGRODZKA)

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Roman Symonowicz (1763–1813), the first mineralogy lecturer and organiser of Mineralogy Department in Vilnius Imperial University, in summer 1803 was sent by his University to 'mineralogical' travel to Transylvania, Hungary and Poland. Since September 1803, Roman Symonowicz started to lecture mineralogy course in the Vilnius University. In 1804 he moved away for one year to Freiberg at Professor A. G. Werner to study mineralogy and geology. In 1806 Symonowicz published the first mineralogy handbook in Polish, and wrought up the first classification of minerals.

Roman Symonowicz's report about his 'mineralogical' travel, submited to the University Council, published first in Lithuanian by the present author in 2005, seems to be an eminently valuable document **written over two hundred years ago.** It is evidencing his broad sophistication and scientific intelligence. Moreover, it reports on specific features of metal deposits and rock-salt exploration in Central European deposits, demonstrating scientific circumstances and the state-of-art in teaching mineralogy and mineralogical researches. Symonowicz earned fame by his 'mineralogical' travel and his scientific achievements allow to call him the pioneer of geological sciences in Lithuania.

A fragment from Roman Symonowicz's report to the Vilnius Imperial University Council about his foreign trip in 1803 gives a brief view to his mineralogical interests*: *"I, the undersigned, was sent by the University to make the mineralogy trip to Hungary and Transylvania**, and now I present the report about the localities I had visited. I departed from Vilnius at the end of June, according to our calendar, and due to slender means–eight hundred roubles–given me by the University, I couldn't post but [travelled] with a coachman. In early August I reached Vienna, and till I was given the necessary passports, three weeks had passed. In late August I departed for Hungary, however, the last winter that had come too early to the mountains, covered them on September 14, therefore it was difficult to reach the mountains to do geognostic observations. In spite of all this I was in Szczawnica***, where I visited four mines: Pacherstolnie with its vein formed mainly of Zinopel, Zygmunt's mine, Stephen's mine and Maximilian's mine with its vein formed of quartz, field spar, and white clay, but earlier – cinnabar."*

Author will report his search of the Symonowicz' travel steps in Banská Štiavnica, Hodruše mine, Špania Dolina, Banská Bystrica, and Hronice made in 2007.

*VUB RS, F 2, KC 337, l. 1-5, 10. Translation from Polish.

**Orig. *Ziemi Siedmiogrodzkiej*.

***Orig. *Schemnitz*, present – Banská Štiavnica, Slovakia.

TO THE HISTORY OF WATER SUPPLY IN MOSCOW

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Moscow city was founded on the small river Moscow. Citizens used water from the river Moscow and its confluents, ponds and wells for water supply. These sources began to be exposed to pollution with the increase of population and development of industry. The water was becoming unfit for use.

In the XV-XVI-s centuries 2 water-pipes were built in Moscow Kremlin. The water-pipes were supplied by springs which were found when the Kremlin walls were building. But only tsar's family and it's surrounding could use it. Mere people had to use former sources of water supply which were polluting more and more. In the XVIII century the situation was so bad, that rebellion occurred in Moscow because of epidemics. Dissatisfied citizens demanded to supply them with clean water. That's why Empress Catherine the Second had to organize the search of a new source of water supply and construction of a new water-pipe.

In 1804 Mytischensky water-pipe was built in Moscow. It remained the main source of water supply till the beginning of the XX century. In spite of repeated modernization it's source was limited. In 1903 water supply point from it ran up to 44000 m^3 per day, but soon delivery volume was limited because the quality of water became too worse.

Moscow government understood that Mytischensky water-pipe couldn't provide city's needs. That's why Rublevsky water-pipe was constructed as a result of researches in 1903 on the river Moscow. But this new water-pipe could supply only 260000 m^3 per day, otherwise the Moscow river could become shallow below the city. But the city was increasing and soon it became clear that the river Moscow might soon run dry.

In 1913 Administration of Water-pipes established the Research commission of new sourses of water supply for Moscow city. In 1913-1917 integrated issues were organized in the basin of the Moscow river upper Moscow city, on the Volga and the Oka rivers. There was established that all the three rivers were good for water supply. A lot of projects based on the results of these issues appeared later. Four reservoirs on the river Moscow and it's confluents and channel Volga-Moscow were constructed. These facilities provide Moscow city with water till nowadays.

THE SEARCH OF GOLD IN AMERICA IN XVI CENTURY – THE COMBINATION OF KNOWLEDGE AND EXPERIENCE OF NATIONS.

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The European expansion in America connected with the gold the gold-searching and gold-mining.

Representatives of many nations (Indians or Europeans) took part in the development of natural recourses of the New World. They had different skills in the sphere of gold-mining. Some Europeans, who had come to America for gold-mining used special ways of search. We can divide these ways into some groups:

1. Geographic – the search of the rich in gold places.
2. Geologic – the search of the new gold-fields
3. Alchemic – the search of the way of transformation of different elements into gold.

One of the most important problems was the search of the rich in gold regions. According to some special documents (capitulations) they were given special places for search.

So they were given such ways of gold-mining as rescate, the extraction of jewelry from burials, the ransoms for the chiefs, they also laid under tribute some conquered tribes. The natives gave information, worked as guides, carriers, so they carried out some important duties. For the generalization of the new information some new posts were established in Spain (cosmographies).

The books about geography or natural history of the new world appeared and in these books nothing was told about Indians contribution to science.

Geological reconnaissance was replaced by speaking to natives. The search methods of Europe, worked out in the Middle Ages, combined Antique and Arabian traditions. Wishing not to loose this knowledge in the end of the century Europeans began to systematize geographic, economic and historic information. The discovery of the new gold-fields didn't prevent alchemists from their experiments. Using the experience of European and Asian predecessors they were studying the characteristics of the minerals that were found in America. So by this they developed the new technologies of gold and silver cleaning.

So, the gold-mining in America in the XVI century was one of the first examples of the synthesis of scientific knowledge.

HISTORY OF THE METEOROLOGICAL OBSERVATION IN BUDA(PEST) SINCE 1781

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The second European meteorological network was established by Karl Theodor Elector Palatinate. The Palatine Meteorological Society, the *Mannheim Society* as commonly known among the meteorologists has started its activity in 1781. The majority of the stations operated in Germany. Two of them worked in North America. Among the 39 founder was the station installed in the Buda Castle. It was run by the University was moved from Nagyszombat (now Trnava in Slovakia) to Buda by Queen Maria Theresa in 1772. The Mannheim centre issued a general instruction about the observation system and prepared standard instruments. The alike meteorological stations measured air pressure, air temperature, precipitation and wind. Unfortunately no copies of the original instruments are survived the turbulences of the history in Budapest but the original '*Annales*' of the Society could be found in the Library of the Hungarian National Meteorological Institute. The books are written in Latin and we can image the used instruments looking at the nice drawings in the year-books. The networks very probable because of the French Revolution wars finished its work soon. No year-book was issued after 1793. The history has not stopped the meteorological observation in Buda Castel, later in Budapest and in the neighbouring stations neither in Vienna or Prague.

The presentation shows the observation system and the instruments using the archaic year books. The significance of the meteorological network and the Mannheim initiative will be evaluated. The importance of the long temperature series have increased in last few decades because of the global warming. The climatologist needs a long time series to demonstrate of the warming. The more then 200-year long Buda-temperature time series will be shown. Not only the instruments but the place of observation has changed since the beginning. In this case the homogenization of the data has got huge importance. The Hungarian homogenization system and its results will be mentioned demonstrating the systematic warming in Budapest temperature series.

Unfortunately no original instrument could be shown but the Hungarian Institute has got a small '*Meteorological Museum*' and the changes in the temperature observation will be shown using few pictures were taken in the collection of OMSZ.

THE FIRST DETAILED GEOLOGICAL MAP OF THE POLISH KINGDOM'S COAL BASIN (1856)

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Mining, later together with steel industry, was always considered as constant process of human being's economic activity. Unfortunately, there wasn't such a continuity in gathering mining and geological knowledge in Poland. It was for sure caused by unfavourable geopolitical conditions.

In the thirties and forties of the ninetieth century Bank of Poland and Governmental Income and Treasury Committee concentrated on creating steel industry. As a result, new hard coal deposits were exploited in great quantities as to satisfy market's needs.

Jan Hempel (1818 - 1886) started his work in coal mines of the West Region of the Polish Kingdom and in 1847 was commanded to organise so called „markszajderyjna sluzba" (surveying service) in coal mines. At that time Hempel introduced theodolite and various methods of coordinate calculus into surveying.

In 1856 Jan Hempel finished four-year-long work on „Mapa geognostyczna zaglebia weglowego w Krolestwie Polskim" (Geognostic Map of Polish Kingdom's Coal Basin). His map was prepared and published on government expenditure in 1857 by M. Fajans' Company in Warsaw. It was printed in 18 sheets in 1:20000 scale. Map presents an area between Czeladz (in the west) and Olkusz (in the east); it reaches Ujejsce and Zabkowice in the north and national border on Bia³a and Czarna Przemsza Rivers in the south.

Hempel got high financial reward and governmental decoration for his work. „Mapa geognostyczna..." was also very positively assessed by his contemporaries. In 1857 Rudolf A. W. von Carnall discussed and prepared extensive report on it during session of the Geological Society in Berlin. Moreover, professor of the Mining Academy in Freiberg – Bernhard von Cotta prepared vast commentary on Hempel's map and handed it over, during his stay in the West Region (1859), to Hieronim Labecki. Also Carl Mauve – director of mining in Myslowice-Katowice area – assessed map highly.

Jan Hempel had a great contribution to the development of geological knowledge of Upper Silesia region. Without specialist geological education he undertook very difficult task of creating a geological map. Yet his thorough knowledge of mining and mineral resources occurring in the analysed area as well as surveying skills enabled him to determine components of structural hard coal beds.

Self-taught geologist discovered traces of Permian products, grouped together coal beds into systems that were later called „under-reden", „reden" and „over-reden". For many years information gathered by Hempel in his map were of great importance for mining in the West Region of the Polish Kingdom.

Regular Session T09-04
Chemistry in the Contemporary Period (1800-)

THE RELATIONSHIP BETWEEN CHEMISTRY AND ALCHEMY IN THE AGE OF THE ENLIGHTENMENT

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The beginnings of modern chemistry are to be found in the Age of the Enlightenment, the period which had the courage to treat nature as a vast reservoir of inexhaustible opportunities. The man started to treat the world as an area that could be explored and exploited by him without any restrictions. From the very beginning, chemistry created itself as being in opposition to alchemy. First of all, it rejected abstract alchemical elements that symbolized opposing quality. Instead, it gave the name of elements – just as Robert Boyle did it some time earlier - to those substances that were obtained at the very end of the analytical process. The number of these elements, which were being discovered as chemistry advanced, was growing quickly. The second fundamental matter in which chemistry took a radically opposing position was accepting the axiom that elements could not undergo any further transformations. Consequently, chemistry denied the possibility of any transmutation, *i.e.* transforming one single element into another. As the scientific quality of knowledge was based on the analytical method which concerned *per se* one concrete research field, it had to evolve towards a more and more advanced methodological reductionism.

The old alchemy, on the other hand, resembling at that time rather philosophy than any empirical science, after having gathered experiences and considerations for a few millenniums and possessing impressive collections of esoteric works, understood nature as a harmonious whole, all components of which – including human beings – remained interdependent. The unity of the whole nature required the acceptance of the argument about the unity of the material from which the universe was built. The universal oppositions of the four Aristotle`s elements formed throughout centuries the basis for interpretation of beings and phenomena of the nature. Alchemists in the Middle Ages and in the Renaissance added new elements to them. The new elements also symbolized philosophical comprehension of quality.

Paradoxically, the rapid development of analytical chemistry delivered new reasons to accept the alchemic idea about the unity of the nature. It were chemists who soon proved that there were only a few chemical elements at the core of the whole of fauna and flora. The division into mineral chemistry and organic chemistry made no sense any more. It was already in the middle of the 19th century that this division had only a didactic meaning.

THE MINERAL CHEMISTRY LABORATORY OF THE POLYTECHNIC SCHOOL OF LISBON AND THE GREAT 19TH CENTURY CHEMISTRY LABORATORIES IN EUROPE*

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In spite of some exceptions, in most countries, almost until the middle of the 19th century, experimentation was carried out by researchers and professors, but not by students, that only watched demonstrations. The classes were performed in large amphitheatres having preparation laboratories connected to them.

The change in methodology in the teaching of Chemistry implied changes in the facilities, and so, in many important universities, large laboratories were built, in order to provide space for practical classes with large number of students.

The experiments, at that time, were carried out with large amounts of chemicals and the concerns for safety were often not strict. As many experiments produced noxious or unpleasant compounds, with bad smell, it was considered important to have large rooms, usually also very high. As this was not enough, the systems of ventilation also had to be improved.

In the large Encyclopaedia of Fremy (1882) two volumes are dedicated to the great laboratories in Europe. The laboratory of the Polytechnic School in Lisbon is not included in the book as at the time of this publication it was not very impressive. However, after reformation it was visited by A.W. von Hoffman in 1890 and, in a letter he wrote, he considered it one of the best and most beautiful in Europe.

In this communication we present a comparative analysis of the different laboratories described in the Fremy's Encyclopaedia and of the Laboratory of the Polytechnic School, with special focus on architectural and functionality aspects.

Bibliography
Fremy, Encyclopédie Chimique, Dunod, Éditeur, Paris, 1882.

THE PROBLEMATIC ACCOMMODATION OF THE RARE EARTH ELEMENTS IN THE PERIODIC TABLE FROM 1869 TO 1913

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Since Mendeleev's discovery in 1869, the periodic table has figured as the ultimate paper tool in chemical research. It has proved to be a vital research instrument in the arsenal of the chemical community. No chemistry textbook, lecture theatre or scientific laboratory is complete without a copy of the periodic table of the elements. Clearly, the periodic table constitutes an important part of the material culture of chemistry. More importantly, the periodic system was constructed in order to embody Mendeleev's periodic law, according to which "the elements, if arranged according to their atomic weights, exhibit an apparent periodicity of properties." Without a doubt, the periodic law has been one of the most fundamental scientific ideas of the nineteenth century and it has heavily influenced the development of chemistry during the past 140 years.

This however, should not necessarily imply that the periodic table has never had to contend with problems. In this communication, the history of the accommodation of the rare earth elements in the periodic table will be addressed. When Mendeleev (1834–1907) published his periodic table in 1869, the rare earths already constituted a major obstacle. Mendeleev was able to include only four members of the rare earths and he experienced great difficulties in positioning these elements. Question marks and wrong atomic weights reigned in the last rows of Mendeleev's system.

This problematic accommodation quickly grew into one of the most serious threats for the periodic law. For over fifty years, chemists continually struggled with the placement of these maddeningly similar elements. As a consequence, a lot of chemists started to question the validity of the periodic law, but others took it as a sign that the concept of a chemical element had to be reconsidered. As a result, this work intends to retrace the mutual influence of the philosophical ideas about the nature of chemical elements and the development of the periodic table from its inception in 1869 to the discovery of Moseley's (1887–1915) law in 1913 and Bohr's (1885–1962) publication of his landmark paper *On the Constitution of Atoms and Molecules*.

The aim of this paper is to show how, on the one hand, the periodic table (as a research instrument) helped in reformulating the contemporary ideas about chemical elements, and how it aided in developing a new research program in order to resolve the rare earth crisis. On the other hand, the question will be taken up to what extent Crookes' (1832–1919) evolutionary ideas about *meta elements* helped in saving the periodic table from a severe downfall by solving the gnawing problem of the rare earth elements. In particular, this work will also focus on the investigations of the Czech chemist, Bohuslav Brauner (1855–1935), who, under the influence of Crookes' ideas, was led to his formulation of the *Asteroid Hypothesis*, according to which all the rare earth elements should be placed in a single case of the periodic table.

STUDY OF WATER-ETHANOL SYSTEMS FROM DMITRIY MENDELEEV TO NOWADAYS

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Water-ethanol binary mixture represents a system with a complicated dependence of properties on components ratio. Detailed study of water-ethanol system was first conducted by Dmitriy Mendeleev (1834-1907), the great Russian chemist who discovered "The Periodic Table of Chemical Elements". In his Doctoral thesis (1865) titled as "Discourse on Alcohol and Water Mixing" and in the monograph (1887) he described density ρ of water-ethanol mixture as a function of solution composition and temperature. On the assumption that derivative $\delta\rho/\delta x$ is a linear function of ethanol concentration x, he suggested a hypothesis that there are three compounds in aqueous-alcoholic solutions: 'twelve-water alcohol' $Et{\cdot}12H_2O$, 'three-water alcohol' $Et{\cdot}3H_2O$ and a $3Et{\cdot}H_2O$ compound. In opposition to existing at that time view on solutions as simple "mechanical" mixtures Mendeleev suggested the theory of hydration which considers formation of new compounds in solution after components mixing.

A big number of studies carried out on water-ethanol systems using different physical methods confirm that water-ethanol solutions are non-ideal. At room temperature the excess volume, excess enthalpy of ethanol-water mixtures exhibit strong deviations from ideal mixing behavior in the region around 20 mol% of ethanol. These thermodynamic characteristics are often attributed to the formation of ethanol hydrates. Other numerous studies showed that there are specific ethanol concentrations around 8-10 and 17-20 mol% where many characteristics of solution reach extreme values. In 1962, almost one century after the Mendeleev study, Franks and Johnson repeated his method of density derivative processing and also discovered a singularity corresponding to $Et{\cdot}12H_2O$ hydrate composition. In other works the hydrate composition was determined as $Et{\cdot}5H_2O$ and $Et{\cdot}17H_2O$, and the authors supposed that the hydroxyl group of ethanol is linked through a hydrogen bond with water frame. It was suggested to call such type of clathrates forming hydrogen bond of guest molecule with water frame, "semi-clathrates". The structure of ethanol hydrates and the corresponding low-temperature solid clathrates has been the target of many investigations. Russian scientist Zelenin using differential thermal analysis found that in water-ethanol system under atmospheric pressure there exist one stable hydrate $Et{\cdot}2H_2O$ and two metastable $Et{\cdot}3H_2O$ and $Et{\cdot}4{,}75H_2O$ hydrates, the last one is of semi-clathrate nature. Recent research conducted at the University of Cincinnati using radial distribution analysis showed the similarity of structure of the $Et{\cdot}6H_2O$ complex in water-ethanol system to the Structure I clathrate.

We give the review on up-to-date experimental data (including our research on Raman spectra performed at Department of Physics of Moscow State University) and discuss the theories of structure for water-ethanol systems published in scientific literature.

TO DO RESEARCH WITH NOSE AND TONGUE: SOME REFLECTIONS ON THE ROLE OF SMELL AND TASTE IN THE HISTORY OF CHEMISTRY

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Since the 17th century visual observation of nature, directly or by experiment, has been a fundament for science. Knowledge based on smell and taste has often been considered vague and subjective, since it could not be quantitatively treated, and was therefore unable to "prove" something scientifically. However, this does not reduce from its significance. This paper aims both to discuss in what ways taste and smell work in chemistry, and to suggest ways how to approach the study of smell and taste in the history of chemistry. A closer look at laboratory journals, private correspondence, autobiographical sketches, and not the least elementary textbooks reveals that smell and taste are often referred to, and that the significance of smell and taste therefore is most evident in everyday laboratory work. It is a well known fact that especially many organic chemists had (have?) trained their noses to an almost extreme sensibility, of great value in the laboratory. Tentatively several uses of smell and taste can be distinguished. They can be used analytically in order to identify unknown bodies, and they can be used to verify the supposed composition of certain bodies (often in combination with other senses). They also have an important heuristic significance, since the immediate experience of taste and smell not only can contribute to ongoing work, but also give impulses for further work and even give rise to new lines of research. Finally the significance of smell and taste in the formation and in the spread of scientific knowledge shall be mentioned. This is especially important in the learning of laboratory skill, something which for long has been done in a handicraft way, from master to apprentice.

THE 50th ANNIVERSARY OF THE HEYROVSKÝ´S NOBEL PRIZE FOR CHEMISTRY

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On December 10, 1959 took over Professor Jaroslav Heyrovský of Prague the Nobel Prize for Chemistry from the hands of the Swedish King Gustav Adolf VI for the discovery and development of polarographic analytical method. J. Heyrovský was the first and till this time the sole Czech laureate of the scientific Nobel Prize. The next day after celebration J. Heyrovský delivered his Nobel Lecture on trends of polarography at Royal Institute of Technology in Stockholm. His lecture had the summarizing character. Heyrovský stated circumstances of his discovery and the development of polarography inclusive its analytical application . An important moment for polarography was the construction of an automatic apparatus for the registration of polarization curves named „polarograph" by Heyrovský and Shikata in 1925.

The polarography- an electrolysis with the dropping mercury electrode- was discovered by Heyrovský in 1922. Heyrovský developed it both experimentally and theoretically almost 40 years.

The Heyrovský´s way to the Nobel Prize was long- first he was nominated in 1934 for the Nobel Prize for chemistry. The nomination for Nobel Prize for chemistry Heyrovský received from 15 foreign chemists between them the laureates of the Nobel Prizes Ch.V. Raman, A.J.P. Martin, R.L.M. Synge, L. Růžička and V. Prelog and other well-known specialists W. Böttger, J.van Nienwanburg, R. Breckpot, J. Gillis, W. Swietoslawski, E. Schulek, I.M. Kolthoff and W. Kemula. Other nominanators were Czechoslovak chemists, physicists and physiologists and doctors (48 persons). During 1934-1959 Heyrovský received altogether 69 nominations for the Nobel Prizes for chemistry, physics and physiology.

THE SAME DISCIPLINE IN DIFFERENT PLACES: ELECTROCHEMISTRY IN SPAIN IN THE FIRST THIRD OF XXth CENTURY

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At the end of XIXth century, Spain was shocked for the losing of their last colonies. For this reason, Spanish Government questioned the utility of the old educational system and attempted deep reforms in order to modernize the country. Due to the fact that electrochemical was one of the most modern and flourishing industries of this time in Spain, Electrochemistry was introduced into the curriculum of the Industrial Schools, new studies which in 1902 tried to replace most of the foreign technicians who worked in the country. Antonio Rius-Miró was one of the electrochemical professors of these Schools, where he was able to maintain an important research work in electrolysis and electrochemical analysis, and supervise some dissertations of disciples of chemistry in the Faculties of Science since the second decade of the XXth century.

We find the first attempts of electrochemical research in "*Laboratorio de Investigaciones Físicas*", an institution created in the first years of the second decade of the century in order to promote investigations of the young PhD who returned from their European stays. Julio Guzmán-Carracido was the director of electrochemical section, where he mainly researched on electrolysis and collaborated with other public and private laboratories. During these years we find different laboratories (industrial, agricultural and so on) that incorporated electrochemical analysis in their practices.

In 1922 Electrochemistry was included into the new curriculum of the Science Faculties, despite its lack of chairs during these years. For this reason, it was given by professors of other specialties as Inorganic Chemistry and Chemical Analysis. Most of them hadn't any training as electrochemist and just taught the industrial, practical and analytical aspects of the discipline. Carlos Del Fresno, professor of Inorganic Chemistry in the University of Oviedo since 1928, was an exception because at the end of his doctoral studies he obtained a postdoctoral fellowship to study Electrochemistry in the laboratory that Erich Muller had in the Technischen Hochschulen of Dresde. Carlos Del Fresno was able to maintain a modest research and direct few dissertations about polarographic analysis in Oviedo.

The purpose of this paper will be to show the introduction of Electrochemistry in Spain by different actors and different places, and how each of them directed the discipline into their own interests and expectations. At the same time, it will be possible to observe what steps they followed in order to achieve their aims in a country with a low scientific and technical level.

CONTRIBUTION OF RUSSIAN CHEMISTS TO DEVELOPMENT OF RUSSIAN SPIRIT AND VODKA PRODUCTION INDUSTRY IN THE 19TH AND THE EARLY 20th CENTURY

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The findings of chemical science were first used in production of grain-based liquors ('bread wine', literally), vodka and alcohol back in the 18th century. This period had seen establishment of research and educational institutions (including technological), publication of first research reports of Russian scientists, launching of specialized journals. The effect of adsorption on carbon in liquid medium discovered in 1785 by the pharmacist T.E. Lovits seems to be the most important among these events. He was the person who suggested the use of charcoal for purifying of water and vodka. This method of water and vodka purification is still used in vodka production industry.

However, systematic use of chemical science in production process has become customary in the 19th century. This epoch had seen publication of generalizing studies of chemical technologies in wine industry of such known scientists as P.A. Ilyenkov, F.S. Ilish, M.Ya. Kittara, N.I. Tavildarov.

The Technical Committee incorporating three Central Chemical Laboratories was established in the second half of the 19th century (in St. Petersburg, Moscow and Odessa) to control the industrial process and researches. Eminent chemists took part in their work. Researches were conducted in the following areas: production of grain-based liquor, rectified spirit and vodka beverages; alcoholometry, invention of alcoholmeters and elaboration of alcohol metering tables (D.I. Mendeleev, G.I. Gess and others); methods of spirit and vodka purification (M.G. Kucherov, V.Yu. Krshizhanobsky, N.I. Tavildarov, A.A. Verigo) and water rectification (N.A. Bunge, A.G. Doroshevsky), study of physical and chemical action of wood charcoal on spirit and vodka, research of charcoal reactivation methods (M. Glasenapp, S. Kelchevsky); manufacturing of alcohol-containing drinks, their classification, strength and quality; manufacturing of malt (N.A.

Bunge), yeast, study of fermentation process; glassware and glass quality; analysis of pitches for bottle corking (A.A. Verigo). Quality specifications for ready-to-drink spirits and vodkas and methods of quality control were worked out in this period.

Russian chemists (A.A. Verigo and others) have elaborated their own research methods. For instance, M.G. Kucherov has developed a method of accurate quantification of fusel oil content in alcohol, which has been adopted as an official one for Russia.

Thus, scientific background for alcohol and vodka industry development was laid down in the 19th and early 20th century.

THE DEVELOPMENT OF MACRMOLECULAR CHEMISTRY IN BELGIUM AND HIS CONTRIBUTIONS TO IT IN THE INTERNATIONAL POLYMER CHEMISTRY COMMUNITY

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Polymer Chemistry in general and particularly in Belgium is inextricably connected with the person of Georges Smets (1915-1991). Indeed Professor Smets has made essential contributions to nearly all fields of macromolecular chemistry. Thus, he was one of the first chemists who showed successfully the possibilities of block- and graft copolymerization by radical chain transfer reaction between a growing chain and a pre-existing polymer. By attaching laterally peroxide-groups to polymers or by putting them at their end, several original methods of graft – and block-copolymerization by radical mechanisms were established years before anionic polymerization would become the customary way to produce them.Another topic for which he was well known was the synthesis and properties of photochromic polymers or copolymers, yielding insight in the internal structure and physical properties of polymers such as e.g. chain segment mobility. He was also involved in several photochemical and thermal reactions e.g. isomerization, dissociation and recombination in solid polymer matrices, stressing the importance of the physical properties of the polymer medium on the course of these reactions. Professor Smets also treated problems such as anionic polymerization, synthesis of polyampholites, etc. The originality and significance of his work was internationally recognized. Apart from an impressive list of awards and honorary degrees he has been President of IUPAC and many of his former students were distinguished by their own work, several of whom hold or held professorial positions in Belgian as well as foreign universities.

CONTROVERSIES ON THE NATURE OF CALORIC IN THE GREEK-SPEAKING JOURNAL *HERMES THE SCHOLAR*, AT THE TURN OF THE NINETEENTH CENTURY

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The spread of the notion of caloric, from the central Europe to the periphery, is reflected in the controversies developed in the intellectual and scientific frames of reference of the journal, *ÅñìÞò ï Ëüãéïò* (Hermes the Scholar*)*, published from 1810 to 1821. Hermes the Scholar cultivated a fertile ground for the so-called "*Modern Greek Enlightenment*", it promoted the spread of new scientific ideas and as a consequence, the efforts for the production of a new scientific discourse.

The issues emerged in this journal concerning caloric are in the contexts of controversies, within the institutionalized concepts produced in Europe. The special issues raised by the Greek scholars[1] reflect the dynamic interactive process between periphery and center, taking into account the pre-existing knowledge in Greek-speaking regions and demanding, also, rationalization and socialisation in the process of formulation of a new didactic tradition.

The controversy on caloric is focused on the issue of caloric as a material substance or as a property of matter. An issue of interest, also, is related to whether it has weight or not. The starting point of the debate was an article of Schinas presenting the two current theories. The first was supported by Lavoisier and the second by, amongst others, Bacon, Euler, Descartes and Rumford. Contrary to the thesis, is presented by Schinas, that caloric is material substance and passes through the pores of the body, Benjamin Lesvios argued that caloric does not have a material substance and does not pass through the pores of the body, because a body penetrating another is unfeasible. Also, its lack of gravity is assumed from its radiation to all directions. Neophytos Vamvas, contributed to the debate and he defended caloric as a material substance adopting Lavoisier's assumption for its role as solvent in chemical reactions, as it is presented to *Traite Elementaire*. The controversy continue with the participation of George Glarakis and Panayiotis Zontanos, students and supporters of Vamvas's and Lesvios's views respectively.

What is remarkable is that the participants in this controversy, although the key issue remains if caloric is a material substance, don't make a substantive reference to Lavoisier's and Black's work. This has a significant interest for the strategy that the Greek scholars developed. Is it the strategy a matter of choice between equivalent traditions, which serves their purposes, or is it the result of rationalization and socialization of scientific concepts, which means the movement from the philosophy through reason, to science, which requires and imposes its terms, and it results to the overthrowing of the pre-existing knowledge? It seems that they rather follow the later.

References

1. The controversy on caloric took place in the following pages of *Hermes the Scholar*, 1811: 297-307 (Dimitrios Schinas), 1814: 21-24 (Benjamin Lesvios), 94-104 (Neophytos Vambas), 168-177(Panagiotis Zontanou), 217-224 (Benjamin Lesvios), 224-240 (Gergios Glarakis).

Regular Session T09-05
Biological Sciences in the Contemporary Period (1800-)

ADVANCES IN MODERN BIOLOGY CAN BE ACCELERATED BY MEANINGFUL CROSSTALK BETWEEN PHYSICISTS AND BIOLOGISTS

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The modern molecular biology has become a truly interdisciplinary science and to solve the many outstanding problems in biology needs input and participation of scientists from different branches of science: physics, chemistry, biology, engineering and bioinformatics, to name a few. The two papers (1,2) I published previously, were based on my interviews with a large number of leading scientists, including Nobel Laureates and Members of the National Academy of Sciences (US) on what the most outstanding problems in biology are and their approach to solve some of them. This paper updates my research in the last ten years and catalogs the progress and pitfalls that still exist in communication between biologists and, in particular, physicists. The general consensus is that fundamental advances in biology require meaningful and effective crosstalk between physical scientists and biologists. I broaden the definition of physics to include physical sciences and biology to life sciences. I show by giving examples from the latest literature how progress is being hindered because of a lack of appropriate communication skill, e.g., the inability of some physicists to speak in a language easily understandable to biologists and, conversely, many biologists' reluctance to appreciate that modern biology has become far more quantitative than it was, say 25 years ago. I discuss the enormous challenges in some of the new areas of life sciences, e.g., system biology which aims to understand how a complex biological system works as an integrated whole and needs a cross-disciplinary environment if it has to progress.

I discuss some of the current ideas on evolution and discuss a conference on "The Nature of Matter, the Nature of Life" held recently and my conversation with some of the scientists who participated.

References:

1) Dev, SB. Migration of physical scientists to molecular biology and its impact, Interdisciplinary Sci. Revs., v. 15, 45-56, 1990. 2) Dev SB: The changing face of biology, Interdisciplinary Sci. Revs., v. 22, 29-36, 1997. 3) Progress towards meaningful crosstalk between physicists and biologists (Submitted)

ERVIN BAUER AND GENERAL BIOLOGY IN THE ALL-UNION INSTITUTE OF EXPERIMENTAL MEDICINE: RISE AND FALL OF A MAJOR SOVIET LABORATORY

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The All-Union Institute of Experimental Medicine was established with generous governmental support in Leningrad late 1932 by a dramatic expansion of the venerable Institute of Experimental Medicine founded in 1890. Its grandiose plans envisioned an all-encompassing complex study of humans in health and disease, integrating laboratory and clinical ones. Extensive collaboration among various departments was regarded a sine qua non for success. A Department of General Biology was immediately organized to provide theoretical foundations for these goals. The theoretical biologist Ervin Bauer (1892-1938), who had a high reputation in the USSR and impeccable Marxist credentials, was chosen to head this Department. This presentation will trace the history of Bauer's work and of his Department from 1932 until Bauer's arrest and the liquidation of the Department in 1937.

Bauer was born in Hungary, received his medical training in Budapest and Göttingen and graduated in 1914. He left Hungary in 1919 and worked in Göttingen, Prague and Berlin before moving to the USSR in 1925. He served as Department head in the Obukh Institute of Professional Diseases (1926-1931), Professor of Biology at the 2nd Medical College of Moscow (1930-1932), and Department head at the Timiryazev Biological Institute of the Communist Academy (1931-1937) before joining the new Institute in 1932. Bauer was well received at the Institute and was regarded as major contributor to its goals. In a public talk, the Director of the Institute mentioned him together with Pavlov and Speransky as the three most prominent members of the Institute. Bauer's Department developed fast and had over 40 members by 1937. He had, however, significant difficulties with the emerging oppressive atmosphere of science based on brigade work and the shock worker principle. Inadequacy of equipment and poor educational background of most of his coworkers also hampered progress.

Bauer developed an original concept of the living based on thermodynamic principles and can be regarded as a founder of modern theoretical biology. Bauer's principle states that all living matter is in a state of permanent energetic non-eqilibrium (1920). He derived all life phenomena from this postulate. His experimental work was to test the implications of this principle in diverse organisms. He summarized his views in his acclaimed Theoretical Biology in 1935. After his arrest he his works were prohibited and could not make significant contributions to biology.

This history reflects in a nutshell many of the contradictions of Soviet science of the 1930s. High hopes of outstanding scientists were crushed by the political power, grandiose plans were hampered by plodding execution, and innovative initiatives were stifled by imposed collectivization.

RUSSIAN BIOLOGISTS AT THE MEDITERRANEAN. SECOND PART OF THE 19th – THE BEGINNING OF 20th CENTURIES

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The development of the biological sciences in the second half of the 19th c. was greatly influenced by Darwin's fundamental book (1859). In the decades following this publication, biologists all over the world were testing Darwin's ideas. Therefore evolutionary investigations based on comparative anatomical and embryological material made up a considerable part of the "biological results" of the century. The majority of the results were obtained in the Mediterranean Sea or were based on works made at temporal or permanent marine biological stations (MBS) which appeared there during the last quarter of the 19th c.

At that period the Russian marine biological investigations carried out mainly in universities of St.Petersburg, Moscow, Kazan and Odessa which had no own MBS. The first very small one was created in 1871 by Novorossiyskoye Naturalist's Society in Sevastopol. However, a number of Russian scientists always worked at the Mediterranean: Messina, Naples, Specia, Villefranche-sur-mer (Villafranca), Marseilles and Banyuls, sometimes even before the real MBS were established in some of that places. The Russian zoological school, especially for comparative embryology and anatomy of invertebrates had one of the leading place in the world's scientific community during the end of 19th – the beginning of 20th cc. Investigations of marine invertebrates, especially those of uncertain origin and phylogenetic relationships, were greatly inspired by the discoveries of À.Î. Êîvalevsky and I.I. Metchnikov who laid down comparative evolutionary embryology as a branch of science in 1865-1885. The research tradition originating from their works was developed by other Russians, namely M.S. Ganin, N.V. Bobretzkiy, V.N. Ulyanin, M.M. Usov, V.V. Zalenskiy, A.A. Korotnev, and some time later by V.M. Shimkevitch, K.N. Davydov, P.P. Ivanov and V.A. Dogiel.

Naples and Villafranca should be mentioned at first among of the Russian investigation's sites in the Mediterranean. The Naples Zoological Station from 1874 till 1934 and the Russian Zoological Station at Villafranca from 1886 till 1914, collected the main Russian "biological forces" – over 250 visitors. Among of them were 15 academicians and 10 correspondent-members of the Russian Academy of Sciences, a lot of professors and others well-known Russian scientists. À.Î. Êîvalevsky, V.V. Zalenskiy, A.A. Korotnev, M.M. Davidov, V.T. Shewiakov, N.K. Koltzov worked there over 10 times; many others did their investigations at the Mediterranean several times as well.

Embryological and anatomical researches made by Russians predominated, followed by faunistic, histological, physiological and cytological studies. Although some of the protists – ciliates, radiolarians, sporozoans, and microsporidia, were studied, the Metazoa remained the main focus, including representatives from major groups, especially planktonic ones and those that have interesting planktonic stages.

BETWEEN SCIENCE AND TECHNOLOGY: THE CATALAN STRUCTURALIST SCHOOL, THE NUCLEOHISTONE STRUCTURE AND THE DEVELOPMENT OF X-RAY DIFFRACTION CAMERAS

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Recent studies in the history of molecular biology have stressed the importance that must be attributed to the instruments in the development of the discipline. This communication presents the case study of a research group, lead by Joan Antoni Subirana and Jaume Palau, which emerged in Barcelona, Spain, in the mid sixties, within a general process which also took place in other European countries: the Macromolecular Chemistry Department.

The distinctive feature of this research group lies in their physical location within an Engineer's School and in the academic training as chemists of their founders. Their postdoctoral training in The United States, United Kingdom and Israel, set their research towards structural molecular biology, to the adoption of the X-Ray techniques and to the development of their own instruments in order to be applied in the structural analysis of biological macromolecules (DNA and histones). The engineer's School workshop allowed them the design, construction and modification of some X-Ray diffraction cameras.

AFFILIATION AND COLLABORATION NETWORKS IN THE BIOMEDICAL SCIENCES IN PORTUGAL IN THE INTER-WAR PERIOD (1920-1940)

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Biomedical research played a central role in the shaping of Portuguese scientific activity during the first half of the 20th-century. The need to update and modernize health care structures in the late 19th-century, introducing laboratory medicine in the daily life of hospitals, together with the supportive attitude of Positivist-minded professors in medical schools, paved the way to the creation of research groups, laboratories and scientific societies, with strong scientific connections to the international community. These included the early creation of a Bacteriological Institute in Lisbon (1892) that soon acquired a national scope (1895) and the steady development of a school of experimental medicine researchers following the establishment in Lisbon of Mark Athias in 1897. This group founded (1911) new laboratories, called institutes, in the Lisbon, Oporto and Coimbra faculties of medicine, in areas such as Histology, Physiology or Pharmacology, but also influenced the appearance of clinical research traditions. It was also from this group that emerged people that were instrumental in the establishment of two important Portuguese institutions, the first privately funded research institute in the biomedical sciences (1921-1927), the *Instituto de Investigação Científica Bento da Rocha Cabral* (IICBRC) and of the first state science funding agency (1929), the *Junta de Educação Nacional* (JEN).

The objective of this paper is to explore the structure of networks of Portuguese biomedical researchers in the inter-war period of 1918-1939, using basic social network analysis methods and techniques. The main source in this study is the series of papers presented (from 1920 to 1939) to the scientific meetings of the Portuguese section of the Paris *Société de Biologie*, called *Sociedade Portuguesa de Biologia*, and published in the *Comptes Rendus des Séances de la Sociéte de Biologie et de Ses Filiales*. The study of the corresponding affiliation and collaboration networks allowed us to identify the most significant sub-networks, and we conducted an additional survey of papers listed and/or collected in official or semi-official reports of the research units directly related with them. This survey centered on the two institutions that were more national in character or had a wider scientific scope, the *Instituto Bacteriológico Câmara Pestana* (IBCP) and the *Instituto Rocha Cabral* (IICBRC).

This exploratory analysis evidenced the existence of large (national and local) two-mode affiliation networks, connecting not just a significant number of researchers, but also various research units, contrasting with much smaller collaboration sub-networks. It also showed that the few large collaboration sub-networks have developed in connection with the great institutes like the Câmara Pestana Bacteriological Institute (IBCP) and the Rocha Cabral Institute (IICBRC). Collaboration sub-networks not connected with the big two, tended to be much smaller egocentric networks around key researchers.

CRITICAL THINKING: HISTORICAL PERSPECTIVE AND PRESENT SITUATION IN TURKIYE

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Even though the journey of development process of critical thinking (CT) can be started from the 2500-year-old probing questioning method of Socrates, the CT factor in education started to be considered in early 1900s by Dewey and then the term transformed into present meaning with the final contributions of Robert H. Ennis, John E. Mc Peck, Harvey Siegel, and Richard W. Paul (cited by James T. Streib 1992). Since 1950s CT has been accepted as an important factor in lots educational studies and school settings.

Although Turkey has already included the elements of CT and other higher order thinking skills in primary school and secondary school curriculums, there is still lack of awareness and application problems for families, students, teachers, and even for teacher trainers.

Nowadays, the CT related educational studies have been getting more and more popular and especially private institutions are quite into disseminate and apply CT theory in their trainings efficiently.

The aim of the present document analysis is to track the trace of the term and idea of critical thinking (CT) so far, briefly in the world and mainly in Turkey. We hope that this overview will provide settlement and orientation for the further CT studies particularly ones in Turkey by extracting the world heritage of CT.

When the issue gets too general and when there are too many studies to deal with, Science education and namely Biology education studies are focused as the main source of interest.

Keywords: history, critical thinking, science education, biology education

EMBRYOLOGY TAKES FORM. CHRISTIAN HEINRICH PANDER, KARL ERNST VON BAER, AND THE CONCEPT OF THE EMBRYOLOGICAL FOLD.

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In a series of investigations conducted in the 1810s and 1820s, Christian Heinrich Pander (1794-1865) and Karl Ernst von Baer (1792-1876) practically laid the conceptual and methodological foundations of the modern science of embryology. Central to this work was the discovery of the germ layer and its role in embryogenesis. According to this theory (largely valid until today) all organs evolve specifically out of one of three primordial layers (ectoderm, mesoderm, and endoderm) through a complex process of convolutions and folding of these layers.

In my paper I will examine the concept of the fold as it was developed in the writings of Pander and Baer. In particular, I will argue that the concept of the fold allowed them to conceptualize development as a continuous temporal molding of substance. It is my claim that the concept of the fold as basic principle of organ formation marked a major epistemological shift in the understanding of the living world: It subjected the organic neither to the rigid permanence of law nor to the reign of chance, but to the continuum of variation.

HISTORY OF NATIONAL INSTITUTE OF GENETICS IN JAPAN

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The National Institute of Genetics (NIG) was established on June 1, 1949 under the jurisdiction of the Ministry of Education. In 1939, an argument of an establishment of a special facility for specific genetic research in Japan was occurred among members of The Genetic Society of Japan. In 1984, NIG was reorganized as an inter-university research institute for joint use by universities. I will report a history of NIG from 1939 to 1984.

First, I will report a brief history of genetics in Japan. First description of Mendel's laws of heredity in Japan was done by a botanist Seiichiro IKENO. He was known by the discovery of sperm of gingko. Also, he had been studying a hybrid of red pepper. Ikeno wrote a voluminous book entitled *Plant Phylogeny* in 1906. He introduced Mendel 's laws of heredity in the section 5 chapter 4 in this book. Kametaro TOYAMA wrote the paper entitled 'Mendel's laws of heredity as applied to the silk-worm crosses' in a Germany journal *Biologishes Centralblatt* in 1906. This paper was famous for the approved of Mendel's laws of heredity even in an animal as well to do. This paper received high evaluation by European biologists. Japanese have been trying to be hybrid experiments in silk worm, Gold fish, Japanese morning glory, variegation traditionally. This may be one of the backgrounds of earlier research of inheritance in Japan.

Second, I will mention about an idea of establishment of institute of genetics. From mid 1930's, much had been discussed, concerning eugenic movement and an enactment of eugenic law in Japan. Mamoru OGUMA, a professor of Hokkaido Imperial University, emphasized introduction of the results of genetics to a formation of excellent races in humans. At the same time, he also emphasized the necessity of an institute of genetics and importance of existence of geneticists. He published a purpose of establishment of institute for genetics in 1939. Actually, 'people eugenic law' was enacted in 1940. Committees of the Genetics Society of Japan discussed an establishment of institute of genetics at the 12 th annual meeting in Tokyo in October, 1939. The next meeting was held at Seoul, Korea. The society approved the establishment of the institute unanimously. In 1941, Oguma wrote a booklet entitled *Toward a Promotion of Genetics.* He described there were many unknown fields in genetics. Promotion of genetics leads to increased production of food and breakdown a superstition such as prenatal care. In the same year 1941, the special committee of Japanese association for promotion of science supported the decision of the Genetics Society of Japan. However, the establishment was not approved during World War II.

Finally, I will report the carriers and personalities of earlier directors of NIG. The first director of NIG was Mamoru OGUMA (1885-1971). He was born in Tokyo. Oguma graduated from department of agriculture, Hokkaido Imperial University in 1911. He was a pupil of entomologist, Shonen MATSUMURA (1872-1960). He wrote a book *Evolution and Idea* (1925). Matsumura described the necessity of struggle for existence between human races. Oguma got the Doctor of agriculture in 1919. His thesis was on histological study of insect's organs. Hereafter Oguma has been studying the number of a chromosome number in humans. The second Director was Hitoshi KIHARA (1893-1986). He was born in Tokyo, too. Kihara also graduated from Department of Agriculture, Hokkaido Imperial University in 1917. He studied plant physiology under the direction of Kan KORIBA (1882-1957). Koriba moved to Faculty of Science, Kyoto Imperial University in 1920. Then, Kihara accompanied with Koriba. Hereafter, Kihara studied genome-analysis of wheat. He studied abroad from 1924 to 1927. Then, he studied under C. Correns, one of the re-discoverers of Mendelian Heredity, at Kaiser Wilhelm Institute. The third director of NIG was Daigoro MORIWAKI (1906-2000). He was born in Iwakuni, Yamaguchi Prefecture. He graduated from Zoological Institute, Tokyo Imperial University in 1929. He was a pupil of Naohide YATSU (1877-1947). Yatsu had been studying at Colombia University and was acquainted with Thomas Hunt Morgan.

Actually, staff members of NIG were against Michurin-Lysenko genetics. Conversely, it seems that NIG gathered Mendel-Morgan line's researchers. On the other hand, the most famous NIG researcher Motoo Kimura was not involved in eugenic movement, though his idea for eugenics was found in his essay.

EDWARD JANCZEWSKI'S WORK ON *MONOGRAPHIE DES GROSEILLIERS*, A MONOGRAPH ON GENUS *RIBES* (1907)

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Monographie des Groseilliers is probably the most detailed and well known work on the genus *Ribes* (currants and gooseberries) as a whole. It was published in 1907 in *Memoires de la Société de Physique et d'Histoire Naturelle de Genève*. In the following years Janczewski published 4 supplements to his monograph, containing mostly new species diagnoses.

The main part of *Monographie des Groseilliers* are descriptions of 133 species, 28 of which were first described by Janczewski. He also described 12 new hybrids out of 21 presented in the publication. Species were grouped into 6 subgenera, further divided into sections. An identification guide was provided. The book also contains detailed characteristics of biology, morphology, anatomy and cultivation.

Monograph was a result of many years of research. All species diagnoses were published in separate articles before 1907, mostly in *Bulletin International de l'Académie des Science de Cracovie.* For his work, Janczewski maintained a vast collection of specimens of this genus. It consisted of over 250 living plants grown in the Botanic Garden of the Jagiellonian University and large amount of herbarium sheets (over 582 preserved).

Living plants were used in descriptions of the biology and morphology. Microscopic slides (463 still preserved), prepared using the specimens from the Botanic Garden, provided valuable data on anatomy of vegetative and generative organs of currants and gooseberries. He also conducted experiments on propagation and hybridization of the genus. It was a continuation of his experiments on genetics of genus *Anemone*, conducted before rediscovery of Mendel's work.

Herbarium was collected thanks to Janczewski's worldwide scientific contacts. The specimens represent the whole world distribution of the genus, including South America and China. Comparative analysis of the materials provided further information on diversity of the genus and allowed describing new species.

Methods used by Janczewski during his research on the currants place him as one of the precursors of experimental systematics. *Monographie des Groseilliers* is one of the earliest examples of using large amount of anatomical data and experimental hybridization to determine infrageneric diversity and relations.

HISTORIOGRAPHICAL ISSUES IN THE INTRODUCTION OF PROTEIN SEQUENCING INTO SPANISH BIOMEDICAL RESEARCH, 1970-1990.

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My paper explores the introduction of protein sequencing techniques in the context of the development of the biomedical sciences in Spain between the 1970s and 90s. I, concretely, focus on the careers of Enrique Méndez and Guillermo Giménez, who were pioneers in the use of protein sequencing at the Centro de Investigaciones Biológicas (CIB), a biomedical centre of the Spanish National Research Council. The CIB was created in the late 50s and became the first centre in incorporating biochemical laboratories in Spain. However, when Méndez and Giménez started their careers (early-mid 70s), Spanish biochemistry focused on functional interactions of molecules in metabolism with little room for structural analyses of proteins.

Méndez and Giménez continued their investigations in the United States and participated in long-term sequencing enterprises of proteins at pharmaceutical R&D centres: the former at the Roche Institute during the second half of the 70s and Giménez the following decade at the Merck Laboratories. In their research, they used semi-automated and fully automatic techniques based on the sequencing reaction that Pehr Edman had popularised among biochemists. Upon return to Spain, Méndez participated in projects within the then emergent genomics and Spanish molecular biology (1980s and 90s), whereas Giménez created a group devoted to multi-perspective structural investigations of proteins. This latter group incorporated not only sequencing, but other techniques for protein analysis, such as mass spectrometry, centrifugation or fluorescence.

The trajectories of Méndez and Giménez raise significant points in the development of the practice of sequencing and, more generally, in the historiography of technology, post-World War II biomedicine and centre-periphery connections. It, firstly, shows that there are significant differences between the invention and widespread use of a technology by diverse communities. Protein sequencing methods were invented by Fred Sanger in the context of purely academic research during the second half of the 50s. However, they did not spread among biomedical researchers until their automation, the decade after, following the sequencing strategy of Edman, different than Sanger's. Researchers, additionally, applied sequencing to medical problems such as those Méndez and Giménez pursued within the pharmaceutical industry. Sequencing, finally, was not important in a peripheral country such as Spain until combined with molecular biology and genomics, or with other techniques of structural analysis of proteins, something that Sanger had never done in his career.

THE SIGNIFICANCE OF SCIENCE INSTRUMENTS IN THE RESEARCH PROGRESS AND DEVELOPMENT PLANT PHYSIOLOGY IN NINETEENTH CENTURY. RESEARCH INSTRUMENTS OF POLISH SCIENTIST EMIL GODLEWSKI SENIOR (1847-1930)

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Plant physiology is a branch of the experimental sciences. Correct results depend on well-planned and realized experiments. The most important for this research are scientific instruments. Plant physiology as modern science started developing around the mid of nineteenth century, when German botanic Julius Sachs (1832-1897) published a handbook, which featured all contemporary knowledge in this discipline and marked out the direction of its further development. Earlier researches were realized in varied conditions: in greenhouses or outside, where it was difficult to control external factors, after that time in the laboratory in controlled conditions. It appeared necessity of application new methods and instruments for physiological researches. In nineteenth century researchers designed and constructed instruments. New apparatus often induce progress in researches. Its precise description and illustration were published, thus it became known to all and was applied in many other laboratories. Sometimes this instrument was used to research new problem. The constructors of those instruments most often were leading scientists. It was contribute to extending and developing knowledge in this part of botany. The instruments were improved by researchers with general progress of science.

E. Godlewski sen. was professor of the Jagiellonian University in Kraków and a pioneer of polish plant physiology. All his long scientific activity was appeared in plenty and variety researches of physiological processes in plants. Godlewski realized majority of his experiments using his own methods and instruments designed by themselves. Moreover he used devices constructed by other great scientists: Julius Sachs and Wilhelm Pfeffer (1845-1920).

Godlewski create simple apparatus for experiments in atmosphere without carbon dioxide, which he used for researches of photosynthesis products. It was simple and ingenious method. This instrument allowed him to research nature of etiolation too. He was also the author of the original instrument used in researching plant respiration, which is know as "Godlewski apparatus". It bring new quality and progress in researches. This apparatus enabled to hold on the same conditions during an experiment. Godlewski using instruments designed by himself to research nitrification, metabolic transformations of protein and fermentation, made a significant contribution in all of these areas. Those instruments were used by his scholars for their own researches. Godlewski published descriptions all of his devices in German scientific periodic therefore this instruments were known among scientists worldwide.

POLISH BOTANICAL AND MYCOLOGICAL RESEARCH IN TERRESTRIAL ECOSYSTEMS OF ANTARCTICA SINCE 1977

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Investigations were usually carried out close to all year Polish Antarctic Station (Polish Arctowski Station, since 1977) on King George Island (South Shetland Islands) or seasonal stations on Livingston Island and Antarctic Peninsula. Programmes of investigations were parts of international research projects co-ordinated by Scientific Committee on Antarctic Research (SCAR). Investigations concerned following groups of plants:

- Vascular plants. Ecological investigations embraced: biomass productivity and growth of *Deschampsia antarctica* in Admiralty Bay, variability of spatial structure of biomass of *Deschampsia antarctica* clumps, and influence of wind on diaspores dissemination of *Deschampsia antarctica* in the vicinity of the Polish Station. Plant communities were surveyed by Braun-Blanquet method. Detailed maps of localities of *Deschampsia antarctica* and *Colobanthus quitensis* on SSSI No 8 were prepared. Sexual reproduction and development of seeds of *Deschampsia antarctica* was examined.
- Mosses and liverworts. Taxonomical and phytogeographical investigations were conducted. 3 species new to science, 12 species new to Antarctica, and 35 species new to King George Island were described.
- Algae and blue-green algae of fresh water and terrestrial biotopes. Investigations referring this group of organisms concerned on few topics: habitat and zonal distribution, seasonal fluctuations of number and structure of groups of algae, influence of penguin rookeries on stream biotopes, anthropogenic influence of Antarctic stations on biocenoses. Over 200 species were recorded from King George Island. 8 species and 1 genus new to science were described.
- Fungi. "Macromycetes" of Admiralty Bay region (King George Island) were recorded, and a new species to science was described. Attention was paid on lichenicolous fungi: 68 species were described, mostly new to Antarctica, 1 species new to science was described. Other objects of interest were lichens. Their distribution and biodiversity in Maritime Antarctica and Continental Antarctica was investigated, over 230 species were recorded.

Colonization and succession processes. Rapid processes of deglaciation (as a result of warming up) are occasion for research over colonization and formation of tundra communities on the ice free areas. Many-years ecological studies are led along transects on moraines and forefields of glaciers. Lichen resistance on stress factors (extreme low temperature, water deficiency) is investigated.

Anthropogenic influences. Early stages of synanthropisation of plant cover were recorded, i.e. devastation of habitats, elimination of localities of plants, and introduction of alien species. Another important problem which is taken under consideration is pollution of heavy metals. Permanent observations have been led since 1980s.

Occasional investigations were also led in Continental Antarctica – in Bunger Oasis.

LITHUANIAN SPACE PLANT BIOLOGY RESEARCHES IN 1975–1990

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In 1982 on board of the orbital station Salyut-7 the plants of *Arabidopsis* achieved a full cycle of biological development. The hardware and the plan of the experiment were created by Lithuanian plant physiologists of Institute of Botany. It is amazing that scientists from a small, just with 3 million population and politically dependant country – at the time Lithuania was a part of the Soviet Union – were the first who achieved such result.

As far back as in 1935, Lithuanian Jonas Dagys was conferred a doctor's degree in plant physiology. After World War II, being well known specialist, he organized plant growth and development physiology studies in scientific institutions of Lithuania. Under the Soviet rule investigations of this field were related with agriculture. In 1953–1956, most accomplished student of J. Dagys Alfonsas Merkys investigated physiological reasons of cereals lodging – the phenomenon related with gravitropic reaction of plants – at Moscow University. Later he revised and detailed two main mechanisms exploring plant gravitropic reaction – Nemec and Haberlandt starch-statolith and Kholodnyj and Went gravitropic growth theories.

In 1957, the first Earth satellite was launched. The investigations on living organism's growth and development in microgravity got acceleration. All spheres related with human life under the weightlessness were on the top of scientific interest in the seventies-eighties of the 20th century. The possibility of plant to grow under weightlessness was a very important question to resolve the problem on space horticulture – creating life support systems for long lasting space flights.

In the middle of the seventies of the 20th century A. Merkys, as a specialist of plant gravitropic reaction, was invited to participate in the Soviet Union's space research programs. The first his co workers in this field were Romualdas Laurinavičius, Algis Jarošius and Danguolė Švegždienė. In seventies-eighties many experiments in spacecrafts Soyuz and orbital stations Salyut-4, Salyut-6 and Salyut-7 with higher plants: peas, *Arabidopsis*, lettuces were designed by Lithuanian researchers. They obtained the results for plant morphogenesis, ascertained the threshold value of gravitational irritation and were the first to achieve full cycle of plant development in space. The scientists also constructed 6 apparatus to investigate plant in space and under the weightlessness conditions on the Earth.

The aim of my research was to study the formation and the development of space plant biology research in Lithuania in 1975–1990. The paper will review this history focusing on historical situation, the origin of plant gravitropism research in Lithuania and the main experiments carried out by Lithuanian scientists in space conditions in the worldwide context.

COMPARATIVE ANATOMY, THE CHAIN OF BEINGS AND FRENCH ZOOLOGY AFTER LAMARCK

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In order to organize the living beings into a hierarchy, naturalists had imagined over the centuries, several series of criteria, all of which were considered as more or less exclusive : anatomical (morphological differentiation, morphogenesis), functional (power, intelligence, etc.), aesthetics (harmony of forms or functions), "neobernardian" (capacity for homeostasis, emancipation from the environment), evolutionary (adaptability, controlling of ecosystems) or, even, more recently, genetically (quantity of coding DNA). But the problems raised by the research of compatibility between the use of such criteria concerning organic improvement and the reference to the principles of plenitude, of continuity and of hierarchy of life forms on the one hand, and the practice of the method of division inherent in the classification's work on the other hand, which is increasingly unified and consolidated, as widespread use of what was to become the organizing concepts of comparative anatomy – these problems were quickly shown as being simply formidable. The traditional and widely used anatomical criteria are also bounded within this same difficulty, in particular the most common of them - one which the naturalists of the eighteenth century called the "composition of organization", before appointing them, in the nineteenth century, the morphological term of "complication"(or "differentiation").

In this paper we consider the analysis and proposals put forward by representatives of three generations rooted within French zoology from the late 18th century and early 19th century; J.B. de Lamarck, H. Ducrotay de Blainville and H. Milne-Edwards, all of whom were promoters in their own way concerning this anatomical criteriology of the "chain of beings", in order to meet the dual challenge of, firstly, its improbable operative character, and secondly, its lack of compatibility with the methods of systematic classification. We show that, if he was able to certify the validity of morphological criteria of the "complication" as a way to measure organic development, the use by Milne-Edwards to a physiological parameter (the division of physiological labour), once coupled with the traditional anatomical criteria, was mired by the theoretical and practical impasses that involved its Lamarckian methodology. Finally, we ask why these recurrent difficulties did not prevent the ground but deep stimulation of the zoological research by such a scheme of the chain of beings, to the point that it could without exaggeration, be charged with having upon the natural history "an effect somewhat similar to what which the table of the elements and their atomic weights has had upon chemical research in the past half-century (Arthur O. Lovejoy)".

ECOLOGICAL SCIENCE AND NATURE CONSERVATION IN JAPAN 1906 – 1975: FOCUSING ON TWO TRANSITIONS IN 1959

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"Nature conservation has been an important theme in ecology from long ago, and it is common that those who made great achievements as ecological scientists have played important roles in consolidating the foundation of nature conservation in their countries." (NUMATA Makoto, 1973)

Before the word "ecology" became a vogue word in 1970, Japanese ecological scientists had committed activities in the field of nature conservation. However, their relationships had not been the same at different times. The motivation to utilize ecological science for nature conservation had not appeared until 1959.

In 1906, MIYOSHI Manabu (1862-1939), who had coined the Japanese word which is the translation of ecological science, began a movement for the protection of natural monuments. He emphasized ecological science in the context of the natural monument protection in 1920s, for the research of plant associations. After his death, MIYOSHI's pupils did not take over his movement.

Fifteen years later, when NUMATA Makoto (1917-2001) looked ahead about "applied ecology" at the first symposium of Ecological Society of Japan (ESJ) in 1954, he considered only the production technologies, such as forestry, agriculture, and region management, ignoring nature protection or conservation (the difference of protection and conservation is not so clear). Until the mid-1960s, ecological scientists often emphasized "nature transformation".

ESJ's first public statement was "Demand for the establishment of nature protection areas, especially the protection of wild forests" in April 1959. Although it concerned nature protection, it was still "Protection (Conservation) for Ecology".

The concept of "Conservation by Ecology" appeared in October 1959. It was mentioned not by ecological scientists, but by TAMURA Tsuyoshi (1890-1979), the director of Nature Conservation Society of Japan (NACS-J). It is maybe because NACS-J needed the academic basis for their activities. And then, ecological scientists did join nature conservation.

EARLY APPARATUS-BASED EXPERIMENTAL PSYCHOLOGY

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Although there is a multitude of contributions to the history of early experimental psychology, this topic has rarely been dealt with from an apparatus oriented perspective. However, for a well-founded estimation of the benefits as well as the drawbacks of early psychological research it seems indispensable to have a detailed knowledge of the experimental equipment and the setups pioneers in empirical psychology worked with.

Accordingly, this talk introduces some of the most prominent paradigms of early experimental psychology by showing not only the rationale of these experiments but also demonstrating the apparatuses experimenters used and the results they obtained by means of these setups, primarily at Wilhelm Wundt's Leipzig institute – the world's very first institute of experimental psychology founded in 1879.

The most important research line in early experimental psychology was constituted by the so-called reaction time (RT) studies where researches tried to measure time consumed by basic mental operations such as stimulus discrimination or choice of the adequate reaction according to a certain stimulus out of a set of stimuli. One important result regarding early RT studies was that – after solving initial reliability problems concerning the time measuring unit named chronoscope – sufficient evidence has been accumulated arguing against a strictly serial information processing approach. This resulted in a new view according to which particular mental operations take place simultaneously as indicated by the finding that RTs were under-summative with respect to the total amount of time consumed by each of the operations solely. This view resembles contemporary theories of information processing.

Within the group of studies on consciousness the attempts to determine short-term memory limitations were the most convincing ones. With tachistoscopes that allowed short-term exposure of sets of stimuli varying in cardinality they yielded results in the mid of the 1880s that were replicated until today (often without knowledge about those former results). Despite all differences in individual function plots, they found in the realm of psychophysics of time perception that lengths of short time spans were subjectively over-estimated, while long spans were under-estimated with a point of indifference close to that value found in current works on the duration of the present. Investigations of simultaneous multimodal stimulus processing did not produce any reliable results, because the exposition unit for the visual main stimulus and the tactile or auditory distracting stimuli suffered from constructional defects that could not be overcome in the beginning of apparatus-based experimental psychology.

BRIEF HISTORY OF ICHTHYOLOGY IN CROATIA

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The first major ichthyological studies in Croatia were conducted by Dubrovnik noble Jakov Sorkočević in 16^{th} century (describing the behaviour of certain fish, law of correlation, that fish emerged via sexual reproduction-genus Phoxinellus). It should be no surprise that the development of ichthyology in Croatia began right in Dubrovnik (Dubrovnik Republic in 16^{th} century), making it the cradle of Croatian ichthyology. The first published list of some Adriatic fish was found in Brunnich's book "Ichthyologia massiliensis" in 1768 in special supplement on page 85. under title "Spolia e mari Adriatico reportata". During 19 century several naturalists done some ichthyological researches (Brusina, Stossich, Plučar, Kolombatović, Katurić) and this investigations were mostly of taxonomic character. Juraj Kolombatović was most successful in his ichthyological research, the field in which he discovered and described 7 new fish species. In 20th century (before the second World War), several authors gave some lists of fishes for some regions or lists of Zoological Museums, while some started with investigations on benthic communities. After the war, there was a great contribution to the ichthyological researches from the results of biological fishing expedition by research vessel "Hvar" in 1948/49., and from results of the researches of fluctuation of life in the sea and estimate of the stocks of small pelagic fish. During this period there was a great contribution of T. Šoljan with his monograph "Fishes of the Adriatic" (1948) which has been reprinted no less than five times. Nowadays, croatian scientists, mostly from the Institute of Oceanography and Fisheries in Split (founded in 1930), using modern technologies and methods are bringing new contributions to the knowledge in fishery science, ichthyology and aquaculture.

ELECTROGRAPHY OF LIVING SYSTEMS OR SO-CALLED KIRLIAN PHOTOGRAPHY, RECONSTRUCTION OF HISTORICAL FAIRNESS AND PRESENT POTENTIAL

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Still in an antiquity people trusted, that each person is surrounding by an energy field, and always aspired to see and investigate it. The ancients tried (and it was not unsuccessful) to embody this field on the very thin metallic plates. However, only at the end of the XIX century a scientist from Belarus, the native of Minsk province, Jacob Narkevich-Iodko (1847 - 1905) for the first time has made it possible to record the electrographic images of living objects. In 1892 he has informed about "a method of registration of the energy which is let out by a living organism at influence on him of an electric field" which was named him as electrography. In 1893 his work has became known in scientific centers of the Western Europe where he has read many lectures and has shown obtained series of photos. In 1900 at the International Congress in France the rank of the professor of electrography and magnetisms has been awarded to him. The developed method was used by Narkevich-Iodko in medicine for a statement of the diagnosis of illness and allowed to receive more complete information on normal and pathological activity of human tissues and bodies. Carrying out numerous experiments he has fixed a difference in an electrographic picture of identical segments of a body of ill and healthy, tired and excited, sleeping and awake people; has predicted an opportunity of use of this method for a definition of psychological compatibility; has revealed acupuncture points on a body. Results of researches of Narkevich-Iodko were appreciated highly by the Russian Academy of Sciences and by many leading scientists, in particular, by Dmitry Mendeleyev. However, after Narkevich-Iodko death in 1905 his innovative ideas were really forgotten, though researchers from the various countries episodically observed electrographic pictures. After a half of a century electrography has gone through a rebirth and today it is known to the public as the Kirlian photography (the Kirlian effect). In the fortieth years of the XX century the information on a method of registration of radiation of a living object offered by Semen and Valentina Kirlian has appeared. During ten years spouses Kirlian at home improved the device and made thousands of photos, studying to their mind the unknown phenomenon. In 1949 they have received the first certificate and their achievements have been protected by twenty one certificates in the USSR. Spouses Kirlian again after a half-century period came to the conclusion, that their method distinguishes illnesses at an early stage of their development: on pictures it is possible to carry out early diagnostics, to reveal relapse of illness and to estimate objectively therapeutic action of chemical preparations and medicines. In their researches the fact was again found out: discharge process is in dependence not only from unhealthy, but also from an emotional condition of a human object. In their honor the International Kirlian Research Association has been founded in 1975. At present, research institutes and clinics in Germany, Switzerland, Austria, Netherlands, Russia and other countries are functioning in which the bioelectrography researches are carrying out and the methods of energy correction and treatment are developing and approving.

THE FINNISH TRADITION OF DEVELOPMENTAL BIOLOGY

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The first experimental embryologist in Finland was Gunnar Ekman (1883-1937). He was a student of J. A. Palmén, Professor of Zoology in the University of Helsinki, an eminent ornithologist and morphologist but not familiar with experimental laboratory work. Ekman learned the techniques in the laboratory of H. Braus in Heidelberg and became later famous for his experiments elucidating the determination of the development of the amphibian heart. He worked as professor of experimental zoology in Helsinki from the year 1928 but got only one student to continue his work. This student was Sulo Toivonen (1909-1995), who began to study the induction problem in ampibian gastrula, a work that he had to continue alone because of Ekman's sudden death. Toivonen published in 1940 his Ph. D. thesis on heteogenous inductors and was able to show that there are two kinds of inductions, the neural and the mesodermal one. Together his student Lauri Saxén (1927-2005) he formulated the so-called two-gradient theory on induction and published a widespread monography "Primary Embryonic Induction". Later on, both Toivonen's and Saxén's students widened the field of the experimentation to chick early development and to the development of different organs, such as the kidney and teeth, and the tradition is nowadays, one hundred years after Toivonen's birth, flourishing in the spirit of modern developmental biology as one of the top fields of Finnish biological research.

MORGAN'S CHANGE OF VIEW ON EVOLUTION, 1903-1932

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The American biologist Thomas Hunt Morgan (1866-1945) is usually associated to the chromosome theory and the genetics of *Drosophila.* His studies of mutations also paved the way for the new evolutionary synthesis of the 1930s. However, in the first decade of the 20th century Morgan denied both the Mendelian and chromosome theories. Besides that, during the two first decades of the century, he also criticized Darwin's theory of evolution: he did not accept gradualism and rejected the principle of natural selection.

Some historians consider that Morgan changed his mind on chromosome theory in 1910-1911 or 1914, after devoting himself to the study of the genetics of transmission in *Drosophila*, and that his "conversion" was due to the evidence he got through those studies. However, a closer look shows that his main motivation might have been the strategical advantages he obtained for his career by that change. Could his changing views on evolution had been influenced by similar motives?

In the beginning of his career Morgan accepted that the evolutionary process occurs by jumps – as claimed by Hugo de Vries in his "mutation theory" – and he denied the principle of natural selection. From 1900 to 1915 he published several criticisms Darwin's theory of natural selection. His main attacks were presented in his books *Regeneration* (1901) and *Evolution and adaptation* (1903). Around 1915, taking into account his own work with the genetics of *Drosophila,* he started to think that the evolutionary process could be gradual and that new genes offering slight advantages would gradually spread in the population. However, some of his criticisms still appeared in his book *A critique of the theory of* *evolution* (1916). According to Garland Allen, only in 1932 – when he published his book *The scientific basis of evolution* – he was completely convinced that the evolutionary process was gradual, and accepted natural selection as the main mechanism of evolution.

This paper analyses the changes of Morgans views on evolution from 1900 to 1932, trying to find out the reasons behind each change. First, the purely scientific reasons for those changes are discussed, pointing out that he gave up some of his criticisms without providing reasonable new scientific evidence or arguments for rejecting them. Secondly, the influence and parallels between his changes concerning genetics and evolution are also analyzed, and it seems that there was indeed an influence, but only from genetics to evolution, and not conversely. Third, this paper discusses the possible influence of extra-scientific factors on Morgan's change of view concerning the theory of evolution, during the first decades of the 20th century. It is likely that there were such factors, since Morgan's change of opinion cannot be explained by purely scientific arguments. A professional strategy, related to an attempt to have a wider influence in Biology – instead of limiting himself to genetics – seems to have had a strong influence upon his change of attitude towards the theory of evolution.

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LABORATORIES AT THE MEDICINE FACULTY OF COIMBRA UNIVERSITY IN THE XIX CENTURY

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The reform of Coimbra University under the Marquis of Pombal in the XVIII century (1772) led to the creation of the Faculties of Philosophy, Mathematics and Medicine, which were always characterized by a close teaching relationship in the field of the Physical and Natural Sciences. Therefore, from the XIX century onwards those faculties witnessed a significant development of teaching in both Natural Sciences and the Medical Sciences which can be visualized regarding contemporary collections, archives and museums of Coimbra University.

Consequently, international relationships have been developed with some prestigious academic and scientific teaching institutions around Europe, when the Laboratories of Experimental Physiology, Histology, Toxicology and Pathological Anatomy emerged as the result of the reorganization of the Faculty of Medicine at Coimbra University in 1866-1872. The Laboratory of Histology provided good conditions of space and light at the College of Jesus where the experimental works were performed with the twelve microscopes including the special Smith, Beck & Beck as well as many other scientific instruments.

The Laboratory of Experimental Physiology was used for the performance of vivisection for the classes of Physiology and Toxicology. The collection of scientific instruments from this laboratory was made of instruments recommended in Berlin, Bonn, Vienna and Paris, during the scientific trip made by Professor Costa Simões in 1865. The publication in 1866 of his book – *Elements of Human Physiology (Elementos de Physiologia Humana)* – was another outcome of his European scientific trip. These instruments are kept today at the Faculty of Medicine of Coimbra University.

THE APPLIANCE OF SCIENCE?: THE LABORATORY AND CLINIC IN EARLY-TWENTIETH-CENTURY SCOTTISH PSYCHIATRY

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In recent decades, much has been made historiographically of the subject of ‘laboratory versus clinic’ in relation to the interface between clinical medicine and laboratory science in the late-nineteenth and early-twentieth centuries. There has, however, been almost no attempt to explore this topic within the medical specialty of psychiatry, particularly within the British context.

This paper wishes to explore the impact that laboratory techniques made upon clinical psychiatry in early-twentieth-century Scotland. In 1897 and 1909, two Scottish asylum laboratories were founded, in Edinburgh and Glasgow respectively. Their history and workings will very briefly be outlined. The remainder of the paper will then focus on one of the main functions of these laboratories – Wassermann testing to discover which asylum patients were syphilitic and thus might be suffering from General Paralysis of the Insane (GPI), a deadly form of neurosyphilis that was diagnosed in up to 20% of British asylum male patients at this time.

The Wassermann test provides an excellent means of studying the interaction between laboratory and clinical psychiatry, and the ways in which both professional groups involved in this testing – pathologists and psychiatrists – produced and negotiated medical knowledge. Given the particular need that psychiatry – of all the medical specialties – had of bolstering its scientific legitimacy, one might assume that the laboratory’s sophisticated technical tools were embraced enthusiastically and led to unequivocal advances in managing the disease. Such assumptions may be unduly influenced by widespread claims in the published medical literature that the Wassermann test played an immediate and central role in the diagnosis and treatment of GPI. However, this study finds that, while good rhetorical use was made of the laboratory model within psychiatry, a detailed study using patient case notes indicates that psychiatrists’ claims in the published literature do not match what appeared to be happening in actual daily asylum practice. Instead, psychiatrists appear to have been deeply ambivalent over how they should incorporate such new laboratory diagnostic tools into their clinical practice, with the importance of the Wassermann test lying in its symbolic, rather than its practical, utility.

PERSONNEL MONITORING AND EVALUATION DOSIMETRY

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Radioactive materials, and x-rays used to diagnose disease and medical radiation is the largest source of man-made exposure to the public. The Kenya Radiation Protection Board was established in 1986 under Cap 243 Laws of Kenya to oversee ionizing radiation issues and to manage radioactive waste The Radiation Protection Board is a statutory body established under Cap 243 of the Laws of Kenya passed by parliament on 29th December, 1982. The chapter 243 of the laws of Kenya is cited as the Radiation Protection Act. This Act provides for the protection of the public and radiation workers from dangers arising from the use of devices or materials capable of producing ionizing radiation. The mission statement of the Board is to accelerate, regulate and expand the contribution of nuclear and irradiation technology to the Kenyan economy through promotion of nuclear and radiation safety culture. The trend analysis of all workers in Kenya, the National Radiation Protection Laboratory (NRPL), provides personal radiation monitoring service to radiation workers. This project was based on studies of radiation doses received by radiation workers from radiation facilities in Nairobi, Kenya, using Thermoluminescent Dosimetry (TLD) methodology. Radiation doses received by workers during performance of a few types of radiological procedures and application of sealed and unsealed radionuclides have been measured at a number of x – ray departments (diagnostic radiology), radiotherapy and nuclear medicine and training and research, and industries. Nuclear medicine recorded the highest dose as compared to Radiotherapy, training and research, Diagnostic radiology and industry. Nuclear medicine recorded an average monthly dose of 0.72 mSv compared to 0.38 mSv, 0.23 mSv and 0.21 mSv for radiotherapy, diagnostic radiology and training and research respectively. The yearly dose recorded were 7.0 mSv, 6.60 mSv, 6.30 mSv, 6.00 mSv, 5.50 mSv and 5.0 mSv for years 2000, 2001, 2002, 2003, 2004 and 2005 respectively. This is because radiation safety has been enhanced/enforced probable in terms of improvement in shielding design, good working practices and good quality assurance and control, technology on radiation protection keeps on increasing and also equipment keeps on deteriorating with time. Overall, the results show that radiation workers in Kenya are working under safe environments since the doses received are within acceptable limits of radiation protection. The data shall serve as baseline information for all radiation facilities in Kenya and the Eastern and central Africa region in general.

RAMÓN Y CAJAL AND THE LAW OF THE DYNAMIC POLARISATION OF THE NEURON

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After presenting the theory on the free termination of the neuron in 1888, Cajal tried to establish the principles which the activity of the nervous cell was subjected to. In the writings published with that aim between 1889 and 1897, a simultaneous interest in the morphological and functional aspects which the explanation of neuronal conductivity possesses becomes evident. These aspects were to combine in the discovery of the *dynamic polarisation law*, without doubt the founding principle of neurosciences. The present study is an analysis of the conceptual, methodological, epistemological and historical keys of that discovery.

THE DEVELOPMENT OF PHARMACEUTICAL INDUSTRY IN SERBIA

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Introduction:

The development of pharmaceutical industry in Serbia, began after Second World War. First company established in 1945. in Serbia was “Galenika”. In years 1953 and 1960, companies “Zdravlje” and “Hemofarm” were founded. In this work, we tried to show the importance of development of pharmaceutical industry in Serbia.

The most influent pharmaceutical companies in Serbia:

“Galenika” was founded in July, 1945. in Belgrade. In the beginning, it was small company, with only 43 employees. Only four years later, in 1949., with “Galenika”, Serbia (former Yugoslavia) started with production of penicilline. Only three states in the world already had penicilline production (USA, Great Britain and France). It’s obvious that development of “Galenika” was very rapid. “Galenika” also had the production of streptomycin, chloramphenicol, novalgyn, biophyl, mercury oxide, silver nitrate. Its Development and Research Laboratory, established in 1961. had succes in various organic and inorganic compounds synthesis and extractions. Today, sixty four years later, “Galenika” is still one of the leading companies in Serbia.

“Zdravlje” was established in year 1953, in city of Leskovac, in south Serbia, as a laboratory, but seven years later, with new factory opened, “Zdravlje” signed contracts with Boehringer and Pfizer, and started production of generic drugs. In the late sixties, “Zdravlje” had production of dextrans, and in eighties, had production of dialysis sets and solutions. In year 2003. Pharmaco company from Iceland became new owner of “Zdravlje”. Finally, in year 2004. Pharmaco changed name in Actavis company, and today, “Zdravlje” is known as “Zdravlje Actavis” company.

“Hemofarm” company was established in year 1960. in city of Vrsac. In the first year, “Hemofarm” producted 26 various drugs. “Hemofarm” had production of tablets, ointments, syrups…, and signed important contracts with famous companies, such as: Ciba, Geigy, Fresenius, Byk Gulden, Farma Italia… “Hemofarm” is today the biggest and most successful pharmaceutical company in Serbia, with significant export capacities in USA, Russia, Republic of Srpska, Montenegro…

Conclusion:

Inspite of fact that pharmaceutical industry in Serbia is very young in compare with pharmaceutical industries all over the world, it was very successful. Also, the fact is that Serbia is facing many political and development difficulties in past two decades, but it is also the fact that our company in last year entered the USA pharmaceutical market. It is a big step forward and a big hope.

References:

www.galenika.rs. (13.02.209.)
www.actavis.rs. (13.02.2009.)
www.hemofarm.com (13.02.2009.)

ASPIRATIONS AND CONFLICTS: THE ‘PROFESSIONALISATION’ OF MEDICINE IN COLONIAL BANARAS

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There have been many studies of religio-cultural aspects of Banaras life. Some writings have also emphasized the pluralistic nature of its society and culture. Plurality of healing practices/culture is an important aspect, which is overlooked when Banaras is cast as a bastion of Hindu orthodoxy. ‘Professionalisation’ of medicine in Banaras too does not seem to have attracted much scholarly attention. In this respect this paper focuses on the social history of medicine and reflects on the multiplicity and complexity of social interaction and encounter between indigenous and western medicine in Banaras during first half of the twentieth century.

It further explores the variety of engagements and interventions in the patronage and professionalisation of modern medical science and the institutional interventions which not only shaped the local history of Banaras but also highlights the contradictory aspects related to harmony and disharmony (simultaneously) in the public sphere. For instance, this paper seeks to show how both Indian allopathic practitioners and indigenous medicine practitioners had to struggle against the professional ‘borders and boundaries’ demarcated for their social standing by the colonial government. What were the emerging public platforms in Banaras which made space for the allopathic and ayurvedic medical practitioners? In associating ayurveda with their cause, what were the tensions generated with other systems of medicine. It further shows how the ‘professionalisation’ of medicine was a common endeavor both for the British and the Indian doctors trained in western medicine and a ground for conflict. At another level Indian allopathic physicians were also engaged in a tussle with indigenous medical practitioners in their efforts to extend their clientele. It then explores how indigenous practitioners sought to refurbish their status and credentials by laying out their own institutional and other criteria for a ‘professional’ standing. It examines the initiatives taken by the indigenous medicine practitioners to create a separate and parallel medical infrastructure equivalent to the allopathic system. This paper argues that the professionalisation in medicine during the twentieth century was not a binary concept i.e. Indian/European, ruler/ruled, indigenous/western, but it was a morass of many strands entwined to each other with many crosses.

This paper is based on local language sources as hitherto untouched record rooms and personal libraries. Variety of new sources have been consulted to integrate the arguments such as tracts and pamphlets written by a wide range of people, brochures and booklets of various medicine shops and drug manufacturing companies. In addition Hindi literature, newspapers and journals was consulted to understand the ambiguity of colonial modernity and its interactions with indigenous system.

HISTORICAL DEVELOPMENT OF THE EMERGENCY MEDICINE IN TURKEY

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Abstract: Emergency medicine is a science involving instant action and fast decision making to prevent deaths and permanent disabilities in health problem cases. In acute illnesses and injuries, specialists monitor patients' proper and continuous stabilization, assessment, treatment and orientation.

Advancements in medical science and technology, plus; increase in the world population and urbanization have deeply changed the presentation of the health services. Particularly to solve emergent health problems and to prevent disabilities and improve allover public health quality, it was aimed to improve the quality of the pre-hospital and emergency services. Under the shadow of all these projections Emergency Specialty was launched. Emergency specialty is unique with not concerning a particular biological system; the public need was the driving force of its made up. Although it has just reached, Emergency Specialty Education has disseminated quickly across Turkiye. Emergency specialty plays a significant role in planning, improving, applying and monitoring of sophisticated and effective healthcare systems. Planning and practice of health services at and after disasters are also under the responsibility of Emergency Medicine Specialty.

In this literature review, domestic and international resources were searched and analyzed data were presented. The study mentions how the emergency medicine came out, the emergency medicine systems in the world, emergency medicine education in Turkiye and the developmental process of the emergency medicine in the world and in Turkiye comparatively.

Keywords: Emergency medicine in Turkey, Historical development of the emergency medicine, Emergency medicine systems

MEDICAL SCIENCE IN XIX CENTURY IN GEORGIA AND ITS SOCIAL-CULTURAL FRAMEWORK

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History of Medicine of Georgia reflected that the development of Medical Science is in focus of activity for Georgian Royal Family too. In XIX century deep traces were left in Medical Science by Princes David and Ioanne.

Prince David was an atheist, he sharing Voltaire's idea. Prince Ioanne was a deep Christian. Their polarization and cultural unity was picture of spiritual and intellectual spectrum of the XIX century Georgia.

From the work of medical character by Prince David (1801-1860), one should separate "Therapeutical Recipes", which is a certain summing up of different European sources and involves the methods of treatment for some diseases.

In his "Short Physics" greater place is given to optics: eye psychology, rules and principles of preparing glasses. The author expresses deep knowledge while discussing the embryology digestive and cardio-vascular systems and other issues.

Ioanne Bagrationi, as his contemporaries say, was a scientific doctor. To him belongs "Kalmasoba" a work of encyclopedic character, which involves many paragraphs of medical character.

He also wrote the so-called "Volume" of medical character. All the problems of medicine of that period are discussed in these books, from theory to practice. The project should be specially mentioned, by which Ioanne suggests an individual maternity hospital for women without husbands. This humanism seems quite a brave act for this period.

Ioanne observes the following disciplines in Medical Science: 1. anatomy; 2. physiology; 3.pathology; 4. therapy; 5.mattermedia; 6.pharmacology; 7. surgery; 8. chemistry; 9. obstetrics-gynaecology; 10. chemist's (with recipes); 11. botany; 12. history of natural science; 13. physics; 14. mineralogy.

If we look through the History of Medicine in XIX century, apparently clear is not only the level of development medical knowledge and ideas in this period, but also social-cultural configuration of Medical Science in Georgia.

ODESSA CITY HOSPITAL (THE FIRST CENTURY OF ACTIVITIES)

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Odessa is a big sea port, where for a long time maked fast the merchant ships from many lands. They brought different kinds of goods, but often also the pathogenes of dangerous diseases. From the XVIIIth century in Odessa were established the quarantine and worked out the possible ways of combating pathogenic microbes. But even at the edge of XVIIIth-XIXth centuries the city had not a special institution for carry out the scientific investigations in this direction.

Odessa City Hospital was opened in 1802 and became the second medical institution besides quarantine in this city and one of the biggest hospitals in Russia. Every year it gave help to 9-10 thousands of in-patients and 12-15 thousands of out-patients. Hospital successful activity was provided by physicians of hight professional scill. At different time in its departments worked the surgeon N. Sclifosovsky (1836-1904), the neuropathologist J. Mochutkovsky (1845-1903), the pathologoanatomist G. Minch (1835-1896), the epidemiologist N. Gamaliya (1859-1949). Bringing into concord theory with practice, they carried out the scientific experiments, made the reports at the Council of hospital physicians, wrote the articles for "Transactions of Odessa City Hospital Physicians".

A broad reputation aquired the typhus epidemics investigations, conducted at Odessa City Hospital. These epidemics especially spreaded in Russia after the Napoleon troops invasion in 1812. At the seventies of XIXth century the nature of infectious diseases remained not distinct, bacteriology taked the first steps. In order to prouve the contagiousness of typhus pathogene, discovered by Obermayer, it was necessary to reproduce this disease experimentally. On 25th April 1874 G. Minch inoculated himself with the blood of relapsing typhus patient. After three grave bouts the scientist recovered. On 10th March 1876 his colleguae J. Mochutkovsky repeated this experiment throught self-inoculation with spotted fever patient blood and also was seriously ill. These experiments clearly demonstrated the infectiousness of typhus patients blood. G. Minch also expressed an idea that typhus may be passed on from patient to healthy man trought the blood-sucking insects. His supposition was confirmed by Scharl Nicolle in 1909 in experiments on monkeys.

The medical faculty of Novorossiysk University was opened only in 1900, and during nearly 100 previous years Odessa City Hospital remained the Centre of practical and scientifical epidemiology in South Russia.

SEROTHERAPY AND MODERNITY IN TURN-OF-THE-CENTURY PARIS

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Following the initial development of serum therapy for diphtheria by Behring, Aronson and Wernicke in Berlin between 1890 and 1894, Emile Roux and his collaborators at the Pasteur Institute introduced the innovative treatment into France.

Thus, the nineteenth century closed in France with this 'miracle' treatment against a deadly childhood disease that would earn Emile Roux a place in the pantheon of French scientists alongside his master and former employer, Louis Pasteur. In this paper, I want to show how this serotherapy represented a new orientation of therapeutic microbiology in line with other changes that were transforming the lives of the inhabitants of large European cities like Paris. Indeed, apart from political crises, the end of the century saw large-scale electrification projects as well as the dissemination of other technological innovations that were challenging traditional norms.

How then did such a medical innovation fit into this urban world in flux, and how did it articulate with other mechanical innovations that were becoming widespread at the time like the bicycle or the typewriter? Comparing it to Pasteur's treatment of rabies, I will show how serotherapy marked a turning point not only in the presentation of medical treatment but also in the implantation of microbiology in France (especially outside Paris). Because of the large number of people, particularly young children, affected by diphtheria and the high levels of mortality associated with the disease, serotherapy opened up new horizons for promoting microbial diagnosis and treatment.

In examining the impact and exploitation of these new possibilities across France, I offer some reflections on the work of Bruno Latour (*Pasteur: guerre et paix des microbes*, 1984) and David Barnes (*The Great Stink of Paris and the Nineteenth-Century Struggle against Filth and Germs*, 2007). Both authors have argued that the force of Pasteur's microbiological explanation of disease was in large part due to its integration with a well established hygiene movement in France, but neither has much to say concerning the impact of serotherapy with respect to this history of the 'pasteurization of France'. The first 'industrial' microbiological human medicine, serotherapy participated in the modernization of pharmaceutical medicine in a way that reflected other modernization processes of the time.

COMPUTER TOMOGRAPHY SCANNER: A REVOLUTIONARY INSTRUMENT

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The most important invention in the field of computer-assisted medicine, which in many ways determined the further development of non-invasive medical diagnostics, was carried out in the 1960's. Although the mathematical basics were already grounded by John Radon in 1917, not until the development of integrated circuits and microelectronics it was possible to do complex calculations in short time periods with the help of computers. After that computers quickly found their way into the medicine.

The first working computer tomography scanner was invented by Sir Godfrey N. Hounsfield in 1971. Based on the works of Allan M. Cormack he successfully took the first human computer tomography image. Since then this instrument changed the whole medical landscape in regard to diagnosis, therapy and surgery planning. But this mechanization did not only bring along new prospects but also new challenges.

Even if the idea of a see-through body already arose with the discovery of the X-Rays by Wilhelm C. Röntgen in 1895, the computer tomography scanner was the first instrument that could recreate a three-dimensional model of the human body with a satisfactory detail resolution for a precise diagnosis. Besides the successes accompanied, the dangers of radiation on the patient and especially on the physician should clearly be kept in mind. The radiation exposure during one computer tomography session is a multiple higher than common examinations.

In this paper the historical impact of computer tomography scanners on medical routines and social impacts on patients is illustrated, along with advantages, disadvantages and risks of this revolutionary instrument.

NEW MEDICAL IDEAS IN OLD HISTORY OF MEDICINE

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The formation of medical knowledge and tradition are deeply rooted in the historical past of Georgia. In XII century Gelaty and Ikhalto Academy were established, where medical sciences were learned . In XI-XVII century excellent physiological and medical treaties were translated and created.

The first High Medical Educational Institution was established in 1918. Before this year Georgian doctors were receiving high medical education in Europe and then came back and introduced the new medical ides and knowledge in the different direction of Medical Sciences and practice. In the first half of the XIX century about ten people received high medical education and from the second half- the number of the Georgian doctors sharply increased. By the end of XIX century their number reached about one hundred.

We have studied the first step of development of new direction and new ideas in Medicine in Georgia in XIX century.

Zakharia Zubalashvili (1810-1877) has graduated from the Medical Faculty of the Leipzig University in 1835, one year later he passed examinations at Derpt University and received the right of practice. According the materials of State Historical Archive of Georgia epidemics of plague and cholera were more frequent and Zakharia Zubalashvili developed the organization of antiepidemic activity and since 1937 he had gratuitously served the patients. Zakharia Zubalashvili's huge merit lies in the creation of the Caucasian Imperial Medical Society, which was not only a scientific organization, but also the association interested in questions of public character (such as public health care, public sanitary and hygiene, social diseases, sanitary education etc), which was absolutely new approach in medicine in Georgia.

In the first year of the work Caucasian Imperial Medical Society the question about opening of a clinic in Tbilisi was raised and in 1867 on the initiative of the mentioned Society a state ambulance station together with a drug-store were established. In this ambulance poor patients received free charge treatments during 20 years. By the initiative Giorgi Tarsaidze (1857-1904) first clinic of eye diseases was opened in 1892, Samson Topuria (1853-1904) established first hospital with several specialized department, including the first roentgenological room etc.

History of Medicine of XIX century reflects many interesting examples of foundation and development of new ideas, knowledge, direction in Medical sciences and practice in Georgia and correlation of this process with the European countries and University. On the basis of the studies Biographies of Georgian doctors in XIX century we created a map, where is indicated the countries (cities) and influence on the development of new different direction of Medical Sciences and Practice in Georgia.

LANGUAGE, INFORMATION, INSTRUMENTS, AND MEDICAL TREATMENT THE MEDICAL ASSESSMENT BY JAPANESE DOCTORS AT THE BEGINNING OF THE MEIJI ERA, JAPAN

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In 1868, Japan underwent a significant change; with the Meiji Restoration, an attempt was made to shift from traditional Oriental medicine to modern medicine in a continuous process of trial and error. This process not only involved the introduction of medical techniques but also the introduction of social facilities, such as medical schools, hospitals, medical journals and so on. However, the most important change was with regard to the interpretive ability of European languages. The new Meiji government projected a simultaneous shift in language and medicine by employing European medical teachers. Such rapid changes were likely to agitate the passive attitude of the general public. However, the history shows more complicated picture.

I would like to elaborate on one aspect of this complicated picture by citing two examples; (1) the introduction of the galvanic cauterization and (2) the introduction of the hypodermic injection method. The exploitation of these two medical techniques began in the 1850s and by 1870 they developed into important medical technologies in Europe and USA.

In 1871, two German doctors and an electro-surgical instrument arrived to Japan and a clinical trial report in Japanese was submitted in 1873. In this report, under the guidance of the German doctors, Japanese doctors wrote about the characteristics of galvanic cauterization, such as, the principle, devices, directions, advantages, disadvantages, and adaptation. The report, however, merely provided an explanation of its efficacy as a new medical technique. On the other hand, a Japanese doctor, Susumu SATO (1845-1921), who had studied surgery in Germany and Austria and had returned home in 1875, had been practicing in Juntendo hospital in Tokyo and had communicated the technology assessment of galvanic cauterization to his disciples. His assessment included the comparative consideration of galvanic cauterization and other medical techniques such as iron cauterization, amputation with the écraseur, etc., for the noninvasive amputation of the human tissue. The assessment was considered the estimation for the effectiveness of such technique and included an economic aspect that corresponded to the situation in Japan at that time.

The introduction of the hypodermic injection has another history. Information pertaining to the hypodermic injection prevailed in Japan through the medical practice of the foreign doctors and the activity of the Japanese medical interpreters. In USA and Europe, the information pertaining to clinical trials for individual diseases, which were susceptible to treatment, were published in medical journals and magazines, and a syndrome caused by the contamination and addiction to morphine gradually came into light. However, in Japan, the spread of such detailed information was prevented by the insufficient interpretive ability of European languages. Moreover, under the guidance of foreign doctors, cheap syringes were introduced into Japan without enough medical assessment with regard to their safety.

CUT UP AND IMAGED: LATE 19TH-CENTURY REPRESENTATIONS OF THE CORTEX

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When medical people inspected the surface of the brain in the 1840s, they detected little order or organisation. In looking at the cortex, they saw much the same as Vesalius had seen in the 16th century when he had opened up the skull and pushed aside the meninges. The convolutions were still commonly compared with the coils of intestine – or, more mundanely, with a bowl of spaghetti. By the end of the 19th century, the surface of the brain looked altogether different to the educated eye. Neurological textbooks now contained detailed and accurate verbal and visual descriptions of the morphology of the brain. Notwithstanding some individual variation, the cortex appeared ordered and regularly patterned. The convolutions of each hemisphere had been divided into four lobes, with fissures and sulci between them, and they had been named and / or numbered for easy reference. Order and organisation extended to the microscopic level as well. The turn of the century saw the rise of the first cytorarchitectonic maps, i.e. maps that describe the cellular structure and arrangement of the cortex. Most importantly, the cortex was now regarded not only as an anatomically regular but also as a functionally differentiated structure, i.e. different functions were assigned to different cortical areas. Within, roughly, half a century, the cortex had changed from a relatively unimportant, unstructured and undifferentiated layer of tissue to a highly structured and differentiated organ that was commonly regarded as the substratum of sensory, motor and mental functions.

The paper charts the main stages of the this process, putting instruments and representations rather than ideas on the foreground. These stages can be summarised as follows:

time	ideas	research technique	key instruments	typical representation
1861	the faculty of articulate language is located in the third left frontal convolution	disease as an instrument or experiment	surgical knife	brain profile
1870-71	there is a localisable motor zone in the cortex	local electronic irritation	galvanic or faradic apparatus	dotted surface map
c. 1900	the cortex is both morphologically and functionally differentiated	serial sectioning	microscope, improved brain microtome	cytoarchitechtonic map

The paper argues, first, that the formation of the ideas was crucially dependent on instruments, and, second, that the dissemination and consolidation of the ideas relied heavily on the reproducible schematic images that condensed these ideas.

CHINESE MEDICINE AND WESTERN MEDICINE ON THE WAY OF SCIENTIFIC ADVANCES AND INTEGRATION

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In the history of our civilization there is one great riddle connected with independent existence of Chinese and Western medicines during two millenniums. Now all artificial boundaries fell, and striking independent European medicine and Chinese medicine becomes a subject of discussion. At 13th International Congress of Logic, Methodology and Philosophy of Science (2007, Beijing) for the first time there was the Special Symposium "Chinese Tradition medicine vs. Western Medicine". At this Symposium scientists of China and France have attempted to compare these independent sciences. But this comparison was like the one of fire and water because the comparison contained only enumeration of characteristics of one and other, which demonstrated clearly their deep difference.

Meanwhile now there is the method which allows to made a bridge from European science to Chinese tradition medicine. This bridge is given by new branch of thermodynamics namely thermodynamics of irreversible processes in systems under electromagnetic radiation [1, 2]. It gave rise the irreversible thermodynamic of physiological processes of electromagnetic radiation. This new science can be a dictionary for translation of philosophy and terminology of Chinese medicine in language of European science. It is possible to show this process. As a result now it is clear the contour of new world medicine of the middle and the second part of 21st century.

References

1. Chukova Yu.P. – Philosophy of the weak and the strong interaction in Western (European) and Oriental (Chinese) Medicine – Second World Congress of Philosophy of Medicine, Krakow, Poland, 2000, p. 17-18.
2. Chukova Yu. P. Turkish medicine: between the East and the West, between the past and the future. Proceedings book of 1st International congress on the Turkish history of medicine. Konya. 2008. Ed. A.D. Erdemir, v.1, p.235 - 251

A QUEST FOR THE "MODERN": LOCALIZING VERSUS UNIVERSALIZING KNOWLEDGE

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In Korea, there exist two parallel medicine systems with distinct professional organizations, hospitals and medical schools: Western medicine (WM) and Oriental medicine (OM). In this paper, I discuss the shaping of modern medicine in a changing legal-political landscape of colonial Korea. WM was introduced into Korea, both through Christian missionaries and through Japanese colonial agents in the late nineteenth century. I first briefly sketch the ways in which Christian missionaries and Japanese colonial agents transmitted Western knowledge to Korea. Next, I investigate the contentious concepts of "Western" and "modern" by paying particular attention to the Oriental-Western medicine controversy in the 1930s.

The Japanese colonial period (1910-1945) is associated with modernization wrapped up with loosely constructed 'Westernization.' The colonial government restructured Korean medicine and tried to marginalize OM, which had existed as the official and orthodox medicine until that time. The colonial authorities repressed traditional OM on the grounds that it was not modern and scientific. Concurrently, the colonial government encouraged WM by establishing both institutions for medical education and public hospitals at major cities. In the 1930s, when this colonial order was stable to a degree, proponents between OM and WM clashed over relative merits of each medicine. In doing so, they contested the nature of West and modernity.

WAGNER-JAUREGG AND THE HEREDITY OF MENTAL ILLNESS. ON SPECIAL FEATURES OF THE VIENNESE RESEARCH PROGRAMME IN PSYCHIATRIC GENETICS IN THE FIRST HALF OF THE 20th CENTURY

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Julius Wagner-Jauregg (1857-1940) is well known for his malaria therapy of progressive paralyze, for which he won the first Nobel prize in medicine, but also for his strong opposition against Sigmund Freud and psychoanalysis. Recently, combined scholarly efforts aiming to asses Wagner-Jauregg's impact on the Eugenics Movement in Vienna, as well as on some outstanding Austrian psychiatrists who contributed to the Munich School of Psychiatry around Ernst Rüdin, provide us with a more nuanced picture of his intellectual habitus. Still, there are many important aspects of Wagner-Jauregg's work that have not been worked out.

This paper engages in historical epistemology and provides an overview of a special kind of medical discourse on heredity, which reflects the peculiarities of the local scientific community. It will illustrate to which regard the local discourse is identifiable with Wagner-Jauregg's arguments for a research program in the heredity of mental diseases. It will indicate the ways of mutual references, which cross-fertilized psychiatry and endocrinology as well as psychiatry and immunology in Vienna to an extraordinary extent and will carve out what epistemic entities allowed Wagner-Jauregg and his school a privileged methodological access to the difficulties of research in psychiatric genetics. On this basis, the ways will be demonstrated in which the Wagner-Jauregg school differed from other prominent psychiatric schools of the day, among them Kraepelin's or Bleuler's.

On this basis, the final part of the paper deals with the question to what extent we would be allowed to say that these epistemic attitudes are represented in some of the research agendas of his colleagues and students, some of which figured prominently in the sterilisation program of the National Socialists' radical eugenics.

US 'SHOPPING LIST' OF HUMAN EXPERIMENTATION DATA PRESENTED BY FORMER JAPANESE B.W. UNITS, ISHII ORGANIZATION

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The relationship after W.W. 2 between US intelligence tricks and former Japanese B.W. (biological wafer) units' activities, including continuous and forbidden experiments on human beings, was revealed by John Powell's 'A Hidden Chapter in History', *Bulletin of Atomic Scientists* (Oct, 1981). In Japanese Army the whole body of those units was called as the Ishii Organization (1932-45, hereafter IO).

This report will discuss the quality of human experimental data by IO focusing on tuberculosis and HFRS (Hemorrhagic Fever with Renal Syndrome)of 22 kinds of researches on US list mentioned below. The author will make clear two points; one is abnormal research based illegal human experiment is not a shortcut, but a detour to the truth. Another is the structure of the birth of myth that data presented to US by IO was highly valuable.

It has been considered that US took those data in exchange for granting immunity its members from war crime accusation in 1947. Before US got those data, investigation teams had invented them and prepared 'a shopping list' of those. The shopping list shows that experiments on human were conducted in 22 kinds of research subjects and resulted pathological slides from at least 754 victims.

Result

On these human experimentation data, Dr. N. H. Fell, one of investigators, wrote in his report (20 June, 1947) 'The results obtained with human beings were somewhat fragmentary because a sufficiently large number of subjects to permit statistically valid conclusions was not used in any of the experiments … the data on human experiments, when we have correlated it with data we and our Allies have on animals, may prove invaluable, and the pathological studies and other information about human diseases may help materially in our attempts at developing really effective vaccines for anthrax, plague and glanders.'

Fell's estimation on Japanese data was not so exiting. On the other hand, C. Willoughby, Chief of G-2, GHQ, wrote in the letter on July 17, 1947, 'Your attention is invited that these really important results, for the benefit of the United States in critically serious form of warfare, were only obtainable through the skillful, psychological approach to top-flight pathologists, who were bound by mutual oath not to incriminate each other in these disclosures. They were assisted by direct payments, payments in kind (food, miscellaneous gift items, entertainment), hotel bills, board (in areas of search for buried evidence, etc).'

Willoughby's letter indicates that US acquisition of data of IO was not realized by granting for accusation from war crime but by giving money and other goods to IO members.

LA CIRCULATION D'IDÉES SCIENTIFIQUES: UNE "ASSEMBLAGE DE LIENS" DANS LES PREMIÈRES REVUES MÉDICALES DE SÃO PAULO

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Au Brésil, spécialement à São Paulo, le processus qui a correspondu à l'institutionnalisation de la santé à des fins du XIX siècle, a été commandé par des médecins qui jouaient tant des fonctions administratives que de recherche scientifique. Leurs actions ont contribué au contrôle le plus efficace de problèmes sociaux, comme insalubrité, endémies et épidémies, et la manque de qualité des produits d'approvisionnement. La participation de la connaissance scientifique et technologique a été importante dans la conduction du pays a un ordre libéral approprié aux conditions tropicaux. Ma perspective est discuter les transformations qui ont caractérisé la société brésilienne et de São Paulo, au moyen de nouvelles formes d'insertion de la langue scientifique dans le quotidien de la société. La documentation principale pour cette discussion se constitue dans l'univers de revues médicales, et semblables, créées entre 1889 et 1950. La période sera présentée dans deux groupes: de l'annonce de la République et aussi moment de création de première revue médicale de São Paulo, jusqu'aux années 1930. De 1930 jusqu'à la création du premier organisme régulateur dans le secteur scientifique au Brésil, en janvier de 1951, du Conselho Nacional de Pesquisa - CNPq. La discussion principale se donnera a partir des travaux publiés dans de périodiques originaires de São Paulo par les médecins: Luiz Pereira Barreto, Adolphe Lutz, Emílio Ribas, Arnaldo Vieira de Carvalho, Vital Brazil et Rubião Meira, personnages avec accès privilégié aux publications dans des journaux quotidiens et spécialisés. L'objectif est discuter les actions, valeurs et la pensée de ces représentants du champ médical de São Paulo et les caractéristiques principales de l'activité scientifique produite dans ce processus. L'idée principale est évaluer les questions résultant de cette documentation dans la forme d'un "assemblages de liens" construites par ces médecins à la recherche d'autonomie pour leurs activités professionnelles, scientifiques et politiques

L'APPAREIL ENREGISTREUR GÉNÉRALE DE FRANÇOIS-FRANCK (1849-1921) LE PAROXYSME DE LA MÉTHODE GRAPHIQUE AU COLLÈGE DE FRANCE

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En 1894, sur les *Archives de Physiologie Normale et Pathologique* de Brown-Séquard va paraître la description d'un "Nouvel enregistreur à bande sans fin avec enfumage et vernissage automatiques".

Ch.-E. François-Franck, suppléant de Marey à la chaire d'Histoire Naturelle des Corps Organisés au Collège de France, a ainsi réalisé la vertige finale de la méthode graphique, l'apothéose de la pléthysmographie simultanée: avoir définitivement étalée sur une bande sans fin de papier fumée, l'essence du vivant, à savoir le mouvement. Son maître a mené la méthode à la perfection, la prenant des laboratoires de Leipzig et en faisant l'objectif de toute sa vie, pour étudier et comprendre la circulation du sang et, surtout, la locomotion de l'animal et de l'homme.

François-Franck va reprendre ces techniques et va les perfectionner sans cesse, avec un mouvement progressif de son programme de recherche visant à éclairer les règles du mouvement des organes internes, leur pulsation réglée par le système nerveux organique, véritable âme végétative des corps organisés. En compétition avec les travaux de Mosso en Italie, Gaskell et Langley en Angleterre, François-Franck vise à la définition ultime et mathématique des mouvements vitaux intérieurs. L'appareil enregistreur général, en combinaison avec une technique opératoire projetée *ad hoc* pour l'enclenchement de neuf pléthysmographes aux viscères principaux, représente l'accomplissement d'un succès personnel remporté par le physiologiste français au Xème Congrès Médical de Berlin, où, dans le laboratoire de du Bois Reymond, il a, encore une fois, vengé Sedan au point de vue scientifique.

Avec Louis Hallion, à cheval sur deux siècles, François-Franck s'engagera dans la démarche titanique d'enregistrer tout mouvement intérieur, toute variation de volume des principaux viscères de l'organisme vivant. Millier de tracés, gardés à l'Institut Mémoires de l'Édition Contemporaine de Caen, constituent le legs de cet effort étonnant.

En réalité, la folie de la mesure - comme cela a été défini - appliquée aux mouvements du vivant va forcer la physiologie française dans l'impasse liée à une ancienne conception iatro-mécanique de la vie qui ne permettra pas d'avertir ce que – bien que pratiquée dans les locaux adjacents du Collège par Marcelin Berthelot – c'est l'avenir de la discipline: la biochimie.

L'insistance sur le mouvement vital et sa représentation graphique va déplacer les intérêts de ces scientifiques vers la photographie et le cinéma, alors que les instituts de recherches physiologiques européens orienteront leur étude sur le métabolisme et les molécules organiques, en déplaçant la pointe avancée de ceux travaux en Allemagne en Angleterre et au-delà de l'océan, aux Etats-Unis.

Regular Session T09-07
Technology in the Contemporary Period (1800-)

MICRO-ALLOYING IN EARLY IRON AGE: A CASE STUDY FROM BADMAL, ORISSA

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Micro alloying is the most interesting feature in the modern world of technology. It is interesting to note that iron technology developed in Indian sub continent around 1600 BCE. The aborigines initiated iron technology in Eastern India during 1000 BCE. The iron making technology in Eastern India completely initiated a new craft and the people developed and flourished using this craft. In case of iron, a solid-to -solid transfer of iron ore into spongy mass was a practical success, not only due to easy availability of iron ores but also mastering direst reduction technology. They also new the technology of tempering and quenching.

In Orissa iron ore deposits are found east of the Brahmani river valley, in the northern and north-eastern highland zones, comprising Bonai-Keonjhar, Gandhamardan, Tomka-Daitari, and Gorumahisani-Badampahar regions. The parent rocks of these deposits are represented by Banded Iron Formation (BIF) and ferruginous shales. The iron bands are also represented by magnetite, martite, goethite and maghemite, although hematite constitutes the predominant band in the layered BIF.

The site clearly reveals that the rich bio-habitat and the vast mineral resources of the region have attracted human occupation right from the beginning of first millennium BC. The settlement developed out of the existing Iron Age cultures of the middle Mahanadi valley, and rose to prominence during the Early Historic period as a bead manufacturing centre in this part of the Orissa highlands.

The in-depth chemical analysis and metallographic studies clearly identified that the smiths of Badmal used vanadiferous iron ores to manufacture extra hard drill bits and other iron tools for their every day use. Not only we find increase in the craft related tool types, but the introduction of low carbon steel making is also visible during the post-Iron Age period.

MAKING OF SOUND RECORDING IN LATE XIX CENTURY AND MODERN PROBLEMS OF RESTORATION AND PRESERVATION OF OLD AUDIO MEDIA

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In this paper I would like to make small review on history of sound recording in it's first decades, as well as describe modern methods of work with authentic audio media.

It's well known fact that phonautograph by Leon Scott (1857) was the first ever device to record acoustical signal in visual form with help of membrane and was used in acoustic studies, but not for sound reproduction. Paleophone described in letter to French Academy of Sciences by Charles Cros (1877) was able not only record, but reproduce sounds also. Just few month later Thomas A. Edison made his tin-foil phonograph – first practical device for recording, storing and reproduction of sound. It was just beginning of new age – age of sound recording industry, million records sales and real headaches for future days archivists.

Wax cylinders, shellac plates, metal matrix, optical paper records is easy to find in great quantity in any audio archives today. Problems of nondestructive methods of restoration audio media is now one of the most discussed question in archive society. I would like to present few well known methods as well as not so known pilot projects in this field in their correlation with history of sound recording technology.

DEVELOPMENT TREND AND RESULTS OF INDUSTRY IN THE ERA OF THE DUAL MONARCHY OF AUSTRIA-HUNGARY

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The economy of Hungary started to develop after the Austro-Hungarian Compromise of 1867. It was reasoned principally the significant growth of industry. The periods of government policy subsidized the development to a great extent with the diverse industry developing laws (1881, 1890, 1899 and 1907 Act.)

In my presentation I show and examine the tendency of economy and industry changing of Hungary and Budapest in the period of dualism. My work is based on statistical data published between the end of 19. century and the beginning of 20. century. These data barely came out and can be found in archives only.

The statistics (achievements and profit) shored up that the industry of Hungary started to considerable growth in the turn of the century, and it verify that Hungary took part in the international industrial and technical developing.

In my presentation I analyse and summarize the background and reason of this economical developing.

THE WAYS OF SEARCHING “RUSALKA” COAST GUARD BATTLESHIP (1893-1894)

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It was the first huge search operation when technical means were used. During the search operation some new devices were put into practice. The general number of suggestions about the ways in which the battleship “Rusalka” could be found were more than 2000 (but most of them were widely criticized). 7th of February 1893 the Coast Guard “Rusalka” battleship left Tallinn for Helsinki. The ship had to cross the most dangerous part of Finnish bay (about 4 hours). The ship was delayed for some hours and when she finally went out into the sea, the weather got worse. The gunboat “Tucha”, which accompanied the ship, had lost the sight of the battleship and came to the terminal point without the Coast Guard ship. “ Rusalka” battleship didn’t appear in Helsinki. The crew of the ship disappeared too.

The search of the battleship three days after the ship had been lost. By that time the fragments of the ship had been found, they were thrown out to the Kremary island. The search lasted from 10/09/1893 till 16/10/1893 and from 30/05/1894 till 31/08/1894. About 15 warships took part in this search. The Committee of Inquiry, on the grounds of the meteorological data, came to the following conclusion. “The battleship was lost at about 4 pm 7/01/1893, southwards of the Eransgrund lighthouse.” The search didn’t reveal anything. The tragedy found a broad response among the newspaper readers, raised different suppositions. A lot of suggestions of the methods of search of the battleship were sent to the General Naval Stuff

Organizing already known and new ways of searching, Staff Captain Zolotuhin prior to major search in Summer 1894 wrote: ‘all yet offered means to search for the lost ship can be divided in the following way:

Ordinary ways, which are usually used in such cases for finding sunken things, like trawls with cats and conventional vehicles.

1. Devices to find a sunken metal objects, based on the use of weights EEIG: Captain McAvoy’s finders of sunken things and Grozdew’s suggestion.
2. Livchak’s method based on the closure of the galvanic circuit by a steel hull.
3. Suggestion that the battleship should be found by a metal arrow.
4. Mr.Froomkin’s suggestion that the battleship should be found by conducting a chemical analysis of water.
5. Methods, based on using strong chemical lighting, here Staff Captain Menshikow’s, Mr. Poshivayew’s and other Mr.Froomkin’s suggestions belong.

Here we must pay tribute to Staff Captain Zolotuhin, because he predicted difficulties of using different methods very exactly. “.. on trawls I can say the following: all of them guarantee success only in case they are used on hard ground which doesn’t content any large stones…”

On McAvoy’s device: ‘We’ve been trying this finder since 1891, but unfortunately these tests weren’t a success. At least we should pay a special attention to it and try to improve it in order to use it in search of the “Mermaid” ship.

270 YEARS OF LIGHTNING: A HISTORICAL REVIEW

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Since the beginning of Human History, lightning has been a fascinating reality. Gods and lightning have always appeared together through the History in different religions and myths. Lightning has always played havoc with properties and human lives. Therefore, its study became important long ago, but if we look back to the eighteenth century we can find a crucial turning point in the way people understood lightning.

Benjamin Franklin (18th century), from his first steps on electricity, using a glass tube, to the design of the first lightning rods and the experiment with the kite, set up the modern basis in the field of lightning and the electrical behavior of the atmosphere. During the nineteenth century, a number of relevant experiments and studies were carried out, and the theories on the physics of lightning changed radically. Lightning events observed under different storm conditions led to new hypothesis, in order to explain the phenomena, its formation and its characteristics. Networks of observers arose to face the problem from different points of view and lightning protection systems were also developed as they could prevent damage in buildings and losses in human lives.

Nowadays, the lightning detection networks are spread worldwide and in these last they have been combined with powerful systems such as weather radars or satellites so that information with a better quality is available for the most significant weather hazards. Lightning has been widely demystified, but it still keeps a few secrets that must be discovered. The actual state of the art in the detection and study of atmospheric electrical events is directly related to the evolution of the theories on lightning in these 270 years.

Theories on physics of lightning have experienced an overwhelming evolution during nearly three centuries. In this compilation the evolution of these theories and how certain experiments let the scientists discard some hypothesis and develop new ones will be clearly explained. This paper also presents the basic concepts of the theories accepted nowadays and it allows the understanding of where the points of stress in the modern detection and measurement techniques can be found. It is necessary to understand the past in order to face the future, and the last advances in weather technology would make no sense without those first years in lightning research.

LARGE INFRASTRUCTURAL SYSTEMS IN THE EXTREME NORTH LEARNING FROM THE BUILD-UP OF WATER- AND WASTEWATER SYSTEMS AND RAILWAY ELECTRIFICATION IN NORTHERN SWEDEN AT THE TURN OF THE 19th CENTURY

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Infrastructural systems delivering gas, water and electricity, facilitating transports and communications as well as the gathering and treatment of sewage, have been critical in the development of modern society during the 19th and 20th centuries. They have largely contributed to economic and social welfare, but have also caused considerable environmental impacts over time. Contemporary strategies towards a more sustainable society therefore often include changes in existing infrastructural systems as well as conscious choices when it comes to the investment in new infrastructural systems. The present paper builds on the assertion that expanded knowledge on how, why and with what consequences the infrastructural systems were built up in the past, can provide us with novel perspectives on how to govern the challenges of today.

In this paper we study the building-up of two infrastructural systems in the northernmost part of Sweden at the turn of the 19th century, where the harsh climate added an extra dimension to the technological challenges. The systems are: (a) the water- and wastewater system of the town of Luleå, then, the northernmost water- and wastewater system in Sweden and probably in the world; and (b) the electrification of Riksgränsbanan Railway (the Frontier Railway), the northernmost railway line in Sweden and the first major section of a state-owned railway to be electrified.

The investments made by the municipality of Luleå and the Swedish State Railways (in close cooperation with a number of private companies), were both bold and radical in that relevant technologies still were in a 'development stage'. Moreover, the harsh and cold climate due to the geographical location added an extra dimension to the technological challenges. The municipality in particular, but also the Swedish State Railways and connected private companies, lacked the necessary in-house expertise. The technological challenges were however dealt with in considerable different ways by the local and the national organization, respectively. Water- and wastewater systems had never before been constructed in the extreme north. Furthermore, considerable achievements within the bacteriology and hydrology fields did contribute to a continued significant development of the water/wastewater technology still at the turn of the 19^{th} century. The municipality needed to rely on external expertise and its ability to get hold of new scientific knowledge and apply this in the system design. What concerns the electrification of the Riksgränsbanan Railway, it was in many ways a trailblazing project where whole new technologies had to be developed and launched on a rather troublesome railway in close cooperation between the Swedish State Railways and a number of private, mainly Swedish companies.

Just as radical as the investments in the infrastructural systems were for the municipality of Luleå and the Swedish State Railways at the turn of the 19^{th} century, modern literature claims the necessary changes of our established infrastructures to be if we want them to become sustainable. The historical lessons of the meanings of the radical changes in the former shift of technology models will give new perspectives on how to govern contemporary changes.

THE COMPLEXITY OF THE CONCEPT *MATERIA TECHNIKA*

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In the paper the concept *Materia Technika* is defined and the main components of this concept are analyzed.

Men /*Homo*/ as material & spiritual entities (beings) in their numerous, simple or complex situations and activities are in contact /use/think/ with various forms of matter: *material*.

Homo Technicus-Technologicus as a complex human *axio*-hypostasis, in his existence and position in the World /*Universum*/ permanently uses/experiences matters/materials/ – items /*rerum*/ which can be considered from several perspectives, defined on the basis of appropriate criteria. We name these kinds of matters <*materia technika*>.

The concept <*materia technika*> expresses different articled situations:

- *Materia technika prima* - material items (corpus-es, systems) in "*status naturalis*", i.e., find by investigators, used by technicians without any technical procession (remake, adaptation, et. al.); this kind of *materia* (raws materials) is necessary for simple /complex technical activities/operations;
- *Materia technika laborata* - material items transformed in various *modus*: by technological procedures, methods, et. al.; they are technologized: are the objects of Science and Engineering of Materials.
- *Materia technika economica* - material items processed in various *modus* operated by users, recommended /advised by the organizers in such a manner to realize maximal /non neglected economy *in quantum & in qualitas*, the actual manners to use technologically this kind of matter is emphasized by the fascinating History of Science and Technique (shortages, savers, management, waste, recycling, ecology, sustainable development et. al).
- *Materia technika vulgata* - material items considered (perceived, felt, think) by "common people" i.e. by individuals and groups interested only / dominantly by their basic needs.
- *Materia technika philosophica* - material items considered (felt; think) by meditative people i.e. by members of the axio-species *Homo Cogitans – Aestetikus – Philosophans – Religiosus*

The concept Sustainable development in connection with the concept of *materia technika* is also analyzed. Historical and more recent examples are given, in Europe, in the middle age, in the "Age of Enlightenment" /*Aufklärung*/, the post world wars period and the contemporary period /XX^{th} century/.

The paper underlines that the topic <*materia tehnica* in the *stricto sensu* / *materia prima*: raw material/ and in the *latto sensu / materia elaborate /* reveals its importance and, together with <energy> are main elements of the technique and the technologies, as basis for social systems – matrix-es of Culture & alveolus of Civilization, in the past, in present time, in the future.

EVOLUTION OF E-BOOKS IN TURKIYE AND IN THE WORLD

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Innovations in information technologies have conveyed information resources from printed physical media into electronic one. Such an abrupt change in the content and in the way of accessing to books, the most preferred material group as reference, brings about variety of different comments by the readers. There are both enthusiastic followers of advancements in e-book technology and also quite a lot of people accepting having a printed book as privilege, and arguing nothing can be compared to have printed books as devoted friends. With a scientific point of view, we had better take the issue in terms of pros and cons and reveal the benefits of it for the good of mankind.

This study investigates developmental process of e-book technology in Turkey and in the world comparatively. The study sets sail from the point where Johann Gutenberg invented the printing machine. And through the old yellow pages, the process was followed to “next generation” web-based books enriched with aspects appealing to different senses. While the history of extremely innovative e-books was examined, anticipations about future applications was also tried to be remarked with the present study.

WIRELESS PHONE IN SZOMBATHELY AT THE TURN OF THE 19th AND 20th CENTURIES

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During the past 100 years, a technical expert, who created technical innovations and inventions in the field of telecommunication-technology in his period, has been forgotten about. Zsigmond Musits, a postal and telegram officer from 1890 to 1907 in Szombathely, carried out successful attempts at creating a wireless phone. The performance of the first successful attempts was reported by the local press in July 1900. In 1902, he made his experiments at the side of the Adriatic Sea – on the Dalmatian Coast, in Lussinpiccolo – where the device functioned well even at a distance of 4-5km. With his two Viennese associates, he submitted his invention to the Austrian, Swiss and English patent bureaus, and in 1902 he submitted it individually to the patent bureau of the United States. The name of this invention was « Apparatus for Wireless Telephony », and its patent number was 777216. The working principle of the wireless phone was not the same as the radio frequency carrier waves we use today, but it aimed to utilize the electric conductivity of earth/water (river or sea).

The innovative ability of Zsigmond Musits is signaled by the fact, among others, that he did not only deal with the above mentioned invention but he also urged the transformation of the « Local Battery » telegraph and telephone systems into « Central Battery » ones, and he performed successful experiments between the telegram offices in and around Szombathely. He also worked on modernizing the microphones used in telephone sets, creating and manufacturing the so-called « unburnable » microphones. He also made a « loud » telephone, which was not really a telephone as it only worked in simplex mode, but one’s voice came back so loudly through the loudspeaker that several people could hear it at the same time. Actually, this is what we call a speakerphone today. In fact, as early as in 1911, he declared this device suitable to be used by people with hearing problems.

I believe, the technical ideas that Zsigmond Musits shaped and also implemented, shows that there were experts living and working in Hungary, within that, in the Western Transdanubian region in the late 19th and early 20th centuries, who were familiar with the era’s technical standards, and could even raise this standard with their innovative activities. His sensitivity towards technical problems is indicated by the fact that we still utilize and apply the above detailed technical problems day by day, as « natural » technologies.

I consider it important to discover the activities of technical experts who have been forgotten through the past decades, thus finding out about the technologies that used to mean the solution to a given technical problem in that particular period, and helping to widen the horizons in the training of technical experts today, as we may encounter solutions that have already been forgotten by today but, placing these solution principles into different contexts later on, we might be able to create new technical solutions.

Regular Session T09-08
Engineering in the Contemporary Period (1800-)

CALORIC THEORY AND WATT'S LAW: HIGH HOPES FOR THE HIGH PRESSURE STEAM ENGINE IN THE EARLY 19th CENTURY

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Steam engines in the 19th century tended to use high pressure steam. Pioneers of high pressure steam engines and most engineers before the establishment of thermodynamics had faulty theories about heat and steam. Arthur Woolf (1766-1837) overestimated expansive force of steam. Davis Gilbert (1767-1839) advised Richard Trevithick (1771-1833) on advantages of using high pressure steam. Gilbert calculated the power of expanding steam in a cylinder. This method was similar to Daniel Bernoulli's method of vis-viva of compressed air.

Caloric theory had a great impact on the theory of the steam engine. It assumed that the origin of heat was a fluid which did not have weight. The property of caloric was similar to water or other fluid substance. So water engines and the steam engine are similar in some respects. The energy of a given weight of water which was contained in a vessel can be used to measure the height of that water. By the same token, the energy which a given weight of a steam has can tell about the amount of total heat. This paper argues that engineers of the time assumed the total heat of steam to be equal to the potential energy of steam.

The development of the high pressure steam engine and the theory of the steam engines were influenced by an analogy of hydraulic engine. Sadi Carnot, a pioneer of thermodynamics, focused on high thermal efficiency of some high pressure steam engines at Cornwall. He studied the ideal heat engine based on caloric theory and on the analogy of the hydraulic engine. And he discovered Carnot's cycle.

Thus, caloric theory had a great role in explaining the advantage of the high pressure steam engine and the nature of heat.

On the other hand, many British engineers believed in Watt' law. Watt's law assumed that "a given weight of steam always contains the same amount of heat at whatever pressure it is created. This is the same as saying that saturated steam will remain saturated whenever it is compressed or expanded mechanically in such a way that there is no loss of heat." It was a false theory. Watt' law together with caloric theory came to constitute the theory of the steam engine. It could no longer explain the advantages of the high pressure steam engine.

In conclusion, caloric theory offered a great hope to engineers for using the high pressure steam engine. The theory of the steam engine based on Watt' law and caloric theory turned that great hope into a disappointment.

THE INTERNATIONAL CONTEXT OF THE TECHNOLOGICAL CHANGES OF THE SLOVAK POWER ENGINEERING BASE IN THE FIRST HALF OF THE 20th CENTURY

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Slovakia

The power engineering in the region of the present Slovak republic experienced decisive technological changes in the first half of the 20th century. All this happened in the background of the turbulent world-wide technical development. All the changes in Slovakia were closely connected with the overall political and economic transformations. In the beginning of the 20th century when Slovakia was a part of the Hungarian kingdom, the first steps towards electrification and transition from steam towards electrical drive had been done. Considerably greater changes in power engineering, corresponding with the world-wide development, occurred during the inter-war period. In 1918 Slovakia became a part of the new Czechoslovak republic. Through the systematic state politics the electrification went from local phase towards building the regional power supplying and distributing systems. This process had continued and reached its peak during the World War 2 as the electrification entered the state-wide phase of development during the existence of the wartime Slovak state. After the restoration of Czechoslovakia in 1945, the building of the state-wide power engineering system was even faster thanks to the new state measurements. The ending point of the proposed study is marked by the year 1948. In this year the communist regime was installed in Czechoslovakia, an event which decisively changed the character of the power engineering development and the overall role of the state in this process.

FROM LEDs TO SOLID-STATE WHITE LIGHTING DEVICES, ANOTHER SEMICONDUCTOR REVOLUTION

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Lighting technologies are substitutes for sunlight in the 425-675 nm spectral region where sunlight is most concentrated and to which the human eye has evolved to be most sensitive. The three traditional technologies for illuminate are fire, incandescence, fluorescence and fourth technology, which showing a spectacular returning is solid-state lighting. Light-emitting diodes (LEDs) produce light when low-voltage direct current crosses a suitable semiconductor junction. The color of light that is produced is determined by composition of semiconductor junction.

The use of semiconductors to produce light is not particularly new. The first commercially usable LEDs were developed in the 1960's by combining three primary elements: gallium, arsenic and phosphorus (GaAsP) to obtain a 655nm red light source. As LED technology progressed through the 1970's, additional colors and wavelengths became available. The most common materials were GaP green and red, GaAsP orange or high efficiency red and GaAsP yellow, all of which are still used today. By the early 1980's the red LEDs performance had increased, and produced amber LEDs. To complement the red and orange LEDs associated with GaAs/GaP technology, GaN chips were developed in the early 1990 s and their efficacies have improved over the last decade to over 30 lumens per watt for the white light sources. The GaN LEDs complement the color scheme by providing violet, blue and green sources. The first economically viable white LED, introduced in 1996, featured a blue LED in combination with a yellow phosphor. The blue light from the LED and the blue stimulated yellow light from the phosphor combined to present a whitish light. Currently, there are three viable options achieving LED-based solid-state white lighting devices: blue LED with phosphor(s), UV LED with several phosphors and three or more LEDs of different colors. At present, the following four R&D programs are underway to make white LEDs practical: discovery of light emitting mechanisms of mixed crystal semiconductors and chemical compounds, development of substrates for homoepitaxy, improvement of epitaxial growth technologies for blue and UV LEDs, and, development of highly efficient phosphors and discovery of practical uses of white LEDs as an illumination system.

Indeed, we are now at the beginning of a new era, with the introduction of solid-state light devices. This lighting system would have the following advantages: less electricity consumption due to high optoelectronic conversion efficiency, ease of miniaturization due to the small size of the light source - the lighting equipment would be smaller, thinner and lighter, long life, simple structure - no special devices would be needed to control the lighting system, and the number of components in the device would be reduced, high reliability due to the use of all-solid-state devices without any gases or filaments – very reliable against mechanical shock.

ENGINEERS AND CONSERVATIVES IN THE CREATION OF STATE HYDROELECTRIC POWER IN CANADA

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In 1906 the Conservative government of the Canadian province of Ontario created what became the largest publicly-owned electric power utility in North America and in the non-Communist world – the Ontario Hydro Electric Power Commission (HEPC). This paper will examine the apparently paradoxical support this enterprise had from a conservative government and the participation of engineers on both sides of the debate regarding the benefits of state control of electrical power. The Conservative party member Sir Adam Beck was the driving force behind what he called "people's power" and he was supported by a number of engineers. There were other engineers, however, who attacked Beck and his plans. The American association of private electrical utilities – the NELA (National Electric Light Association) – was a particularly fierce opponent of the HEPC, which was considered a prime example of the evils of "socialist" control of electrical utilities and published a number of pamphlets attacking it. This paper will examine the role of engineers in the debate over public power and attempt to untangle the various ideological and technical strands in the debate.

Regular Session T09-09
Space Exploration and Research in the Contemporary Period (1800-)

HUBBLE SPACE TELESCOPE'S SEVERAL LIVES AND UNEXPECTED CAREER

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The Hubble Space Telescope, deployed and in operation three hundred miles above the earth for some nineteen years, is perhaps the best-known and appreciated astronomical instrument in history. Conceived just after the second world war as the unexpected development of military rocketry seemed to open new scientific possibilities, and designed and built during the 1970s and 1980s, it represented the culmination of space-based scientific instrumentation, and would rely on the Space Shuttle, itself the highest expression of technological space craft development. The telescope itself and its associated changeable scientific instruments were specifically directed toward the frontier problems of astronomy and astrophysics of the time. Its signature mission was cosmology—to refine the value of the "Hubble Constant," a measure of the age and extent of the entire universe developed and estimated in the 1930s by the telescope's namesake. Like the large and highly productive mountain-top telescopes used by Edwin Hubble himself, the public was enthralled with the challenge and drama of an audacious scientific project.

Unlike its ground-based counterparts, however, which led rather staid, if extremely productive lives after coming into service, the Hubble Space Telescope seemed at times alternately cursed and charmed. Immediately after reaching its orbit in 1990, astronomers discovered its mirror had been shaped precisely to the wrong figure, turning it into an example of incompetence and overreach. Refurbished by a spectacular and ambitious shuttle repair mission in 1993, it went on to make good on its many promises in exceptional fashion, and capture the adulation of the public. The repair mission gave comfort to the developing International Space Station program, which needed validation of its plan for extensive and numerous spacewalks during construction. Over the next decade, the Hubble Space Telescope produced a scientific bounty, a public relations bonanza, and earned a loyal public following.

Ironically, Hubble's launch had been delayed for years by the sudden and tragic loss of the Space Shuttle *Challenger* in 1986, and then it fell prey to anxieties and enhanced safety concerns after the loss of the Space Shuttle *Columbia* in 2003. While its final servicing mission promised to extend its productive life far beyond initial predictions, that mission was suddenly cancelled as NASA regrouped after the loss of *Columbia* and the political establishment grappled with recovering space policy. The public, however, rallied against the decision, and with other constituencies succeeded in overturning it. This paper will examine the entanglement of this instrument with the scientific, technological, political, and social factors that encouraged, threatened, and then ultimately sustained its checkered career.

Joseph N. Tatarewicz has been working and publishing on the history of the Hubble Space Telescope and other aspects of space flight and policy for nearly three decades. He directs the Human Context of Science & Technology program at UMBC.

"THE SOCIAL LIFE OF SPACECRAFT": INSTRUMENTS, IDEAS, AND INVESTIGATORS ON INTERPLANETARY ROBOTIC MISSIONS, 1970-2008

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To the public eye, NASA or ESA's robotic spacecraft appear to be unified, singular systems operating autonomously on the frontiers of deep space. Backstage, however, they are in fact operated in concert by a group of scientists and engineers with an interest in different pieces of the puzzle. With different Principal Investigators and teams tied to each on-board instrument and only limited time and bandwidth on board, conducting scientific observations with these spacecraft quickly becomes a question of negotiation. Inter-institutional rivalries, international partnerships and proprietary data rights further complicate matters and require constant massaging, negotiating and carefully staged interactions whenever decisions about spacecraft operations must be made.

The paper examines the changing practices by which decisions are made and agreement is negotiated among these different instrumental stakeholders on robotic space missions. To do so, I draw upon archival work on the *Viking*, *Galileo* and *Pathfinder* projects, as well as historical and ethnographic work on the *Mars Exploration Rover* team and the *Cassini* mission to Saturn. Throughout instrumental negotiations, the social organization of the spacecraft team on Earth around the robot's technical components (such as its instruments or mobility systems) is paramount to understanding how decisions are made and how science "gets done." As the politics on Earth generate commands for the vehicles that may prove more or less detrimental to its overall operation, the paper also attempts to articulate the co-ordination points between social and technical infrastructures in the collaborative operation of instruments.

SPACE EXPLORATION AND RESEARCH IN THE CONTEMPORARY PERIOD

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Sooner or later it is inevitable; scientists say that earth's gravitational field will attract one or several of these celestial bodies." Civilization Threatening asteroids (rocks having a diameter of one to 10 miles) are so tiny in space that scientists rulely detect their presence until they are very close to earth. Scientists calculate that asteroid 1989 P C missed earth by only six hours on March 1989. They also maintain that it is highly probable that it will return at some point in the future and this time be given closer to earth! What is shocking about passed by earth on January 7-2002 a small asteroid (2001 Y B S). About 1000 feet in diameter missed earth by twice the distance between the moon and earth. Although this may sound like a safe distance.

The asteroid was traveling to word us at 70000 miles per hour. In other words we missed an impact by daily a handful of hours! This asteroid will revisit our place in space in about three years and 7 months since the writing. A document on the nasa internet site currently states that earth's closest miss with an asteroid has been only a matter of minutes! One asteroid whizzed with in 62000 miles of earth. It is inevitable scientists say. Earth will once again bit of an asteroid large enough to cause mass extinctions, national geographic. January 1985 (page 47) scientist clerk Chapman and David Morrison start led horn geoscientists at the American geophysical union in December 1989 saying in terms of risk the significant danger (from asteroids) comes from impacts with global implications.

Statistically the greatest risk to risk to each of us is (that) the impact could cause a Global disruption of crops and perhaps the death of most of the earth human population. We call this a civilization threatening impact at that time of the meeting (1989) Dr. Chapman was a scientist at the planetary science institute in Tucson. Arizona and Dr. Morrison was chef of the space science division at nasa Ames research center in mountain vien California. Scientists have known for years that asteroids and meteorites strike the earth and moon in predictable patterns. In fact if asteroid 1989 for had hit earth. Dr. Bevan French at nassa's solar system exploration division calculated it would have released energy equivalent to 20000 hydrogen bombs. If it had hit a metropolitan area such as Tokyo, leangles or New York, millions of people would have died instantly. Fortunately most meteorites that have impacted the earth in recent times have being small and have had no sufficient consequence. How ever the media reports fire balls and meted rites regularly. As an example, on November 22, 1996, a small meteorite impacted Honduras making a crater 150feet in diameter.

THE THREE HEROES OF SPACEFLIGHT: THE RISE OF THE TSIOLKOVSKY-GODDARD-OBERTH INTERPRETATION AND ITS CURRENT VALIDITY

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The single most enduring interpretation in space history credits three thinkers with independently proving the scientific and technological feasibility of spaceflight in the late nineteenth and early twentieth centuries: Konstantin Tsiolkovsky in Russia and the USSR, Hermann Oberth in the German-speaking world, and Robert Goddard in the United States. Precursors and others, such as Hermann Ganswindt and Robert Esnault-Pelterie, are assigned to a distinctly second rank. In recent years, prominent space historians have labeled this scheme as a "cliché" (A. Siddiqi) and as something invented in the 1960s that "bears reexamination." (D. Clary).

This paper will trace the creation of this interpretation to the fight for priority inside the international space advocacy movement between the 1920s and 1950s. Characteristic of many other arguments over science and technology in the period, national priority claims featured strongly, notably in the countries of the three main claimants. At the same time, spaceflight advocates in many countries, but not all, came to accept the actual superiority of the theoretical contributions of Tsiolkovsky, Goddard and Oberth to other claimants. Once the "space race" began with Sputnik in 1957, with the USSR crediting Tsiolkovsky as its founder, the United States rediscovering Goddard as its hero, and the former Germans in the United States (notably Willy Ley and Wernher von Braun) continuing to assert Oberth's influence, the interpretation hardened into a set pattern visible in almost all histories of spaceflight, especially those in Western European languages.

The paper will conclude with a reexamination of the validity of the "three heroes" scheme in the light of the newest scholarship on the early history of space movements. It is my conclusion that, viewed from the narrow perspective of theoretical originality, the traditional interpretation still holds up fairly well, but at the cost of ironing out many complexities, such as the intellectual foundations of the various space movements, and marginalizing many important contributors and popularizers like Ganswindt, Esnault-Pelterie, Hohmann, von Pirquet, Kondratyuk and Tsander.

Regular Session T09-10
Computing Sciences and the Internet in the Contemporary Period (1800-)

THE FIRST HUNGARIAN ELECTRONIC (TUBE) COMPUTER – THE M-3 – IS 50 YEARS OLD

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An unbelievable story

The most important early Hungarian calculator-like machines

- 1791: Farkas Kempelen's Talking Machine. Analogue automaton on the mechanism of human speech.
- 1878: Ányos Jedlik's Oscillating Device. Analogue, mechanical computing machine, adding three different oscillations and one motion in a straight line.
- 1926. Istvan Juhász. GAMMA-Juhász mechanical and electromechanical gun director.
- 1936-1940. László Kozma. Several programmed electromechanical calculators in Antwerp.
- 1936. Tihamér Nemes. Several cybernetical constructions; one of the most famous was the pocket logical machine, and the genetical logical machine.
- 1955-1958. László Kozma. The first Hungarian electromechanical (relay) computer, the MESz-1.
- 1955-58. László Kalmár. Electromechanical logical machine Szeged, designed by László Kalmár, constructed by Dániel Muszka.

The M-3 computer.

- The idea was conceived in Budapest Central Prison, where the inventors were political prisoners.
- Their names were: Rezsõ Tarján, László Edelényi and József Hatvany.
- They wrote a letter in 1954, through the "Political Police" to the Class of Mathematics of the Hungarian Academy of Sciences, they stated that they were ready to design and construct a computer for the Academy of Sciences. The suggested computer was (probably) a clone of EDVAC.
- The Class of Mathematics refused their offer.
- The political atmosphere of the years before 1955 changed and the prisoners were soon released. They had an opportunity to construct the computer, its name was: **B**(udapest)-**1.**
- Then the Hungarian Academy of Sciences established an institution: Cybernetical Research Group (MTA KKCs); Sándor Varga, an earlier communist emigrant to Moscow was appointed its director, and Rezsõ Tarján deputy scientific director.
- The B-1 computer was unsuccessful, thus Varga asked the Soviet Union for a medium-size computer design – practically for drawings and electronical parts – of the M-3. The same computer design was bestewed on China and Estonia, where these were the first computers in these countries, as in Hungary, too.
- MTA KKCs employed several freshly graduated mathematicians and electronic engineers – I was one of them – and we started to understand and to construct the computer from mid 1957, and we finished the M-3 in 1959.
- The first computer worked till 1965, then we transported it to the Cybernetical Laboratory Szeged.
- The M-3 finished its „life" on 2 January, 1968.

The M-3 will be 50 years old these days.

THE CULTURAL HISTORY OF CHARACTER ENCODING

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One of the most ambitious projects of modernity is *encoding,* that is transforming information-for-human-understanding to machine-readable in order to be able to process it more efficiently. A special chapter of this story is that of *character encoding*, when written language entities are replaced by numbers.

This problem gained central importance in the historical moment, when it became clear that the computer will not serve only for the processing of numerical data but also for producing and transmitting cultural content. That happened at the rise of the *personal computer,* as the everyday user was no more thinking about his machine as a calculator but rather as a communication device.

At this point in the field of character encoding the long time hegemony of *American Standard Code for Information Interchange (ASCII)* also got to be questioned. Since it soon became evident, that one of the main properties of a person going to use a computer is his *nationality*. That means, that he would have a strong expectation for being able to give an accurate representation of this part of his self–that is communication and cultural production in his national language–in the new virtual environment as well. English as the 20th century *lingua franca* in the world of science and technology was no more sufficient to serve all kinds of users' demands. Suddenly the ASCII standard seemed to be the "oppressor" of national cultures and, on the other hand the main obstacle for the world wide marketing of the new gadget.

The resolving of this tension started on parallel lines. The "great European cultural languages" went in an extended character encoding system labeled *ISO 8859-1*. Meanwhile "small" languages, such as Hungarian were forced to make their own revolts against the unsatisfactory standard, trying to bridge the cultural gap by some "home-made" encoding (see for example the special Hungarian fonts made for the text editor *ChiWriter*). Later some of these languages got emancipated through the modified character set *ISO 8859-2.* As this was still far from satisfactory (many languages stayed out, and languages in different character sets were constantly interfering), the happy ending of the story finally came only with the conceptualization and step by step realization of the character encoding system *ISO 10646.*

In this way the history of character encoding forms one of the few examples, where a merely technological issue becomes a thoroughly cultural one. On the ideological level it gives an interesting case study to see how *technological standardization* as one form of *universalism* may go hand in hand with *economical globalization* as another, while they are both advanced surprisingly by the *particularism* of *cultural nationalism.*

THE SOCIAL CONSTRUCTION OF COMPUTERS AIDED BY SOCIAL NETWORK ANALYSIS

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The basic concepts of social construction of technology (SCOT) were defined by Trevor Pinch and Wiebe Bijker (1987) in their article: "The social construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other."

We are going to apply this theory to describe the development of computers in the middle of the 20th century.

Original conceptual framework consists of four related components:

1. relevant social groups
2. interpretative flexibility
3. closure and stabilization
4. wider context

The concept of relevant social groups is used to denote institutions, organisations (such as military or some specific industrial company), as well as organised and unorganised groups of individuals. The key requirement is that "all members of a certain group share the same set of meanings, attached to a specific artefact."(Pinch & Bijker 1987 p. 30)

The interpretative flexibility suggests that technology design is an open process that can produce different outcomes depending on the social circumstances of development.

The third component of the theory is defined as closure which can be rhetorical closure when a declaration is made that no further problem exits, and closure by redefinition when unresolved problems are redefined by social groups.

Finally the wider context refers to the wider socio-cultural and political milieu in which artefact development takes place.

Numerous scholars have criticized the original formulation of SCOT as insufficient, we now focus on the critiques related to the relevant social groups. Although Hans K. Klein and Daniel Lee Kleinman has made some remarkable suggestion in their paper: “The Social Construction of Technology: Structural Consideration” but the intergroup connections, the social groups dynamics remained unexplored.

We are arguing that using the methods of social network analysis for relevant social groups we will reach a better understanding of social shaping of technology.

SEARCHING METHODS IN ARTIFICIAL INTELLIGENCE

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The historical origin of Artificial Intelligence is usually established in the Darmouth Conference, 1956. But we can find more arcane origins. As in Leibniz, with his attempt at explaining the possibility of quick computation. But such date is at least debatable. Because from Plato to Raimundo Llull, and from him to Leibnitz, or Boole and Babbage..., there are many premonitory ideas. And in more recent times, the work of many prodigious thinkers, such as Janos Neumann, Leonardo Torres Quevedo, Norbert Wiener, Alan Turing, Claude Shannon, Grigor Moisil, or Lofti Zadeh, among others.

In the subsequent times, around the 50s and 60s of the past century, the work was over idealizations of the “real world”. So, attempting the automatical proof of mathematical theorems, modelizing in game theory, and so on.

The origin of the ideas about the possibility of thinking machines, the mechanism through work the human brain, the possibility of imitate its behavior, if we produce some computational structure similar to neuron, or to neural system, with their synapsis or connections between neurons, to produce Neural Networks... All this appear with resonances either of a science fiction movie, or a futuristic roman.

The basic purpose of Artificial Intelligence is to create an admissible model of the human reasoning and knowledge. Its subject is, therefore, “pure form”. We try to emulate the way of reasoning of a human brain. This must be in successive, approximating paths, but the attempts proceed always in this sense. Often it requires *Logic.* But its Classical version shows too many insufficiencies. So, it was necessary to introduce more sophisticated tools, as Fuzzy Logic, Modal Logic, Non-monotonic Logic systems, and so on.

As is well known, the problems in Artificial Intelligence can be classified in two general types, *Search Problems* and *Representation Problems.* We aim, in this paper, to draw a panoramic vision of such Searching Methods.

Keywords: Non-Classical Logics, Fuzzy Logic, Modal Logic, Heuristics, Artificial Intelligence, History of Computer Science.

HISTORY OF COMPUTER SCIENCE IN RUSSIA

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The Computer Science presents one of the highest achievements of contemporary scientific mind. The widespread use of computers and networks has a major impact in all aspects of the fabric and development of the society. History of Computer Science should be considered as a part of human understanding how the development of computing has affected the human environment. It is an important societal challenge to explore and disseminate the knowledge on the history of origin and progress of computing. Nevertheless, there exist many blank spaces, including Europe, on the map of historical development of Computer Science.

Unfortunately, the history of Russian Computer Science was almost unknown in the West until now. The background of this report is the research in the history of computing carried out, during some recent years, at the Siberian Branch of the Russian Academy of Sciences on the initiative of the present author. The outcome of this research was in compiling, editing, and publishing of several monographs:

1. *Essays on the History of Computer Science in Russia* / Novosibirsk, 1998, 662 pp. 2. *Kolmogorov and Cybernetics* / Novosibirsk, 2001, 159 pp. 3. *Aleksey Andreevich Lyapunov* / Novosibirsk, 2001, 524 pp. 4. *Leonid Vital'evich Kantorovich: a Man and a Scientist* / Vol. 1, Novosibirsk, 2002, 544 pp.; Vol. 2, Novosibirsk, 2004, 614 pp. 5. *History of Computer Science in Russia: the Scientists and Their Schools* / Moscow, 2003, 486 pp. 6. *From the History of Cybernetics* / Novosibirsk, 2006, 301 pp. 7. *Axel Ivanovich Berg* / Moscow, 2007, 518 pp.

Our books contain a collection of authentic essays, reminiscences, interviews and other historical documents amassed, edited and published by the author of this paper. A number of materials were obtained from private archives of such famous scientists as A. Kolmogorov, A. Lyapunov, A. Ershov, and other leading Russian scientists who were in the middle of the 20th century in the front line of development of Computer Science. Virtually, the mentioned books cover all sections of the Computer Science as well as all stages of development of this science in Russia. Thus, the considered collection allows one to reconstruct the authentic view of the history of Computer Science in Russia. In this presentation we will narrate different episodes of this history illustrated by a variety of historical photos. The author of this report intends to bring to Budapest the mentioned books (one copy of each) and to ask the LOC for a limited space where the seven books could be exposed to give the participants make acquaintance with the historical pages of Russian Computing History. Naturally, these books are published in Russian. However, an English translation of the Foreword and Contents is included in each volume. Reading of these reference materials is sufficient to get a notion of corresponding Russian book. Besides, the author will prepare a booklet containing reference materials (in English) to all seven books, bring them to Budapest, and hand them out to interested participants.

Regular Session T09-11
Geography in the Contemporary Period (1800-)

PAPER FORTRESSES: RENAISSANCE MILITARY ARCHITECTURE IN THE CONTEXT OF HAPSBURG CARTOGRAPHY

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The rapid expansion of the Ottoman Empire in the early 16th century transformed Central Europe. After the fall of Hungary in 1526, the war against the Turks became an all-European conflict: for almost two centuries the Ottomans and Habsburgs would battle mainly across the former Kingdom of Hungary. The transformation of the military border was organized after 1556 from Vienna. Along the military border a system of border fortresses was constructed.

Systematic fortification work, modernization and maintenance required the plans of fortresses. The makers of these maps were foreign, in the 16th century mainly Italian military architects, who were also commissioned for the construction works. For the foreign military leaders of the Habsburg army spatial knowledge about the territory was essential. For different military purposes geographical, chorographical or topographical information was needed. The new method of warfare included the extensive use of natural land barriers, especially rivers, swamps, and mountains. The representation of the third dimension in general was a serious problem.

This paper re-interprets the manuscript atlases created by Italian military architects in Vienna in the 1570s. Members of the Angielini family compiled remarkable military atlases, known in slightly different copies. The work of the Italian master builders integrates various modes of Renaissance chorography. Their fortification plans follow the tradition of architects and urban cartography, the chorographical maps represent the pictorial, the decorative elements and the Vienna-centered point of view suggest propaganda and ideology: the entire atlas can be interpreted as a vision of the contested space.

The paper explores the contexts of the plans, views and maps made in the sixteenth century by a group of Italian military architects, scholars and painters in the Habsburg court in Vienna. I focus specifically on the fortification atlases produced in the 1560s and 1570s by the Angelini family, to study how their work relates to, first, traditional and contemporary Italian art and architecture and, second, Northern cosmography and mapping paradigms.

EXPERIENCE AND RHETORIC IN SIXTEENTH CENTURY SPANISH ATLANTIC CARTOGRAPHY: UTILITY AND CONFORMITY IN DOUBLE GRADUATION CHARTS

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The aim of this paper is to inquiry into the strategies used by 16th century Spanish cartographers, cosmographers, and navigators to resolve technical and practical problems produced at the Casa de la Contratación (Seville). The Casa was created in 1503 by the Catholic Monarchs, Ferdinand and Isabella, to manage all matters related to the colonial enterprise. In the context of the great geographical discoveries, this institution housed the first school of navigation and mapping in Europe. Its members not only designed instruments and maps but also found ways to centralize and systematize information from the Indies.

One of these instruments was the nautical chart of double graduation (*cartas de doble graduación*), such as built by the cartographer Diego Gutierrez in 1550. These charts contained two distinct latitude scales with the aim to solve another great scientific problem of the Early Modern World, the magnetic declination. This new representational model established in the Iberian Peninsula was produced by a small number of cartographers to both contemplate and explore the New World.

Not without controversy, double graduation charts caused one of many scientific disputes arising in the Casa. Pilots and cosmographers disagreed about what constituted satisfactory cartographic representation.

On the one hand, pilots, who were practically illiterate, maintained that the most desirable charts were those that made navigation easier. Pilots defended their by referring to the experience, to the practical knowledge and know-hows experienced in the long transoceanic voyages. Since navigators were the real users of the charts, they outlined the utility of these representations to carry out their work.

On the other hand, cosmographers of the Casa argued that the best charts were those based on sound theoretical knowledge. They opposed double graduation charts because they were not built according to the theoretical knowledge required for their design. In this vein, they denounce their use to the monarch and the Indian Council's officers. The charts with two distinct latitude scales were, they argued, inadequate and erroneous, artifacts that were not manufactured in accordance to reality.

PERCEPTION OF GEOGRAPHICAL FEATURES AND THE GENERAL CONCEPT OF "SHUI-KOU" IN THE FENG-SHUI THOUGHT OF EAST ASIA

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Feng-Shui thought has extended throughout East Asia centering on China and is a systematic method of performing divination and selecting preferred directions and locations. The fact that Feng-Shui includes a type of divination has resulted in its being criticized as a type of superstition. However its general concept and methods of perceiving natural features are employed in all regions of East Asia and are often expressed in pre-modern topographical or geographical manuscripts in addition to old maps. This review examines the Feng-Shui term "shui-kou" and considers the characteristics of a perception of geographical features using this general concept centering on the Korean peninsula.

"Shui-kou" is originally a word meaning an entry or exit point for water. However as shown in Figure 1, "shui-kou" in Feng-shui thought describes a location where a river flows out of a basin which is a preferred position to obtain "Qi". The theory of Feng-Shui thought teaches that the periphery of a preferred location which "does not allow leakage of Qi" must be bound by mountains. Thus the "shui-kou" must be "tightly closed" and is said to be an important location. If this location is "open", it was thought in China and Korea to be necessary to fill in that gap symbolically by planting forests, constructing miniature hills or erecting pagodas or bridges.

During the Choson Era during which Feng-Shui thought experienced considerable development, terms such as "shui-kou" on the Korean peninsula began to be used to express a perception of geographical features. For example, the "Eup-chi" which is an official topographical manuscript from the Choson Era uses the term when depicting the natural environment of a region. In the famous geographical manuscript the "Taengni-ji", the city Kimhae in the lower reaches of the Nakdong-gang river in the south-east of the Korean peninsula is designated as "shui-kou". This is due to the fact that Kimhae is the outflow for the entire Nakdong-gang river basin. In this manner, the term "shui-kou" is not only a term in Feng-Shui thought but is also used in the comprehension of a broader region by indicating the outflow for a catchment area on the level of the region.

Figure 1

THE ENGLISH AND AMERICANS IN THE EASTERN SIBERIA AND THE RUSSIAN FAR EAST (NINETEENTH - EARLY TWENTIETH CENTURIES): ON HISTORY OF GEOGRAPHICAL EXPLORATION AND GEOPOLITICS DREAMS

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American and British travelers had been to Siberia for quite different reasons, including such as scientific explorations, local military and Navy actions, traveling for sport, hunting and adventure, visiting Siberian prisons and mines, studying Siberian, Russian and Native population, as well as opportunities for future development of industry and international trade, trying to convert the Siberians into the protestant Christianity. Even the preliminary browsing of their works proves that the majority of them had gotten "geopolitical overtones," especially as regards Russo-Chinese relations and opportunities for American and British business and commerce in the Eastern Siberia and Russian Far East. Captain Cook expedition had arosed a great scientific interest to the Russian North-Eastern Asia and the Pacific North. This interest was materialized in the first prominent British and American continental travels in the North-Eastern Siberia in the late Eighteenth Century. All these travels were fulfilled by or with participation of members of Captain Cook's crew. These travels had been followed by English missioners in Selenginsk (1817-1840). In the same period an Englishman of rather different temperament and tastes, Captain John Dundas Cochrane, traveled through the whole Siberia up to Kamchatka (30.000 miles)(1824). In 1848 - 1854 the English architect, painter, and traveler Thomas Witlam Atkinson (1799-1861) visited the Siberia, Mongolia, Manchuria, and Central Asia, describing in three volumes (1858-60) his impressions of travel, illustrating them with watercolors and drawings. The important group of travelers and authors was connected with the Project of Transpacific Telegraph line (1863-1867). This group included: P. M. Collins, George Kennan, Richard J. Bush, and some others. At the end of the XIX-th – beginning of XX-th centuries the Gold Rush in Alaska spilled to the Kamchatka, Chukotka, and Maritime Province which led to many foreign travels, Russian protective measures and even to some Russian plans of selling these regions to the United States, the last of which being proposed by Lenin in 1920. I hope that materials on English and American travels in the Eastern Siberia, which I have presented, show their role in the historiography of geographical exploration of the territory, its native and Russian population which before that travels where not known to then western Europeans at all. These works, being very different in their aims and quality of contents had been united by one mutual feature, which contemporary to them Russian, more detailed, works by explorers and travelers were lacking. The essence of this feature is the fact that the majority of these descriptions were "sights from the outside" of persons who had not been included into the process of the Russian State territory's expansion and had not been under any obligations to the Russian authorities. On the other hand such foreign travelers by will or bondage were "promoters" of their native countries' geopolitics plans who tried to use Siberia as a "back side door" to Mongolia, Tibet, and China to widen their markets and missioners' activates, as well as "to grope ground" for future encroachments and implanting themselves in the Eastern, poor populated and mastered outskirts of the Russian Empire for exploitation of their rich nature resources and using them as markets for their trade goods. The presented materials are also of importance as sources for study of different nature components (vegetation, animals, rivers, relief, atmosphere and whether, seasonal changes, and so on) at the relevant periods, as well as for description of native peoples of the Eastern Siberia and Far East in the process of their traditional cultures' transformation under the influence of their contacts with Russians and other representatives of the European civilization.

Regular Session T09-12
Social Sciences in the Contemporary Period (1800-)

OPTION PRICING THEORY AND THE CONSTRUCTION OF MATHEMATICAL FINANCE IN THE 1970S: AN IDEA, INSTRUMENTS AND A CONTEXT

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In 1997, Robert C. Merton and Myron Scholes, two Finance professors, respectively from Harvard and Stanford University, were awarded the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel for their "new method to determine the value of derivatives", a specific type of financial instruments used for insurance and speculation purposes. This new method was derived in 1973, in two papers: one written by Scholes and the late Fisher Black, and the other written by Merton. These two papers had a tremendous impact both from an academic standpoint and from a practical standpoint.

From an academic standpoint, these articles and the ideas they contained were the inspiration for a large body of work that elaborated on them, to become a proper sub-field of Financial Economics (now known as Mathematical Finance), with its own concepts, models, techniques and scientific journals, and deeply rooted in probabilistic theory, stochastic calculus and the stochastic integration theory developed by a Japanese mathematician, Kiyosi Itô, in the 1940s and 1950s.

From a practical standpoint, Black, Merton and Scholes's methodology was not only very quickly adopted then adapted by traders on financial markets. It also shaped the way operators on the markets thought about options and priced them. And even if it has been widely criticized specifically for one assumption, Black and Scholes' model continues to be used and taught and, above all, it continues to permeate financial practice on options' markets.

At the core of the Option Pricing Theory developed by Black and Scholes and elaborated on by Merton, there was a crucial and intuitively appealing idea: that of dynamic hedging. There were also sophisticated probabilistic instruments (Brownian motion, stochastic processes, stochastic calculus, Itô's lemma). And there was a particular context: the 1970s with the end of the Bretton Woods agreements and the deregulation of currencies and interest rates. In 1973, the Chicago Board of Options Exchange (CBOE), the first standardized exchange for the trading of options, was created. Two years later, the CBOE officially adopted the Black and Scholes formula for the pricing of traded options.

While, in spite of the "Nobel" prize, there is still some debate between mathematicians and economists on whether Mathematical Finance is a subfield of Applied Mathematics or Financial Economics, and as the models of Mathematical Finance are being blamed of all evils in the turmoil of the subprime crisis, we believe a historical investigation of how Mathematical Finance emerged as a field in the 1970s might provide some useful insight.

ON THE THRESHOLD OF MODERNITY. ALVA AND GUNNAR MYRDAL VS. ELI AND EBBA HECKSCHER ON THE SUBJECT OF SCIENCE AND SOCIAL WELFARE

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The battle over modernity, and especially over social welfare, was fought with social science as a weapon. This is an established fact in the history of social science in Sweden. Swedish modernism was from the 1930s and onwards propagated by a number of young intellectuals: economists, architects, journalists, politicians, etc. Foremost among them and a central node in a Stockholm-based intellectual milieu were Alva and Gunnar Myrdal, him being a young economist with Keynesian ideas, her being a feminist and social reformer. Using Keynesian economics and sociology as a foundation, they became involved in issues rangeing from labour market policy to the size and planning of working-class homes.

A less well-known fact is that the opposition to the ides of the Myrdals and to welfare policy in general, also was founded on science, or rather, on history as an academic discipline. Eli F. Heckscher, Swedish economist with a neoclassical stance, and his wife Ebba, took the Myrdals on in open battle in 1934. In this year the Myrdals published their celebrated book "Kris i befolkningsfrågan", in which they claimed that the falling Swedish population rates were the result of lacking social policy, and proposed measures to counter this development. Heckscher had by then left his identity as an economist behind and transformed into an economic historian, a discipline that did not yet exist in Sweden. As an economic historian he deplored the use of history as a dark and dreary reference point against which the bright future could be sketched. Instead he tried to use history as an argument against the Myrdals and for laissez-faire as a principle in economic as well as social life.

The battle between the Myrdals and the Heckschers was a public affair, as it took place in Swedish newspapers in December 1934. It was also a matter that was discussed in the correspondence between the two couples. The debate, which is the central theme of this paper, brings up a number of crucial conflicts and themes which had great actuality. There was the issue of scientific objectivity and what that was, something that was closely related to the unstable and debatable boundary between science and politics. There was the issue of state finances and which was the role of the state in society. And there were also moral issues relating to the responsibility of the individual, in public as well as in private life. The Heckscher-Myrdal debate contains in a nutshell most of the central conflict lines of a Sweden on the threshold of modernity.

EPISTEMOLOGICAL CONDITIONS FOR A SUCCESSFUL TRANSFER OF POLICY RELEVANT KNOWLEDGE: A LESSON FROM THE HISTORY OF CENTRAL BANKING

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The ethos of scientific knowledge production that was crystallized during and after the scientific revolution prescribed empiricism and abstraction as epistemological conditions for objectivity. The emergence of this ethos was tightly connected with the emergence of the liberal political order Shapin and Schaffer demonstrated. In the nineteenth century the precepts of empiricism and abstraction were borrowed by the nascent social sciences as an epistemological model, and the association of knowledge production to the Western, industrial, liberal nation-state tightened as was demonstrated, e.g., by the history statistics, political economics and public health. At the same time the social sciences went through a process of standardization, internationalization, mathematization and objectification. During the colonial era social sciences were transferred, together with their associated practices, from imperial countries to the colonies. The industrial liberal models that were assumed by the social sciences were enforced on essentially different societies.

Since WWII the transfer of policy-relevant knowledge from industrial to peripheral, new and developing but sovereign countries has become a pressing problem both epistemologically and politically: did post-colonial states required a "different science"? The entering of new and different states to the international community put in a new light the question regarding the generality and universality of social and economic laws.

The questions I discuss in my paper are both historical and prescriptive: can we talk about a new ethos of knowledge production in social sciences due to the entry of developing countries to the system? And, *should* we promote a new ethos in response to the growing diversity of the international system since WWI and the "discovery" of structural and cultural differences, between societies and states?

My suggestion is that many fields of policy-relevant knowledge – particularly economics – have overemphasized the epistemological precept of *abstraction* and underrated *empiricism*. While this tendency was epistemologically successful and politically effective as long as it was applied to industrial liberal countries, it proved to be unsuccessful and ineffective when it was applied to other types of countries.

I demonstrate my argument by an example from economics: the worldwide diffusion of central banks and central banking. Partly based on secondary literature, and partly based on my own study about the central banking in the post-WWII period, I identify five waves of globalization of central banks. This case enable me to trace the epistemological and institutional condition for successful transfer and translation of knowledge to "similar" and "different" countries.

HELMHOLTZ RESONATORS AND THE MECHANISTIC REVOLUTION IN PSYCHOLOGY

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Before and during the 19th century there was a consensus against the idea of using methods practiced by natural sciences to study psychological phenomena. Nevertheless, to detach from philosophy and reach its scientific status, the new psychology had to demonstrate its capability of producing objective statements derived or at least related to testing procedures applied to its study objects. Natural sciences, especially physics, were the model to be followed.

The foundation of laboratories, the creation and acquisition of equipment and all kinds of research tools gave assurance of the objective character of the naturalized psychology. Pioneer psychologists tried to impulse the development of their discipline installing laboratories to conduct their reaserch.

Since then, the controversy on the scientific status of psychology has been centered upon two main problems: the legitimate adoption of testing methods and the empiricist nature of the new psychology.

Even so, most books on history of psychology basically state the fact that scientific psychology began and describe the main actions and activities of the founders, though they hardly tackle the question of how this epistemological and methodological shift came to be. It is quite dissatisfactory to accept that the new psychology just proved wrong the philosophers who denied the possibility that this discipline could become a science.

For a better understanding of this qualitative shift, I think that the consideration of the historical instruments used in pioneer investigations, before and during Wilhelm Wundt´s foundation of the first psychological laboratory, can assist us for this purpose.

Hermann Ludwig Ferdinand Helmholtz is an impressive scientist of the 19th century, whose work exceeds a single domain within natural disciplines like physics, physiology and mathematics, with a strong understanding of philosophical matters and a great hability in creating instruments for his experimental research, became the main character of my historical and philosophical inquiry.

In this paper I will examine Hermann von Helmholtz´s research and defense of an objective dimension of sensations and perceptions, to show that his use of resonators (among other instruments) was guided by significant epistemological and theoretical conceptions. Through his innovative approach, inadvertently but firmly, Helmholtz made the transformation of psychology possible.

HUNGARIAN-CHUVASH ECONOMIC AND CULTURAL CONTACTS IN MODERN CONDITIONS

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Historical connections of Hungarian and Chuvash folks have arisen as far back as in ancient times. Magyars have much in common with Chuvashes. In 1960-1970th years friendly communications have been established between the Chuvash Republic and Heves County of the Republic of Hungary. In the capital of the Chuvash Republic - Cheboksary - there are the streets which names have a direct bearing on Hungary: Heveshsky, Mate Zalka, Egersky parkway. In March, 1997 between the Government of the Chuvash Republic and the Ministry of the Industry, Trade and Tourism of the Hungarian Republic the Agreement on expansion of trade and economic cooperation has been signed.

The new coil to development of the twin-city relations was given by the cooperation agreement signed in May, 2004. Within the frameworks of its realisation the exchange of official delegations is carried out. Chuvashia have become the first region in the Russian Federation which has carried out the co-project with the Hungarian Republic on building of residential block. Building has begun in 2004 with attraction of credit lines of the Hungarian banks. And now it is entitled precisely – «The Hungarian block». It became known to all Russia, and successful experience of Chuvashia is adopted by other regions. Development of new directions in agriculture of Chuvashiya - goose and duck breeding – is one more large-scale hungarian-chuvash project. LLC «Cheboksary Poultry Farm» and “FBZ Hungaria KFT.” have concluded the contract on cooperation for 2005-2010. Nowadays there is an exchange of incubation, cultivation experts between Chuvashia and Hungary. The further development of mutually profitable cooperation between the Chuvash Republic and the Hungarian Republic in the area of animal breeding is in the long term planned.

Active work on expansion of cooperation in the field of culture, science and education is conducted. Exchange tours of professional and amateur creative collectives, exhibitions of works of artists and masters of national crafts take place within the frameworks of mutual relations. In 2005 pupils of Cheboksary school of arts participated in the International symposium in Eger on composition creation in sgraffito style. In 2006 the international biennial of arts among children and youth «Eger – Cheboksary or unusual travel of Antala Reguli to Russia» took place. Close connections with Scientific Community of the Hungarian Republic are established by philologists of the Scientific Research Institute at the Government of the Chuvash Republic and the Chuvash State Pedagogical University of I.J.Jakovlev, joint researches with scientists of The University of Debrecen are conducted. An exchange of ethnographic expeditions, researches of national folklore take place.

The Chuvash Republic is interested in attraction of the hungarian capital in the food and process industry, chemical and light industry, the industry of building materials. Cooperation on introduction of building and power saving up technologies, participation in modern programs of the hungarian architect and building organisations, attraction of financial resources for realisation of joint projects and programs is actual.

THE EVOLUTION OF MAN IN THE LATE NINETEENTH CENTURY: DARWINISM AND *THE HISTORY OF HUMAN MARRIAGE*

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In 1891, a book appeared by a young unknown Finnish academic named Edvard Westermarck (1862–1939). *The History of Human Marriage* was published by Macmillan, following a letter of introduction by leading anthropologist Edward B. Tylor, and contained a preface by one of England's most famous naturalists, Alfred Russel Wallace. The book — which ran to three editions and was translated into seven languages — described how natural selection could be used to explain the marriage preferences of mankind. Historian of anthropology George Stocking has noted the apparent originality of Westermarck's project: "That three decades after Darwin this could be seen as an innovative approach is confirmation of the fact that sociocultural evolutionism … had not been elaborated in Darwinian terms".

What did it mean to apply 'Darwinian' explanations to man, a full three decades after the publication of Darwin's *Origin of Species*? I will use Westermarck's book to explore the differences in the reception and status of evolutionary thinking in Britain and Scandinavia, where Darwin's ideas had different histories. Historians have shown that the publication of the *Origin* and the *Descent* in the 1870s generated little controversy in Finland and that Darwinism only surfaced during the ideological tumult of the 1880s, when Westermark was a student. In Britain, the status of 'Darwinism' was complex, and it is often said that support for natural selection in the 1890s was at a low ebb. However *Human Marriage*'s generally warm reception in the press, and the little explicit antipathy towards Westermarck's use of natural selection, suggests that the status of natural selection at that time was not as low as is sometimes claimed.

Human Marriage is a particularly interesting marker for late-nineteenth century applications of evolution to man because while Westermarck wrote the book in dialogue with luminaries of an older generation — Tylor and Wallace — it was reviewed by a somewhat younger generation. Westermarck's application of evolution to man was very different to its application by sociocultural evolutionists, and was more characteristic of some natural historians. The anomalous character of Westermarck's book is exemplified by the terms of his title: among its largely favourable reviews, many reviewers questioned the tautology of the phrase 'human marriage'. Indeed, Westermarck's conflation of 'nature' and 'culture' in the word 'marriage' epitomises the tension between his project and the activities of other anthropologists.

Regular Session T09-13
Natural History in the Contemporary Period (1800-)

SIR ROBERT SCHOMBURGK'S BIODIVERSITY SCIENCE LEGACY IN GUYANA

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Modern Guyana's biodiversity wealth is far from complete inventorization and assessment since Sir Robert Schomburgk's pioneering scientific expeditions of 1835 – 1844. Mandated by the Royal Geographic Society of the United Kingdom to 'investigate the physical and astronomical geography of the interior of British Guiana,' Sir Robert, definitely went beyond the call of duty to provide world class documentation of then British Guiana's biodiversity. His botanical and zoological collections have had a major impact on collectors and collections in the 20th century and to date. The botanical collections, a treasure trove of type collections, form the major corpus of his biodiversity legacy in Guyana. Schomburgk's perspicacity for taxonomic novelties led to a several eponymous plant taxa. A count from the National Herbarium of the Netherlands alone reveals about 81 of such honours.

From his numerous publications, we have considered Sir Robert Schomburgk's remarkable contributions to biodiversity studies in Guyana to span several disciplines. His breadth of contributions based on his collections and writings in terms taxa, habitats/ecosystems and geography/topography (aquatic, terrestrial, montane, arboreal), span the following disciplines: plant ecology, plant taxonomy, economic botany, forest botany, mycology, plant morphology, landscape ecology, orchidology, animal taxonomy, herpetology, ichthyology, mammalogy, ornithology, fisheries biology, limnology, ethnomedicine, ethnopharmacology and, interestingly, what we term "ethnobiotechnology." His collections have also contributed in part to the work of Charles Darwin and evolution science. Beyond these contributions we may also justifiably ascribe to him contributions to Guyana's ethnography, documentation of indigenous knowledge and sociology.

Biodiversity science is fundamental to biodiversity economics, natural resource management and related resource economics and modern-day bioeconomy enterprises. Robert Schomburgk's pioneering biodiversity work in Guyana is monumental and will remain so for posterity.

EMERGENCY OF THE MEXICAN PHYSICAL ANTHROPOLOGY IN 19th CENTURY, WITHIN THE CONTEXT OF THE EUROPEAN IMPERIALISTIC EXPANSION AND THE CONSTRUCTION OF THE NATIONALISM IN MEXICO.

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Mexico got its independence of the Spanish kingdom, at least political, during the course of the second decade of 19th century. Since this moment, it followed a slow and complex process of consolidation like country and construction of a nationalistic identity. This process, can affirm, was not completed in political and economic matter until the last third of the same century, while in the cultural level it would be necessary to wait until the arrival of the following one.

Of simultaneous way, the rising country looked for to come in the call concert of the civilized nations, by means of the promotion of science like guarantee to the access to a progress stage. The studies in the field of the medicine, geology, national geography, and, finally, of natural history could offer the access to status of modernity.

Towards 1862 the French troops of Napoleon III arrived at the Mexican coasts in order to extend their political, economic and cultural dominion on American earth. In this sense, the Scientific, Literary and Artistic Commission of Mexico, had priorities, one of this was the promotion of science to complete the process of pacification in Mexico and to legitimate the military intervention. The Scientific Commission was integrated by several sections, the number sixth was dedicated, among others matters, to promote the anthropological studies on the Mexican populations.

The anthropological program was settled over the theoretical proposals formulated by French scientists, some of them were members of Anthropology Society of Paris and of the Museum of Natural History. Its perspective over the human groups rested in the conception of a hierarchized natural order, where the different human races occupied a specific place. In this order the base was constituted by the primates, followed by the African Black races, the American Indians, the Asians and finally, in the peak of the scale, the European white races.

The arrival of these theories about the racial differences, determined essentially by the physical and intellectual conformation, also supposed the implementation of specific practices to identify the peculiarities of the diverse Mexican groups.

Nevertheless, in Mexico, diverse factors of geographic, social, demographic, cultural and political order constituted a serious questioning to the anthropological European theories and practices, locally producing the emergency of the anthropo-physical discipline with peculiar characteristics. In this work I analyze the mentioned factors in their double: the French process of imperialistic expansion in the decade of the 1860 and process of nationalistic construction that Mexico attended in the referred period.

ZOOLOGY IN THE LIBRARY OF MARTORELL MUSEUM OF NATURAL SCIENCES OF BARCELONA, SINCE 1882 TO 1915

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The Museo Martorell was opened in 1882 with the patrimonial donation made by Francesc Martorell y Peña and the attention gived at the idea by the Ayuntamiento Constitucional de Barcelona.

This museum, eclectic in its origins, early abandoned the generalistic tradition of Cabinets to get his own scientific character, with a strongly tendence for the study of malacology. At the same time, in the library of the museum also occurred one process of specialization in natural history and mainly in malacology.

This work rebuilds and explains part of the history of that library.

Key Words: Museum, Cabinet, Naturalist, Natural History, Zoology, Malacology, Library, Catalanism, Evolution.

THE ANTHROPOLOGY LABORATORY AT THE NATIONAL MUSEUM OF RIO DE JANEIRO: RECONSTRUCTING THE NETWORK BETWEEN THEIR SCIENTISTS AND THEIR SCIENTIFIC INSTRUMENTS (1909-1935).

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This study intends to analyze the construction of the Anthropology Laboratory at the National Museum of Rio de Janeiro in the beginning of the XX^{th} century specially in 1909 when the laboratorial activities started until 1935.

The Museum has been created in 1818 and the scientific practice of Anthropology has been officially institutionalized in 1876 during a restructuration of the working areas done by the Museum Director, Ladislau Netto, bringing it together with other current practices at the time, Zoology, Anatomy and Animal Paleontology.

Anthropology, as a new scientific practice, was basically performed by medical doctors which joined the institution as scientists between the late XIX^{th} and early XX^{th} centuries, like: Dr. João Batista Lacerda, Dr. José Rodrigues Peixoto, Dr. Júlio Trajano Moura, Dr. Edgard Roquette-Pinto and Dr. Álvaro Fróes da Fonseca.

The first investigations are from 1876, which were performed by Dr. João Batista Lacerda, with primitive skulls from Brazil. Following the criteria developed by Paul Broca from the *Société d´Anthropologie de Paris* and his *Ecole d' Anthropologie*, some instruments were acquired to assure proper measurements as per established standards. Over time, the Anthropology section from the National Museum had a substantial number of anthropometric instruments, even not having an established laboratory.

In 1894 the Director of the Anthropology section, Dr. Júlio Trajano de Moura, decided to increase the number of available instruments to implement an official Anthropology laboratory and asks for the establishment of photography facilities. The laboratorial registers only appear with the studies performed by Dr. E. Roquette-Pinto in 1909 when finally the laboratory was implemented.

The Anthropology Laboratory started to gain more attention and importance as the quality of the studies performed increased over time, due to Roquette-Pinto and Fróes da Fonseca. All these studies were published in institutional periodicals like the *Archivos do Museu Nacional* and *Boletim do Museu Nacional* which allowed a thorough analysis of their theoretical reference.

SEEING PAST SPECIFIC BEHAVIORS: CLASSICAL ETHOLOGY'S FAILURE

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This paper intends to analyse one of the failures of classical ethology in regard to contemporary investigations of animal behavior: its inability to account for what could be termed infra-specific behaviors.

After I summarily circumscribe what can be defined as classical ethology (a qualification based upon sociological and epistemic elements), I proceed to describe the species-centred conception of animal instinct advocated by classical ethologists. Lorenz's "instincts as organs" analogy is useful for this purpose. Although it is intend to be an argument advocating the adequacy of motor patterns for the comparative method, and hence for taxonomy, it is also a commitment toward a specific understanding of behavior.

Next, with regards to what would become the study of behaviour a few decades later, I proceed to put classical ethology's failure into a broader perspective. Three of the main tools that would soon be used to recognise infra-specific behaviours and behavioural characteristics, were either already available or being developed by the time ethology reached its apogee. First, psychology's use of statistical methods was already providing a tool to test correlations of either individual or environmental characteristics, hence allowing for the discrimination of individuals or groups of individuals. Second, fully developing during the same period ethology was, ecology, was also designing concepts and methods to assess how individuals fare, how conspecifics relate, and how species interact, in a given environment. Last, and also maturing during the same period, economics was to provide game theory, thus allowing for the discrimination of infra-specific behaviors, tactics.

FLORISTIC RESEARCH OF THE CZÊSTOCHOWA UPLAND (POLAND) BETWEEN THE MIDDLE OF THE 19th CENTURY AND THE END OF THE FIRST WORLD WAR

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This article is devoted to the presentation of the floristic research in the Częstochowa Upland (Poland) between the middle of the 19th and the end of the end of the First World War.

It began in 1850 when a group of naturalists from Warsaw led by zoologist Antoni Waga and botanist Wojciech Jastrzębowski, conducted in 1854 a physiographic research of the Częstochowa Jurassic Upland. Among the other members of the research team were Kazimierz Stronczyński (zoologist), Władysław Taczanowski (ornithologist) and Jan Wańkowicz (entomologist). They travelled along a route stretching from Częstochowa through Olsztyn, Złoty Potok, Żarki and Pieskowa Skała to Ojców. They described their research journey in *A Report From a Journey of Naturalists to Ojców in 1854* (Waga et al. 1855, 1857). The Warsaw Naturalists strongly emphasized the distinctive character of the Jurassic Upland and its unique nature. The flora of the Jura region in the victinity of Olsztyn and Złoty Potok was considered as one of the elements describing the physiography of the terrain. They introduced 39 vascular plant species and 6 species of the *Bryophytina.*

Probably during that expedition its participants did not compile any herbarian documentation, because no herbal specimens from the respective period and region have so far been traced in Polish herbaria.

Ferdynand Karo, a pharmacist and a botanist, in his work entitled *The Flora of the Częstochowa Region* published in 1881, described 778 species of vascular plants from the area of Częstochowa. This is the first fundamental botanical work relating to that region. F. Karo in this publication describe the locality of a new species of the plants' taxon: *Galium cracoviense* Ehrend.

The bryological research in the Częstochowa Jurassic Upland was conducted by an eminent botanist, Franciszek Błoński, who distinguished 143 species of moss in the area of Częstochowa, Blachownia, Olsztyn, Janów and Złoty Potok.

In the first years of the 20th century, the research work in the area of botany was taken up by several young scholars, whose careers peaked in the years of independent Poland. Among them was Zygmunt Wóycicki who in 1914 published *The Pictures of the Flora of the Polish Kingdom and the Neighbouring Countries* devoted to the flora of the Częstochowa and Olsztyn area.

Regular Session T09-14
Environmental Studies in the Contemporary Period (1800-)

A HISTORY OF RESILIENCE SCIENCE: FROM RANGELAND ECOLOGY TO GLOBAL CHANGE 1973-2008

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Global change and resilience are two of the key words in environmental management and policy today. These terms have 'plain English' meanings, but they are also technical terms in environmental science. Climate scientists use *global change* to emphasise the human dimensions of climate change. *Resilience* is the capacity of a system to 'bounce' or recover from shock. The global change community (including the Intergovernmental Panel on Climate Change, IPCC) often uses resilience as a concept to operationalise 'sustainability'. It is concept that can map the way sustainability might operate over time (historically) in a system or a society. Sustainability is a description of a state rather than a process over time. Some regard it as a goal or an aspiration, rather than a direction for action. Resilience is a measurable process with a history, which has precise implications for environmental management. It is increasingly being discussed by communities concerned about global environmental change, whether they be primarily concerned with science, management or poetics.

Resilience science began in 1973 with the writings of ecologists, CS (Buzz) Holling and Brian Walker. Many of its foundational ideas were tested in rangeland ecology, in the deserts of outback Australia, where the natural 'booms and busts' of a highly variable ecological system challenged the rules of equilibrium that apparently worked in other rangeland systems. This paper will outline the development and globalisation of resilience in ideas about environment and society. It will trace the death of equilibrium (and climax) theory in ecology, which arose out of work in relatively local agricultural science and developed through the Resilience Alliance and the online journal *Conservation Ecology.* Resilience is now applied to global systems science, and to global environmental management, as evidence by the world congress on Resilience, held at the Stockholm Resilience Centre in April 2008.

Key References:

Holling, C.S. 'Resilience and Stability of Ecological Systems'. *Annual Review of Ecology and Systematics* 4, 1973: 1-23.

Westoby, Mark, Brian Walker and Imanuel Noy-Meir, 'Opportunistic Management of Rangelands Not in Equilibrium', *Journal of Range Management*, 42(4), 1989, 266-74

Carl Folke, Steve Carpenter, Brian Walker, Marten Scheffer, Thomas Elmqvist, Lance Gunderson and C.S. Holling' 'Regime shifts, Resilience and Biodiversity in Ecosystem Management', *Annual Review of Ecology, Evolution, and Systematics,* vol. 35, 2004, pp 557-81.

SUSTAINABLE DEVELOPMENT ON COMMUNITY LIVESTOCK.A CASE OF NORTH EASTERN PROVINCE, KENYA

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North Eastern Province lies in Kenya with a semiarid climate. The area is only suitable for drought tolerant crop farming, due to erratic and unpredictable rainfall, which frequently causes crop failure. The livestock management systems in this area are historically extensive. Commonly reared types of livestock are cattle, goats, sheep and chickens. The East African goat is the breed traditionally reared by this community, however, other breeds such as the Galla exist. The area is highly tse-tse infested, leading to heavy cattle losses from trypanosomosis. This together with increased human population has compounded the land use problem with more land being opened up by the community for cultivation as farmers look for alternative livelihoods. This has led to development of semi-intensive systems of livestock production.

The grazing land has thus been reduced, creating a major constraint in livestock production despite the use of on farm crop residues for nutritional purposes a practice that is not adequate.

The approach adopted by farmers is communally managed utilisation of locally available goat genetic resources among the resource poor farmers. The Galla goat is an indigenous breed mainly found in the pastoral areas of Kenya. The natural habitat of the Galla is similar to the ecological conditions found in North Eastern. It is well adapted to harsh climatic conditions of the arid and semi-arid lands. The East African on the other hand is distributed all over the East African region and it has the ability to survive under harsh climatic conditions. The Galla and the East African goat are used as a local goat gene pool for the arid and semi-arid lands in Kenya, which the local community is exploiting to harness positive traits. In the case of North Eastern this is achieved through a group approach.

To facilitate this initiative, multiplication of the Galla goat locally is essential for distribution to the local breeders. This will reduce the logistical costs required in procurement of the Galla goat. The more informed and economically able farmers have shown an interest in the multiplication.

Technical support is provided by local personnel from the Ministry of Agriculture and Rural Development and Community-based animal health workers in areas of buck selection, disease control, feeding and general animal husbandry.

LA CRISE ENVIRONNEMENTALE GLOBALE ET LA NOUVELLE DYNAMIQUE DU DÉVELOPPEMENT DANS DES RÉGIONS PÉRIPHÉRIQUES

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Cet article est part d'un projet de recherche plus large sur la thématique du développement. Dans ce travail, je cherche à faire quelques considérations sur les changements conceptuels sur développement lorsqu'on inclut la philosophie sociale et économique du libéralisme contemporain et au même temps essaye donner réponse à la crise environnementale globale. Je cherche à analyser comme les approches scientifiques, les défis teórico-metodológiques sur développement, bien qu'ils soient très importants, ne se superposent pas aux thèses pragmatiques, marquées par des idéologies qui envisagent des projets sociopolitiques des organismes officiels et les gouvernements engagés d'assurer le gouvernance global devant la crise environnementale. Celle-ci peut être considérée inhérente au modèle lui-même du développement social dominant. C'est-à-dire, je pars du principe selon lequel les variations et des adjectivations et des changements conceptuels du développement, construites maintes fois avec des contributions théoriques peu précis comme le holisme, par exemple, bien que ce soit résultant de analyses d'experts et de programmes de recherches, il n'a pas d'origine scientifique. Dans ce cas, ce n'est pas la pensée qui guide des changements dans le modèle (théorie) de développement. Les questions sociopolitiques sont les inductrices des changements, considérés comme des paradigmes. Les nouveaux concepts et la théorie du développement apparaissent en règle générale dans le sein des dispositions de l'ordre économique mondial en vue se protéger le système, au détriment de les possibles coûts sociaux. L'économie dominante semble toujours être protégée. Les coûts sociaux des ajustements structurels sont payés non seulement pour les économies plus fragilisées, mais principalement pour les groupes humains des pays sous-développés placés dans des régions périphériques, où les niveaux d'inégalités sociales et le degré de pauvreté sont les plus graves. Avec la crise environnementale globale les régions périphériques, tributaires de la grande dette sociale de la modernité brésilienne inachevé, sont guidées par une nouvelle norme de développement - le développement soutenable. Ici il est important comprendre dans quelle mesure les sciences socio-environnementales sont capables de formuler des théories sociales de l'environnement et de révéler les idéologies qui impliquent un sujet aussi diffus et abstrait comme les problèmes environnementaux globaux. Il est important encore d'analyser dans quelle mesure le modèle de développement soutenable se configure comme une proposition de développement qui aperçoit la gestion des ressources naturelles globales en harmonie avec les intérêts de groupes qui dominent les richesses mondiales ou il est un nouveau contrat social inclusif capable d'abriter de nouvelles dispositions sociopolitiques et environnementales pour assurer la dignité humaine promise par les modernes. Les nouvelles ordres politiques pour surmonter la crise environnementale seront-ils capables de réduire l'éloignement entre l'homme de Hegel et l'homme de Hobbes lesquels habitent tous les coins de cette planète, ou est-il un Mythe?

THE TELECONNECTION BETWEEN SEA SURFACE TEMPERATURE ANALYSIS FROM IN SITU DATA AT EAST MOLE, LAGOS AND GLOBAL WARMING

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Marine weather observers have since 1988 been making sea surface temperature observations at East mole station, about 2 kilometres from the Coast. The station uses the rubber sea – temperature bucket thermometer and makes observations on hourly basis, sea surface temperature has influence on Lagos coastal weather and it is important especially for coastal fishermen, offshore oil and gas industries, shipping vessels, coastal recreational and port handling facilities. Some evidences of global warming in Nigeria have been observed using sea surface temperature (SST) for the period of 1989 – 2007 which statistically analyzed, results shows that the Nigerian coastal waters is warmest in April and Coldest in August. The period 1989 – 2007 mean yearly data of sea surface temperature (SST) show some of the teleconnections with global warming.

The attempt in this paper is however to highlight the features of sea surface temperature over the Lagos coastal waters. Indicating the global warming is evident in the environment of Nigeria Coastal line.

A STUDY OF THE HISTORY OF ENVIRONMENTAL SCIENCE IN SOCIAL CONTEXT IN THE FIRST HALF OF TWENTIETH CENTURY

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The twentieth century has seen tremendous changes in modes of transportation, power generation, food production and processing and data collection and processing, leading to the information superhighway. However, this has been accompanied by environmental degradation wrought about by some of the prevailing forms of industrial and agricultural activity which is widespread and is no longer politically and socially acceptable. We no longer have the option of ignoring or refusing to pay for the economic, political and ecological consequences of pollution. If we have any economic development, it must be based on sustainable development in all fields of activity.

This consciousness about environmental protection became widespread in the last few decades of the twentieth century (for many, the first milestones of the movement of environmental protection was the publication of the book " Silent Spring" by Rachel Carson), but the seeds were sown much earlier in the first half of the twentieth century, when a handful of environmentally aware persons began to predict the harmful effects of rapid industrialization and urbanization and drew our attention to the need for moderating and modifying our ways to save the environment.

The present study examines how the foundation of the environmental sciences was laid in the first half of twentieth century either by individual efforts or by the formation of a society like the National Audubon Society in 1905. Sporadic efforts of environmental awareness included the legal suit by the so-called radium girls to seek compensation for life-threatening chemical pollution and the creation of National Park Service in 1916 by US president Woodrow Wilson for biodiversity conservation. The study also examines the impact made by such individuals or groups on future environmental protection and how the efforts peoples to take up the cudgel for environmental protection in the second half of twentieth century.

It is true that in the first half of twentieth century, environmentalists were few and their voices were difficult to be heard amidst the clamour for rapid industrial growth and economic property. However in order to put the environmental consciousness of modern era in its proper perspective, it is imperative to go back to the first half of twentieth century when the first effort for environmental protection began to be made.

HISTORICAL OZONE MEASUREMENTS MADE IN THE HABSBURG EMPIRE DURING THE 19th CENTURY

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Measurements of atmospheric ozone were made at several sites in the Habsburg Empire throughout the second half of the 19th century. Measurements were begun in 1853 at six meteorological stations (Krakow, Kremsmünster, Senftenberg, Stanislau, Vienna and Szeged). The number of stations measuring ozone increased to nine in 1854. Measurements were carried out twice a day to get a diurnal and a nocturnal value. Ozone was measured using a technique developed by Schönbein, which was in use until the 1920's. Daily means of meteorological variables (temperature, humidity, wind, clouds, precipitation) were also recorded. All of the data found in the meteorological yearly-books for the measurement period (1853-1856) were put into electronic form. Long term ozone and meteorological datasets from Buda (1871-1898) were also investigated.

These results potentially offer a greatly enhanced view of ozone levels at high spatial and temporal resolution, which is particularly suited for the study of the evolution of ozone levels spanning the period from pre-industrial levels through the growth of anthropogenic emissions during the 19th century. However, the results obtained by the Schönbein method must be corrected for interference by atmospheric water vapor and certain pollutants. This was done by examining the meteorological record for information about transport from nearby sources.

The spatial and temporal variability of corrected ozone data have been presented and compared with the present-day measured results as well. Generally the ozone values in 19th century were less than 15 ppb.

(This abstract does not necessarily reflect EPA policy.)

ANCIENT WATERWAYS AND HYDROTECHNICAL CONSTRUCTIONS OF THE EUROPEAN PART OF RUSSIA (HISTORICAL AND ECOLOGICAL ASPECTS)

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Without understanding the past, as you know, it is not possible to anticipate future. Long-term work on the study of various aspects of the history of interaction between nature and human through his tools and instruments held in the S.I. Vavilov Institute of History of Science and Technology of the Russian Academy of Sciences. Since 2002 the authors developed a new scientific direction - a historical and geographical study of natural and artificial waterways and hydrotechnical monuments in Russia and their role in changing environmental conditions. During preparation for field studies all the maps and textual materials relating to the construction and design of the ancient hydrotechnical systems and objects (canals, dams, dikes, watermills, bridges, etc.) were analyzed into correlation with socio-cultural and natural environment in the region. The field studies of Mariinsky and the North Dvina locked systems, of Ladoga and Onega channels, of lakes and canals system of the Greater Solovetsky Island and of Belozersk-Onega portage waterway were carried out. All materials received during the research expedition are processed and published.

Historical, cultural and spiritual heritage monuments are not a «point» objects detached from their natural environment. Moreover, they form a coherent whole with the surrounding nature and constitute a special kind of landscape - a landscape-historical complexes. In addition to natural and anthropogenically transformed components of morphological structure, they include cultural elements, the so-called «anthropogenic layer of landscape ». Consequently, the multiple-aspect analysis of the waterway history is subject and methodological basis of research. The traditional historical and scientific examination of the hydrotechnical monument is complemented by geographical, landscape and environmental studies. Study of landscape structure and his influence on water system were performed by methods of dendrochronology and spore and pollen analysis.

North Dvina water system including the lake-river systems connected by channels with hydrotechnical monuments represents the striking example of landscape-historical and cultural complex. During field studies following major works were conducted: mapping of the current state of the water system, making of a vector (digital) map of entire research area (with the method of visual interpretation and retrospective analysis of old maps and satellite data), specifying geographical coordinates of water objects with a view to detect changes in the water. Detailed descriptions and measurements of hydrotechnical monuments are carried out, their location clarified prepared by the registration and identification card sites for possible future restoration or reconstruction. Studies of disrupted and operational hydrotechnical constructions revealed their dual role in the social context: as a technical object that has governed the economic development of the region, and as an object of the history of technology, contributing to cultural development.

Regular Session T10
International Scientific Exchange

THE RESEARCH ON RADIOACTIVITY IN PORTUGAL AND THE *INSTITUT CURIE DU RADIUM*

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Between 1925 and 1938 four Portuguese scientists worked in the *Institut du Radium*, with Marie Curie and her team. These researchers got their PhD in Paris, and there, they published papers in several domains of radioactivity and nuclear physics. Crossing information about those researchers, in the Curie's archives and in the Portuguese ones, it would can be possible to clarify some aspects of the collaboration among the *Institut du Radium* and the foreign scientific institutions like the Portuguese Universities.

Even though all the four Portuguese had a similar scientific beginning at *Institut du Radium*, their activities and careers were very different after their returning to Portugal. It is important to characterize these differences in order to understand the development of the scientific research in Portugal, as well as the role of the several institutions which participated in that development.

Radioactivity became a prestigious theme of research in the 20's and the *Institut du Radium* was an international symbol of that research. Perhaps this is why the history of the Portuguese scientific activity in the 20th century is deeply connected with the theme and with the Institute. The scientific life of the four Portuguese researchers who worked in the *Institut du Radium* would can allow get some conclusions about the evolution of the Portuguese Universities and its relationship with research activity in the 20th century.

In conclusion, the aims of this work are mainly to understand:

1. The collaboration between the *Institut du Radium* and the Portuguese institutions of teaching and research.
2. The role of the research in radioactivity in Portuguese science.
3. The evolution of the researchers who had been training at the *Institut du Radium*

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THE MOSCOW COLLOQUIUM ON ELECTROENCEPHALOGRAPHY OF HIGHER NERVOUS ACTIVITY (1958) AND ITS IMPACT ON INTERNATIONAL BRAIN RESEARCH

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Late 1950s was a period of recognition of Russian neurophysiology by international neuroscience community and vice versa. This process of "opening windows in both directions" might be illustrated by *The Moscow Colloquium on Electroencephalography of Higher Nervous Activity*.

The paper is based on unpublished records of international contacts of Soviet neurophysiologists and organization of the Moscow Colloquium from the Archive of Russian Academy of Science (ARAN), reports in Soviet periodicals, publications in Festschriften etc.

The Colloquium took place on October 6-11, 1958 at the House of Scientists in Moscow. It was organized by Academy of Sciences of USSR under the initiative of the Institute for Higher Nervous Activity and focused at: 1) EEG correlates of cortical excitation and inhibition; 2) electrophysiological study of different brain structures and their role in conditioned reflexes and 3) EEG of higher nervous activity in humans.

There were 46 participants from 17 countries who delivered 29 talks during 10 sessions. At the final session it was suggested to launch an International Year for Study of Brain and to ask UNESCO for international coordination of brain research. This resulted into the International Brain Research Organization (IBRO) founded in 1960.

CONSERVATION SCIENCE IN CONTEXT: HUMPHRY DAVY AND THE HERCULANEUM PAPYRI

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Much has been written about the relations of science to various practical technologies, such as the steam engine, electrification and chemical engineering. However, comparatively little has been written about the role of science in conserving buildings, objects, manuscripts and the like. Yet this is now a major part of curatorial activity in libraries, archives and museums. This paper will discuss one of the earliest examples of conservation science in its political and cultural settings.

Following the restoration of the Bourbons to the Neapolitan throne, Ferdinand IV/I sent a number of 1st century AD papyri that had been excavated in Herculaneum to his fellow sovereigns in gratitude for their help in regaining his kingdom. Among the recipients was the Prince Regent in England. He wanted to unroll the papyri and formed a high level committee one of whose members was the chemist Humphry Davy. Previously papyri had been unrolled mechanically which subjected them to damage. Davy proposed a chemical means of unrolling which looked as if it might be successful. He consequently worked in Naples on the papyri and the Prince Regent also sent a classical scholar to read what Davy had revealed. This led to a massive argument as to who 'owned' the cultural property produced and ultimately forced Davy's departure from Naples in 1820. Thus conservation science is not simply about applying science, but is intimately related to the nature of cultural exchange which then, as now, can produce acute problems of national identity.

THE INTERNATIONAL COMMISSION ON MATHEMATICAL INSTRUCTION (ICMI) THE ITALIAN CONTRIBUTION FROM THE FOUNDING TO THE 1950s

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The ICMI was created in 1908 in Rome during the IV International Congress of Mathematicians (ICM). Its first president was Felix Klein, eminent mathematician and promoter of significant reforms in the teaching of mathematics in Germany. Eighteen countries from all over the world joined, including Italy, whose delegates were Guido Castelnuovo, Federigo Enriques and Giovanni Vailati. The choice of delegates was not surprising: Castelnuovo was among the organizers of the Congress and a member (as was Enriques) of the renowned Italian school of algebraic geometry. Above all, both Castelnuovo and Enriques shared Klein's ways of conceiving research as well as of teaching mathematics. The choice of Vailati as a delegate was also a natural one, because at the time he was engaged in the project to reform Italian secondary school, and Klein was one of his points of reference.

The initial goal of the Commission was to "promote an inquiry and publish a general report on current trends in secondary teaching of mathematics in the various countries". Since its founding, the ICMI has gone through successive periods (cf. http://www.icmihistory.unito.it/timeline.php) of more or less intense activity (connected with the dramatic events of the first half of the twentieth century) before arriving to the end of the 1960s, when it experienced a veritable renaissance based on new aims and work methodologies:

- *Foundation and early period up to World War I.* During this phase, justly called the "Klein Era", an important international network of national subcommittees was established for the preparation of reports on the state of mathematical instruction as well as on thematic issues.
- *Crisis and dissolution in 1920-21 and ephemeral rebirth between the two World Wars***.** The ICMI, reconstituted during the ICM in Bologna (1928), was not able to produce new ideas and projects, and was limited to carrying out the old agenda, until WWII forced a second arrest of activities.
- *The rebirth in 1952 as a permanent sub-commission of the IMU***.** With difficulty, the ICMI defined its structure and established fruitful collaborations (OEEC, UNESCO, CIEAEM), which led to a greater internationalism and to a broadening of the lines of research and new approaches to mathematics education.
- *The Renaissance in the late 1960s and the projection into the future***.** This phase was dominated by Hans Freudenthal, a charismatic figure whose broad mathematical knowledge was joined to a profound interest in culture. He had a particular talent for organisation and the independent spirit necessary to mark a turning point in ICMI activities.

- *Important changes in the relationship between mathematicians and mathematics educators during the last decades.* As a result of recent fundamental revisions (ICME 2006, Madrid) of the infrastructure and governance of ICMI, responsibility for the election of the Executive Committee falls to the ICMI General Assembly.

In my talk I will illustrate the Italian contribution to ICMI activities from 1908 to the early 1950s, when the *Commissione Italiana per l'Insegnamento della Matematica*, was created, focusing on the following points: the most relevant figures (Castelnuovo, Enriques, Ascoli, etc.), with particular emphasis on their ideas on the teaching of mathematics and their various initiatives in Education; the reports on the inquiries (cf. http://www.icmihistory.unito.it/questionnaire.php) of the early periods and the influence on the school reforms in Italy; the political role of Salvatore Pincherle, IMU President, in re-establishing International collaboration in 1928; the genesis of *Commissione Italiana per l'Insegnamento della Matematica.*

THE BRAZIL-GERMANY RELATIONS IN THE CONTEXT OF PSYCHIATRY

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The present paper examines the impact generated by the German medical-scientific movement in Brazil in the first quarter of the 20th century. It analyzes, also, the efforts by Brazilian psychiatry in Europe in its quest for international recognition. This way, the paper intends to show to what extent this reciprocal motion was significant for Germany to achieve its goals of scientific and economic hegemony in Latin America.

From the 1920s, several initiatives were put into practice by the German medical and scientific community in relation to Latin America, including that of the Hamburg Medical Journal; the Society of Friends of the Marine and Tropical Institute of Hamburg; the Ibero-Germanic Medical Societies; and, in Hamburg and Berlin, specific courses were given in spanish for Latin American students (Sá e Silva, 2007). Moreover, doctors from Latin America were invited to disseminate their researches at institutes and universities in Germany. It is important to emphasize that this movement was accompanied by the German pharmaceutical industry.

A topic stressed in this paper is the role played by some key figures of this movement: among German psychiatrists seeking to disseminate their views to the Brazilian physicians, is easy to point out Flechsig, Frankel, Rohleder, Weil, among others; among the Brazilians Artur Ramos, Renato Kehl, Juliano Moreira and Afrânio Peixoto stand out as respectable figures in scientific circles that published in Brazilian and European magazines, participating in international scientific societies and committees. In special, Juliano Moreira is focused, since he actively competed for the entry of the German teorical model and care in Brazil, between 1903 and 1930.

Thus, the period considered by this workl is framed between the period of Juliano Moreira's Direction of the Mental Assistance in Brazil (1903-1930), as well as the period of the edition of the *Medical Journal of Hamburg*, German publication founded in 1920 which was the first agent of the process and main vehicle to align the German medical science with the Latin American public and that was published until 1938.

INTERNATIONAL EUGENICS: REEXAMINING THE RELATIONSHIP BETWEEN BRITISH AND GERMAN EUGENICISTS PRIOR TO THE SECOND WORLD WAR

Bradley W. Hart

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After 1933, Adolf Hitler's Nazi government began to implement public health policies in Germany based loosely in the ideas of eugenics and racial hygiene. The first legislation of this type was the so-called "Sterilization Act" that mandated the compulsory sterilization of individuals deemed to be carriers and potential transmitters of hereditary illness. However, the idea of sterilizing the "unfit" did not originate in Germany, and throughout the 1920s and 1930s many medical and public health professionals in a large number of countries had advocated similar measures.

One of the most important groups that supported sterilization of the so-called unfit, on a voluntary or compulsory basis, were the eugenicists. Originating with British polymath Francis Galton's teachings in the late 19th century, eugenics sought the improvement of "the race" by controlling human reproduction. By the early 20th century, eugenics was openly discussed in most Western nations, and eugenics societies sought the passage of eugenics-based legislation including sterilization. However, as Daniel Kevles has observed in his important work on the Anglo-American eugenics movement, in the 1920s and 1930s a new breed of eugenics oriented toward less Draconian means of population control, such as developing and encouraging the use of reliable birth control, rather than compulsory measures, largely took control of the movement. In Kevles' narrative, the dominance of these largely younger eugenicists after the mid-1930s led to a decline in the importance of the concept of race within the movement and positioned eugenics in Britain to reject overtures by their German counterparts after the rise of the Nazis and the introduction of compulsory sterilization.

However, a close examination of British perceptions of Nazi population policy after 1933 erodes Kevles' thesis that the British movement took a new direction thanks to the influence of the "reform" faction. In reality, even the eugenicists who are considered to be the paradigm examples of these reformers were largely enamored with the example of Nazi Germany in the early days and seem to have only avoided a full-fledged endorsement of its policies out of public relations considerations. Accordingly, this paper shall examine these perceptions to examine the international transmission of eugenics ideals in the years prior to the Second War and argue that the international eugenics movement was more ideologically harmonious than scholars have previously believed. The relation between science and power shall also be examined, as the Nazis provided the eugenics movement with its first true political champions, only to appropriate its tenets for unrelated and unscientific ideological purposes. Within the context of international movements, eugenics must be recognized as a truly transnational scientific discourse that fundamentally reflected views about the nature and value of humanity that had far-reaching consequences in the Second World War and beyond.

Regular Session T11
Scientific and Technical Museums

A COLLECTIONS DEVELOPMENT STRATEGY: SELECTING ARTIFACTS FOR THE INTERPRETATION OF CANADIAN AGRICULTURAL SCIENCE AND TECHNOLOGY

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The Canada Agriculture Museums mandate is the interpretation of the role played by science and technology in Canadian agriculture. In order for this to be possible the museums curatorial staff need to undertake several levels of research all aimed at guiding the development of a collection of artifacts with which to explain what for most visitors is a very foreign topic. This presentation will outline the types of research projects undertaken and will show how that work results in a collection with which we successfully describe what was/is going on in the lab, barn and field.

NATIONAL TECHNICAL MUSEUM IN PRAGUE FOR THE FUTURE: RECONSTRUCTION OF HISTORICAL BUILDINGS AND NEW EXHIBITIONS, THE PROJECT

Ivana Lorencova

National Technical Museum, Prague, Czech Republic

Reconstruction of historical Buildings and New Exhibitions

The National Technical Museum (NTM) is a memorial institution assembling collections of material evidence of the development of technology, industry, transport and architecture, particularly from the territory of the Czech Republic and it has a status of the central museum of the Czech Republic and the scientific institution with the documentation, presentation, methodological, and information functions. In the period 2008 – 2010 celebrations of the centenary of its foundation await the museum. On this occasion a special reminiscence exhibition, Story of the National Technical Museum, will be opened. Since the end of 2006, the museum has been closed to the public, for its building is undergoing demanding reconstruction. The NTM itself was established in 1908 under the name Technical Museum of the Czech Kingdom. The present building was realized in 1938–1942 and it is one of the most successful examples of a modern museum building in the Czech Republic (architect prof. dr. arch. Milan Babuska). The building was designed in the style of later functionalism. In September 2008, the second stage of the long-term reconstruction was completed. The result of this will be reconstructed premises for the entrance hall, permanent exhibitions, exhibition and conference halls, offices, operating and technical premises. Particular exhibitions will be completed during 2009 – 2010. Availability of all displays and exhibitions to the public is planned by 2010: specific permanent exhibitions (*Transport, Mining, Photography and Cinema, Printing, Communications, Technology in Everyday Life, Astronomy* and *Architecture and Civil Enginering*) and exhibition Story of the National Technical Museum. The management of NTM together with teams of specialists works on the creation of new museum programmes.

The Architectural Heritage Centre Project

The aim of the project is to link two currently underused, but significant units of tangible cultural heritage – the collected items of historical architecture and unused buildings at the National cultural monument´s site in Plasy – for the purpose of protecting them, permanently preserving them, making them accessible to the public and, primarily, using them for education and research. The Architectural Heritage Centre will have several parts, especially following: the study depositary with a reference collection of historical building materials, elements and structures, the school for historical building trades, which basis will be courses and training designed as additional study areas for practising tradesmen, partially for the professional public. The centre will also provide space for conferences, seminars and workshops. The part of its activities will be develop its own publication activities and create the basis for deeper scientific and research activities in related areas.

POLITICAL AND CULTURAL GROUNDS AS DRIVING FORCE OF SOVIET BROADCASTING TECHNOLOGIES («BROADCASTING» EXPOSITION IN THE A.S.POPOV CENTRAL MUSEUM OF COMMUNICATION, RUSSIA)

Borisova N.A.

The A.S.Popov Central Museum of Communication, Russia

The report is about an initial stage of the broadcasting development (between the First and the Second World War).

Overall objective of the museum exposition called “Broadcasting” is to demonstrate technological means evolution, to tell the story about people, whose contribution to the domestic broadcasting is considerable. But it is impossible without the reference to political and cultural history. Separate mass media occurred in historical process owing to interference of two factors: social factor caused by expansion of information requirements of a society and technology factor. The report tells about this interrelation in a museum exposition (the A.S.Popov Central Museum of Communication, Russia, St.-Petersburg).

The history of Russian broadcasting began during October revolution (1917), then there was civil war, then the period of the national economy restoration. The first radiotelephone message (a voice, instead of the Morse code!) sounded on air on February, 27th, 1919 – «Hello, Nizhniy Novgorod laboratory speaking». On the one hand, it was a success. But with another this message has been sent on air by means of the arc generator. The further experiences proved that working with it was hopeless. New technological decisions were necessary for the further development of broadcasting.

The powerful stimulus at the state level was needed for acceleration of the regular broadcasting beginning. Such stimulus was the decision of USSR Council of National Commissioners from July, 28th, 1924 «About private reception radio stations». Private users were authorized to have reception radio devices, and radio amateur - to design radio receivers. Earlier similar business was considered to be illegal. Besides, this decision stimulated expansion of industrial manufacture of broadcasting receivers.

Regular broadcasting began on October, 12th, 1924 at 12 o’clock in the afternoon (through Sokolnichesky radio station). It was the report «V.I.Lenin’s role in development of the Soviet radio engineering and problems of the worker radio amateurishness». Then the radio station builder A.L.Mints made the message on the technician of broadcasting. After a break the concert of the Moscow State Conservatory took place. Since then broadcasting had been conducted regularly according to a strict schedule which had been published in advance in newspapers.

Requirements of mass media, propagation stimulated intensive development of on broadcasting technological means.

The report tells about powerful radio transmitters, broadcasting network not only in Soviet Union huge territory, but also abroad. Images of the museum pieces (the equipment of rural relaying systems, street loudspeakers, receivers of a wire broadcasting etc.) show wire broadcasting development.

An interesting museum piece is mentioned in the end of the report. This device is called “speaking paper”. It is an analogue of the tape recorder which had not been invented at that time. Industrial manufacture of “speaking paper» began in the Soviet Union before the Second World War. This device was to become a conductor of culture and political ideas in the most remote areas of a huge country. Arias from the operas on a paper tape are kept in the museum archive. The device ”Speaking paper" is in working order. It is possible to hear to arias from operas. This device is at the international exhibition in Austria now.

EARLY HISTORY OF THE GEOLOGICAL MUSEUM OF CHINA: WITNESS OF THE EARLY DEVELOPMENT OF GEOLOGICAL WORK IN CHINA

Cao Xiping

Geological Museum of China, China

Zhang Erping

National Geological Library of China, China

Geological work by Chinese central government started in 1912, when there was only one geologist working in the government organization. In 1913, the National Geological Survey of China (NGSC), with one staff member, together with a geological school was established, which is now recognized as the most important step toward the start of geological work in China and the preparation period of the Geological Museum of China (GMC). After three years of study, the school had collected a large number of specimens during field practice. On July 14, 1916, the school celebrated the graduation of its first students, and a geological exhibition with 917 specimens was held. Most of the graduates went to NGSC, and formed the first push of the geological work in China. The geological exhibition became the museum of NGSC later. It has lasted, survived World War II and the Chinese Civil War, and developed into the present GMC.

The first Director of the Museum was Ding Wenjiang (V.K. Ting), who studied geology in the University of Glasgow in Scotland, United Kingdom, and came back to China in 1911. The second Director was Weng Wenhao (W.H. Wong), who obtained doctor's degree on geology from the , , in . The third Director was Johan Gunnar Andersson, , , , used to served as the Director of Sweden's National Geological Survey, and was invited to in 1914.

Many interesting exhibitions were held by the Museum in its early days. They include the exhibition in 1922 about the first discovery of prehistoric site in China, the exhibition in 1930 about the first discovery of Peking Man's skull, etc.. These exhibitions demonstrated some of the early studies by NGSC.

SCIENCE AND TECHNOLOGY MUSEUMS AND ARCHIVES - A JOINT STUDY OF FUNDS FOR OBTAINING NEW INFORMATION (ON THE EXAMPLE OF THE HISTORY OF PHOTOGRAPHY IN THE FUNDS OF RUSSIA AND FRANCE)

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The invention of photography, one of the greatest discoveries in the history of culture, dates from 1839, when a Frenchman, Jacques Mandé Louis Daguerre, announced the results of his works, based of long standing studies of Joseph Nicéphore Niépce, and have demonstrated the first pictures. Approximately on the same time, the results of making photographic images on method of British inventor, William Fox Talbot, became known.

Both methods and its use in practice were under investigation of a Russian scientist, Academician of the St. Petersburg Academy of Science, Joseph Hamel. As already then there was a question of priority in the invention of photography, so Joseph Hamel has decided to consider all circumstances of the above mentioned opening to establish the truth. The son of Nicéphore Niépce, Issidor, who was a friend of Hamel, has transferred to him numerous of manuscripts - letters, notes, agreements, and other documents. Unfortunately, Hamel was unable to carry out his plan , and after his death all these documents were transported into the archive of the St. Petersburg (Russian) Academy of Sciences.

In the late twenties of the last century an attempt has been undertaken to study and publish those documents. The Second World War has interrupted this work. After the War, In 1949, the scholars from the USSR Academy of Sciences archive had prepared and published, in French and Russian, one volume of correspondence between French inventors of photography, as well as other documents from the Hamel's archive. However, during this period the USSR State Authority pursue a policy of isolation of domestic Russian science from the world; publications in foreign languages were forbidden, so the whole edition of the book (except a few copies) was destroyed.

Only lately these documents became known to the Nicéphore Niépce Museum of Photography (Shalon, France), and supplemented its exposition, giving the opportunity to get some new information about the photography invention. Possibility is now considered to prepare joint Russian – French project on re-publication of documents mentioned, with use of funds of the Russian Academy of Sciences archives and of French funds, in particular the funds of Nicéphore Niépce Museum of Photography.

ENGINES AND SOCIETY: MUSEOLOGICAL INTERPRETATION OF INDUSTRIAL HERITAGE

Munoz, Joan & Vallmitjana, Santiago

Museu de la Ciencia i de la Tecnica de Catalunya (mNACTEC) & Universitat de Barcelona, Departament de Física Aplicada i Optica

The Science and Technique Museum of Catalonia (mNACTEC) has created the "Gas and Oil: Fossils Energies" exhibition, which explains the origins, research, marketing and use of energy from fossil fuels. In this communication we talk about the multimedia resources used to explain the relationship between engines and society to improve the visitor's knowledge.

The exhibition Gas and Oil: Fossils Energy covers an area of 600 m2 and uses museological resources focused on the practical and everyday applications of the different energy sources, above all with regard to the relationship between the use of a specific energy resource and its environmental and social impact. Real, interactive models, information boards and working mechanisms the public can operate are used to achieve this aim and to aid understanding of the entire exhibition's concept.

The information is presented at different reading levels making use of various museological resources to adapt the exhibition to the general public. The introduction of interactive models is used as a museological resource that, in some cases, aids the understanding of a mechanism and, simulates their relationship with concepts.

The aim of this report is to explain the relation between eight real engines shown in the exhibition and the museological resources created to aid the understanding of how exhibited engines work. The eight original engines are: Escuder, Wankel, Crossley, Sulzer, Petters, Sirio, Gasification and Four-Stroke. For example, Escuder engine is the first internal combustion engine that was made in Spain, in the city of Terrassa, in 1879 and Sulzer engine is the first diesel engine made in a production line in the year 1922 by a Winthertur company.

The multimedia museological actions located in the Gas and Oil: Fossils Energy exhibition are at the same time in a virtual version in www.mnactec.cat. All the interactive devices have been setup using photographs of the original engines.

TABLE TOP PHYSICS: OLD SCIENCE, NEW AUDIENCE

Jane Wess

The Science Museum, London

An exhibition characterizing 19th century physics has recently been proposed at The Science Museum, London, and a case of objects has been displayed as a taster for prospective funders. The presentation of this topic has thrown up some interesting questions and tensions, both concerning the development of the subject and its portrayal to a lay audience.

Firstly, in what sense can physics be characterized holistically in this period? To what extent do we take into account the moving away from natural philosophy and the establishment of a recognized discipline, which arguably only occurred in the third quarter of the century? Can we include demonstrations of appealing, but relatively early instruments such as the kaleidoscope and stereoscope and maintain rigour? If we are primarily contrasting physics now and then, is it also possible to show development during the 19th century or should we take a 'vista' approach?

Essentially, what are the salient characteristics of 19th century physics, as opposed to physics now, that can best be utilized to engage a 21st century audience? The exhibition, as revealed by the title 'Table Top Physics', has focused on the scale as being a feature which can be easily comprehended. The intimate, tangible aspect of the apparatus allowed a more immediate communication than the physics of today. Focussing on scale leads effortlessly to considerations of place and audience. The extreme conditions demanded by contemporary physics dictate its physical removal from the public sphere, so while the reliance on democratic support is constant, communication is more challenging and less immediate.

It is intended that replicas of the original instruments on display will be available for the 21st century audience to manipulate, conveying in a straightforward manner how they work. This can then be used to discuss the more profound question of how they were interpreted, and how that may differ from how we interpret them now. Can we enable our audiences to both engage with the 19th century mindset and learn something of physics as we understand it today?

THE ROLE OF SMALL TECHNICAL MUSEUMS IN PRESERVING THE CULTURAL HERITAGE

Ante and Ivan Sekso-Telento

Fortia Co. - Šibenik, Croatia

Josip Trbus

HEP ODS - Bjelovar, Croatia

Sándor Jeszenszky

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The cultural heritage of modern times includes the field of technology and industry in many aspects. Various electricity based technologies and particularly the industry of electric power systems have made a great influence on everyday life and on culture in its narrow and broader sense. It is generally accepted that electricity thorough its various common applications influenced the most on the material lifestyle, but also created a new fields of arts (film, TV etc.) and enabled great cultural dispersion. Great electric power systems through production, transmission and distribution of electrical energy to each corner of the world are considered as the most important engineering achievement of the past XX century. It is therefore strongly recommended to preserve and to study the role of early electrification in narrow technical and in broader social and cultural context.

Technical museums can be unofficially divided into two main groups: great and old technical museums and small and mostly not so old museums or technical collections. In most cases the greatest technical museums are located in capitals or main industrial towns of the world and they generally cover the huge area of various technical branches from the early times to now. Small museums or collections are popular in recent times and they usually cover much narrower field, but going much deeply into the specific technology. Second characteristics of s.c. small technical museums is their location, very often "on the site", i.e. on the location of some important old technical installation and therefore distant from great cities and located in small towns or even in villages (e.g. Museum "Strom und Leben", Recklinghausen, DE, "Tauernstrom", Kaprun, AT etc.). It must be point out that in latter-day economical crisis many small museums try to find a way of survival "under the wing" of great state museums, but again trying to maintain their specific mission.

One such example of a small and new technical museum is Technical collection "Munjara" in the small and important town of northern Croatia, in Križevci. Munjara was the first electric power plant in that region, built in connection with factory Ganz from Budapest. The building of Munjara is maintained in its original state and according to some meritorious opinions belongs to important samples of modern industrial architecture in Croatia and it is preserved as the cultural monument. Its interior is modified according to the future purpose for permanent technical exhibition of the first DC power system in the region. It is decided to establish the close collaboration with the Hungarian Museum for Electrical Engineering (now under OMM). An «Agreement on scientific cooperation» is signed recently thus enabling the care of common Hungarian-Croataian heritage in the field of power systems.

MICROSCOPE HISTORY VIRTUAL MUSEUM

Koltovoy Nikolay

Labmetod, Russia

It was created "Microscope History Data Base". It was collected images of antique and new microscopes from difference firms, from difference country.

It is –Virtual Museum of Microscope History, Virtual Microscope Collections.

Time interval: from 1619 to 2008.

Country: Australia, Austria, Belarus, Canada, China, Czech, Denmark, England, France, Germany, Holland, Hungary, India, Italy, Japan, Poland, Russia, Spain, Sweden, Switzerland, Ukraine, USA.

It is 32.000 images for 18.000 microscopes in database.

No.	Country	Firms (Makers)	Microscopes
1	Germany	195	3.370
2	England	303	2.604
3	USA	155	2.298
4	Japan	124	1.491
5	Russia	24	809
6	France	91	777
7	China	21	469
8	Austria	10	348
9	Italy	22	184
10	Holland	29	154
11	India	10	134
12	Czech	7	85
Total			18.000

Firms:

1-Leitz (Germany)– 912 microscopes,

2-Zeiss (Germany)– 839 microscopes,

3-Baush&Lomb (USA)- 460 microscopes,

4-LOMO (Russia) – 402 microscopes,

5-AO/Spencer (USA)- 348

6-Nikon (Japan)– 339 microscopes,

7-Olympus (Japan)– 304 microscopes.

8-Reichert (Austria) – 282

9-Watson (UK) – 183

10-Nachet (France) – 174

11-Swift&Sons (UK) - 128

Database include next fields:

1-Country, 2-Town, 3-Firms (makers), 4-Model of microscope, 5- Serial Numbers of microscope, 6- Yeas of productions, 7-Some images of microscopes.

Regular Session T12
The Formation of Scientific Languages

THE DEVELOPMENT OF SYMBOLIC LANGUAGES IN THE FIELD OF LOGIC (1854-1903)

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In the second half of the nineteenth century, the theory of logic knew important developments in Britain thanks to the work of the mathematicians George Boole (1815-1864) and Augustus de Morgan (1806-1871), and their immediate followers, William S. Jevons (1835-1882), John Venn (1834-1923) and Lewis Carroll (1832-1898). In effect, they introduced a symbolical approach to the subject that made logic closer to mathematics, although it was still an important part of philosophical inquiry. This new approach allowed logicians to make theoretical choices on their convenience in order to simplify their logical systems and even to abandon the common use in natural languages.

Between the publication of Boole's *Laws of Thought* (1854) and Bertrand Russell's *Principles of Mathematics* (1903), several symbolic languages were introduced by different authors, each supporting a distinct logical theory. This plurality made the communication between these authors more complicated and led to several misunderstandings, in addition to the gap that aroused between mathematically-oriented logicians and traditional (philosophically-oriented) logicians. In this presentation, we will discuss the usefulness of this symbolic approach and how these languages co-existed within the British logic community until a standard symbolic language was adopted gradually after Russell's work at the beginning of the twentieth century.

THE BIRTH OF THE MEDIAEVAL HEBREW MATHEMATICAL LANGUAGE

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In my talk I will describe the interesting process by which Hebrew mathematical language was created, during the Renaissance of the 12th century. By this time Hebrew was no longer a language used solely for religious purposes but also became a language of science. New historical circumstances and social processes led to this new dimension of Hebrew. Abraham Bar Hiyya and Abraham Ibn Ezra were the key contributors to medieval Hebrew mathematical language. I will describe their very different philological approaches to coining new mathematical words and the role that the Arabic language played in this process for Bar Hiyya. We shall have a glimpse into some of these mathematical terms and describe their formation.

MEDICINE AND THE NATIONAL LANGUAGES IN THE HABSBURG MONARCHY (1770-1830)

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Transylvania, a small province of the Habsburg Monarchy , had a very complex cultural, ethnic and religious back ground. The population was using Hungarian, German, and Romanian, beside Latin which was the official language of the administration. A feverish activity of book production and translations was characteristic of the period. There was a wide range of printing that included original scientific and medical books, translations of all sorts. This presentation looks at the way in which Romanian medical language was shaped and enriched in the process of translation. In this enterprise several actors were involved: the state authorities, nobles and intellectuals (scientists, physicians, and priests), each one with a different agenda. Some of the translators and publishers were members of a new social stratum of literati, belonging to a growing species of cultural mediators. They contributed not only to the enrichment of their national languages but also to the national self-assertion on the part of the translators.

My Transylvanian case study (drawing on translations from Latin, German and Hungarian into Romanian, accounts of the translators, their letters and some secondary literature) intends to highlight the way in which the translation and /or the production of scientific knowledge helped to the 'construction' of the national languages. Thus, it promises insights into the mechanisms through which medical and scientific achievements were used to build a national identity.

SEMANTIC REFLECTIVENESS IN DEVELOPING ENGLISH PHARMACEUTICAL TERMINOLOGY

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Having known as one of the most receptive languages in the world, the English language has developed many of its semantic aspects due to borrowing terms and expressions from other languages. Many English dictionaries provided evidences in accepting loans from various languages to create its sematic nucleus or derivatives for general vocabulary or scientific terminologies. Pharmaceutical terminology developed on a huge historical background associating social and economic aspects that interfered with a lot of scientific approaches. The main objective of this paper will be to consider basic pharmaceutical terminology in the light of content verbalisation influenced by the Latin idiomatic nucleus. The analyses will be focused on the noun phrase with a special outline on the contextual reflectiveness of its verbalised part to other segments. Their restricted or extended meaning depending on the degree of detalisation will be also considered. All the examples will be organized schematically to show gradually developing process and many references to modern English pharmaceutical terms interfering with the terms of some Romanic languages will be presented.

Key words: verbalisation, reflectiveness, Latin influence, equivalence, nonequivalence, modern terminology.

Regular Session T13
The Evolution of Teaching and Public Involvement

LEARNING IN THE LAB: HIGH SCHOOL SCIENCE TEACHING IN ONTARIO, 1880-1921

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The importance of science pedagogy as a window onto the public understanding of science has been increasingly acknowledged by historians of science in recent years. The history of science teaching at the high school level, in particular, sheds light on the broader social goals of science education. In Ontario, science had achieved a secure place on the high school curriculum by 1880. Debate focused no longer on whether science warranted time on the curriculum, but rather on which scientific subjects were most valuable. Unlike the United States, which by 1880 was moving towards universal secondary education, Ontario's high schools were attended by a minority of adolescents. They remained academic in nature, with curriculum content determined largely by the University matriculation examinations. Only around 1921, in the wake of mandatory attendance legislation, did Ontario high school curriculum planners begin explicitly gearing course offerings to a more diverse student population.

Despite the officially mandated place of science on the curriculum, in practice the situation varied greatly from school to school, as evidenced by the often exasperated reports of school inspectors. In 1886, government grants became conditional upon properly equipped science laboratories. Haggling between ministry officials and school boards over the costs of scientific apparatus, building renovations, and the ensuing burden on local tax-payers led to pockets of resistance toward the encroachment of science upon an already crowded program of studies. As a result of such complaints, the teaching of chemistry in particular was given short shrift, its apparatus deemed overly complicated and expensive and its place on the curriculum negligible compared to that of physics, botany and zoology.

As the Province's universities gradually began to favour individual laboratory work, the Department of Education stressed, in turn, that high school science be taken up practically and experimentally. Meanwhile, in educational journals such as *Canadian Educational Monthly*, educators debated – seemingly in isolation from the input of practicing scientists – the best ways in which to instill in students a problem-solving method based on "experiment, observation, and inference." This paper argues that the particular confluence of factors shaping science teaching in Ontario – namely, the long reach of the provincial Department of Education and its control over local school governance; the well-entrenched academic tradition of the high schools; and the influence of a small coterie of vocal science masters – led to a series of narrowly defined pedagogical goals for high school science teaching that would remain immune to reform until the mid-1960s.

THE TEACHING OF RADIOCHEMISTRY IN PORTUGAL

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The discovery of radioactivity in 1896, influenced many changes in the fields of Physics and Chemistry, mainly regarding atomic theory, and thus affected the teaching of these subjects both at universities and secondary schools.

This communication will try to present an overview of the situation in Portugal.

KANT MEETS COMTE AMIDST INDUSTRIAL CONFUSION : THE FORMULATION OF THE IDEA OF APPLIED SCIENCE IN 19th CENTURY BRITAIN

Robert Bud

The Science Museum, UK

The concept of applied science proved enormously significant in the 19th century. It expressed the claim that science could make sense of industry and indeed of industrial change. Meinel has shown the interesting development of the concept of applied chemistry in the 18th century and Klein has looked at applied science in late 19th century America. Gerrylyn Roberts and I have shown how the concept was deployed in promoting the teaching of chemistry. This paper will show how the concept was originated, how it was promoted and how it changed in Victorian Britain.

Firstly the paper how ideas derived from Metaphysische Anfangsgründe der Naturwissenschaft by Immanuel Kant in 18th Century Königsberg were introduced to the very different context of industrial revolution England by Samuel Taylor Coleridge through the structure of the influential Encyclopedia Metropolitana. Kant had opposed an idea of ‘reine Wissenschaft’ which was as certain as knowledge could be and based on a priori principles to empirical ‘angewandte Erkenntnis’. In the *Encyclopaedia Metropolitana* Coleridge translated these two concepts into the categories of pure and applied science. In editing this influential encyclopedia between 1822 and the 1840s. Coleridge was followed by other religiously inclined editors for whom science was a way of taming the threat of industrial change and its radical social consequences. At the same time the positive philosophy of Auguste Comte became popular in England through the promotion of utilitarians whose general approach to society was quite different but whose heirachy of sciences was very similar.

The early British Association founded in 1831 was led by men such as William Whewell who had also been influenced by Kant directly and were skeptical about the new industrial world. Its sections followed a Kantian heirachy from the certainty of mechanics, via chemistry to more empirical topics and engineering. This ordering was itself important. It influenced the subject organization of the Science Museum in its seminal years of the 1880s. The influence could be seen a century later in the departmental structure.

The paper will also show how the Kantian principles of a priori and empirical get confused with the Comtian categories of theoretical and practical through for instance the work of Charles Babbage. His *Economy of Machinery and Manufactures* of 1832 (a first draft of which had appeared in the *Encyclopaedia Metropolitana*) defined applied science in a wonderfully hybrid manner. ‘The applied sciences derive their facts from experiment; but the reasonings, on which their chief utility depends, are the province of what is called abstract science.’ This understanding would underpin the development of South Kensington as a great teaching and museum centre by the utilitarians around Prince Albert, such as Cole and Playfair. They found the concept of ‘applied science’ as it is deployed by Babbage as a powerful tool for promoting science teaching as the key to industrial competence. In their hands applied science was deployed as a polemical tool once again.

“ELEMENTARY” TEXTS AS A SCIENTIFIC GENRE IN EIGHTEENTH-CENTURY FRANCE

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In the course of the eighteenth century, vast numbers of texts were published in France bearing titles such as *Éléments de…, Traité élémentaire de…, Cours de…, Leçons de…*, *Institutions de…,* or *Introduction à…*. These kinds of publications, which we might loosely call a genre, typically endeavored to present an introductory and comprehensive survey of a science or art, often with an emphasis on those concepts, principles, or skills presumed to be foundational. With the exception of a few excellent case studies and some recent work on chemical textbooks since Lavoisier, relatively little sustained scholarly attention has been paid to this genre. In general accounts of the French Enlightenment, these books are often characterized as exercises in “popularization,” and are primarily invoked to show the diffusion of Newtonian and scientific ideas among a broader reading public.

Yet these works often addressed a surprisingly wide variety of potential audiences and pursued a wide variety of aims. Although in some respects similar to the modern textbook or popular science book, they cannot be directly equated with either. For while some were clearly designed to supplement formal lectures in *collèges* or universities, others were written for the general reading public, and a great many spoke simultaneously to several different target audiences, from students, to pedagogues, to lay readers, to experts in the field. Indeed, elementary texts even occasionally served as a venue for publishing new discoveries or engaging in ongoing learned debates with colleagues, and in certain subjects like grammar or logic, they constituted one of the primary genres of publication within the field.

One conseqeunce of this plurality of audiences and aims, I suggest, is that elementary texts sometimes played an important role in shaping learned, as well as popular, perceptions about the nature of the scientific enterprise. I discuss the particular example of the abbé de Condillac (1714-1780), whose ideas about a universal "analytic method" underpinning all of the sciences and arts were widely cited in the late eighteenth century. Condillac's doctrine of method has often been attributed to his enthusiasm for contemporary developments in mathematical analysis and Newtonian physics; yet in fact Condillac learned most of what he new about the mathematical and natural sciences from elementary texts. As a result, key features of his method can be traced to some of the recurring preoccupations of these books. In particular, in claiming that scientific exposition should follow the "analytic" order of discovery, Condillac acted as a kind of spokesman for a pedagogical innovation central to a number of mid-century elementary texts by Clairaut, Maupertuis, Du Marsais, the abbé de la Chapelle, and others.

IDEAS OF MODERN NATURAL SCIENCES AS THE INSTRUMENT FOR FORMATION OF PEOPLE RATIONAL THINKING

Olga Golubjeva

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Today many public problems and prejudices become aggravated that people in the majority do not own rational thinking. Meanwhile nature studying helps not only to receive knowledge about a modern natural-science picture of Universe but also to apprehend scientific rational thinking. From this point of view such sciences as Physics, Chemistry, Biology, Cosmology, etc. should be considered as a single whole, in which the main subject of interest are the most general patterns of nature descriptions. In this case a defining role is played by mutual relations between an studied object and its environment.

For 15 years in higher education of Russia there exists the course of study "Concepts of Modern Natural Sciences». Initially it is intended for students who do not specialize in the area of natural sciences and choose liberal studies. The purpose of the given course of study consists in that to acquaint people with global concepts of the nature description on accessible level, not going into details of the concrete information. First of all among them we choose two approaches – classical which is based on ideas of a rigid determinism, and non-classical based on ideas of chance phenomena and probability.

In the frame of the classical approach we consider following concepts: nature objects modeling, regular (non-stochastic) influence of an environment on object, the entire world of events, measurement of characteristics objects. In the frame of the non-classical approach the key role is played by concepts of the stochastic influence of an environment and modeling of behavior of nature objects characteristics. These ideas generate representations about thermal and quantum states, fluctuations, correlations, spontaneous violation of symmetry in the Nature, a role of fundamental constants, self-organizing and evolution of the live and lifeless nature objects.

Now the course of study "Concepts of Modern Natural Sciences» has received so wide popularity that there is an experience of its distribution among students of engineering and natural-science specialization. We think that the given course is very useful. It develops skills of logic thinking – both within the limits of the formal alternative logic "either one – or the another" as well within the limits of the informal (non-classical) logic «and one – and the another». Besides it acquaints students with history of occurrence of some natural sciences fundamental concepts, with modern conceptual structure of knowledge about the nature, forms representations about variety and unity of the material world. The modern society suffers from orthodoxy. For its survival and progress it requires flexible rational thinking and scientific world outlook. Studying of the natural-science picture of the Universe gives them fine possibilities for its development.

MODERN MATHEMATICS AT THE CENTER FOR THE TEACHING OF SCIENCES OF BAHIA (BRAZIL), 1965-1969

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The Center for the Teaching of Sciences of Bahia (Centro de Ensino de Ciências da Bahia – CECIBA) was one of six created by Brazilian Ministry of Education in association with universities and local secretary of education of different regions of the country with the objective of bringing modern trends for secondary teaching of sciences. With support of federal resources, university professors of sciences and mathematics would develop projects for training secondary teachers for improving their class activities with modern trends of science and mathematics teaching. Originally, these Centers had sections of Physics, Biology, Chemistry and Mathematics. This paper will present the results of the historical research did on the projects developed on mathematical section of CECIBA with the goal of introducing modern mathematics for the mathematics teachers of public secondary schools of Bahia. These projects was coordinated by Omar Catunda, head of the Mathematics Department of University of Bahia, and Martha Dantas, professor of didactics of mathematics of the University of Bahia, two important leaders of Modern Mathematics Movement at Brazil and Latin America. One of the most important aspects of these projects was the teaching of geometry using transformations, carried out with textbooks of their own production, tested in experimental classes and used for in service training teachers.

Regular Session T14
Scientific Institutions - Learned Societies

ACADEMIES OF SCIENCE IN 18th-CENTURY EUROPE AND THE APPLICATION OF SCIENTIFIC METHODS ON EXPLORATION – A COMPARATIVE STUDY

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In the 18th century, exploration witnesses a growing tendency towards a systemization of the observation and registration of scientific data overseas. Explorers come under the influence of scientists who want to intervene in the practice of scientific travelling by formulating specific guidelines for field investigation.

These scientists themselves are subject of the growing demand of central state governments for verified knowledge on the utility of new discoveries in the field of geography and natural history. Exploration enters a new phase in its development and becomes the instrument of a utilitarian state directed scientific policy. Each of the imperial powers of Europe has an Academy of science or a learned society that plays a crucial role in this development. Nonetheless, we witness some remarkable differences in approach between these nations and hence between these learned societies.

In this paper I make a comparative analysis of the instruction texts addressed to explorers by the Academies of science of 18th-century Europe, from the Parisian *Académie royale des Sciences* to the *Royal Society* in London and the *Imperial Academy of Sciences* in Saint Petersburg.

ACADEMIC DRIFT AMONG SCIENTIFIC INSTITUTIONS–NECESSITY OR SERENDIPITY?

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This proposal is primarily intended for the Regular session 14. "Scientific Institutions – Learned Societies", but may of course also fit under other session titles. The concept of academic drift has been used in order to frame a more or less generally observed academization of higher engineering education at different engineering schools. (Cf. Jonathan Harwood, "Engineering Education between Science and Practice: Rethinking the Historiography", History and Technology 22 (2006), 53-79.) But the concept may be expanded to denote tendencies of scientific institutions in general to exclude others than established scientists (and university-based humanists as well as social scientists when those categories apply) at the expense of politicians, entrepreneurs, engineers and additional actors with a potential interest in knowledge formation.

Thus, I would like to propose a similar general development of academic drift among scientific academies and learned societies more generally. Admittedly, many scientific academies and societies established in a variety of primarily European countries in the 17th and 18th centuries were founded in very dissimilar institutional environments and with a range of intentions. Nevertheless, creating an alternative to existing organizations for knowledge production and diffusion, i.e. universities, was often a feature in common for academies such as the Royal Society in London and Academie des Sciences in Paris. But from originally housing a mix of what we today would call entrepreneurs, natural philosophers, politicians etc., scientific academies have since then drifted towards more or less exclusively select and appoint their members from a small scientific elite with a shrinking group of members having complementary backgrounds. In this sense, many of the scientific academies founded in the 17th and 18th centuries have been subject to academic drift.

Of course, the dynamics of this process have been very different when comparing academies and learned societies in different countries, for instance in terms of speed and intensity. Nevertheless, the notion of academic drift seems suitable to describe developments generally. In this paper, I will explore the underlying mechanisms for academic drift such as the different procedures developed for the election or selection of members as well as the influence of financers in cases when a society cannot rely on their own resources solely. In addition, I will also point out that this observation may be generalized beyond academies and learned societies to a wide-ranging set of so-called knowledge intermediaries, i.e. organizations aiming to transfer knowledge between knowledge producers and potential knowledge users. The same pattern of academic drift can namely be observed among research institutes founded in the 20th century as well as the already mentioned engineering schools established for professional training of the 19th century, both often established in order to function as knowledge intermediaries with a potential capacity to transfer knowledge.

THE MISSING LINK IN SCIENCE COMMUNICATION: THE ROLE OF LEARNED SOCIETIES AND POPULAR JOURNALS

Jørgen Burchardt

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Academic societies and popular journals have been and are important players in the communication process. In the future, they likely will continue to fulfill this role, but they will also likely change into new forms.

Academic societies and popular scientific journals, which are often edited and written by researchers themselves, play an important role in scientific communication. These two entities acting as communication channels provide two-way communication among practitioners in private companies, public groups, and interested citizens. However, the established channels vary greatly depending on the related academic field. Academic societies are very well established in the field of medicine, rather strong within the technical area, and quite loose in the fields associated with humanities and social sciences.

Communication found in popular journals often has two distinct different profiles. The journals associate with the science-technical-medical (STM) area often employ “translators” (i.e., journalists) to make the science more understandable to the average reader, whereas researchers in humanities and social sciences often write directly to the educated citizen themselves.

My research corresponds with the theories of the Italian researcher Massimiano Bucchi. His work is detailed in his book *Science in Society: An Introduction to Social Studies of Science*; in this and other works, he discussed the food chain from universities to society. Based on these theories I will look at the present development influenced by globalization, the use of internet, and other current developments.

I am an engineer and an anthropologist, and over the last several years, I have worked with technological development, knowledge, and management within industry and transport. Currently, I work as a senior researcher for the Danish National Museum for Science and Technology.

In addition to my own research, through the years I have worked within science communication as an editor for some international and national academic journals. Within Nordic countries, I am considered a pioneer based on my work with the use of the Internet through my work for the Nordic Councils of Ministers in 1991, and I implemented the first open access for a Danish peer-reviewed journal 1999/2001.

The presentation will be based on my three books from last year - a white paper about Danish research dissemination based on a detailed analysis of the communication channels for researchers at universities in Denmark. This research was sponsored by the Ministry of Science, Technology, and Innovation through DEFF (partner in Knowledge Exchange together with JISC).

SAINT-PETERSBURG ACADEMY OF SCIENCES IN 1855–1917: PROJECTS OF REFORM

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A series of projects were undertaken to reform the Imperial Academy of sciences: in 1856–1857, 1864–1866, 1890–1891, 1901–1902. These plans called for revision of the statutes confirmed in 1836.

The main points under discussion were as follows:

1. **Purpose and functions of Saint-Petersburg Academy of sciences**.

According to the statutes of the 1836 Academy of Sciences was designed to perform three major tasks, namely, to conduct scientific investigation, to implement the scientific results, as well as to disseminate enlightment while spreading knowledge and culture among the people In the projects of new statutes the enlightenment was not anymore considered Academy’s duty; its activity was restricted to fundamental research and its practical development.

2. **Structure of Saint-Petersburg Academy of Sciences**

The occurred since 1836 principle changes in the Academy’s structure were embodied in projects of new statutes: division into three classes (1841), foundation of the department of *belles letters* (1899); widened network of scientific institutions and specialities. There was also discussed the question of joining together Russian Language Department with History and Philology Department.

3. **List of members of staff at Saint-Petersburg Academy if Sciences**

Some projects cancelled the rank of adjunct and extraordinary academician with only the rank of ordinary academician remaining, and a new rank of honorary academician being introduced. There was also reviewed the order of elections.

4. **Correlation of the national and international**

An important tendency of transition from international in its membership to the national Academy of Sciences found its reflection in the projects. There were discussed the questions of assigning the name 'Russian' to the Academy of Sciences, of the principal language for academic publications. Russia was introduces as a subject of Academic scientific interest and research.

The actual reorganization of the Emperor's Academy of Sciences was conducted without radical breaking in the statutes and was finished in 1917, when it was renamed into Russian Academy of Sciences and the academician A.P. Karpinsky was elected its first president. By the time principal equality for all full members had been declared, new specialities were introduced, the number of academic institutions was extended, the financing increased. The major principals of academic life stayed unchanged and immune.

ÉCOLE POLYTECHNIQUE DE LISBONNE *VERSUS* ÉCOLE POLYTECHNIQUE DE PARIS

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Au XIX[ème] siècle l'évolution de l'enseignement en France a eu des répercussions considérables au Portugal, en particulier dans le cas de la formation scientifique, et surtout en ce qui concerne celle des ingénieurs et des ingénieurs-militaires.

Dans ce travail on étudie les ressemblances et les différences entre l'École Polytechnique de Paris, crée par le Ministère de la Défense français en 1794, et celle de Lisbonne, crée par le Ministère de la Guerre portugais en 1837.

En France, l'enseignement de l'École Polytechnique était conçu pour former les futurs cadres militaires ou des corps de l'État. Le but de l'École Polytechnique de Lisbonne était aussi celui de préparer les étudiants pour fréquenter les Écoles de l'Armée et de la Marine, mais les connaissances y acquises envisageaient, au même temps, une formation supérieure dans plusieurs domaines scientifiques donnant accès au métier d'ingénieur.

À fin de caractériser les ressemblances des deux Écoles on analysera les manuelles qui ont servi comme modèle dans l'École Polytechnique de Lisbonne, ainsi que plusieurs publications qui continuent à exister dans la Bibliothèque du Musée des Sciences de l'Université de Lisbonne, telles que les *Comptes Rendues*, et aussi l'Histoire *et Mémoires de l'Académie des Sciences de Paris*, et encore le *Journal de l'École Polytechnique*.

Dans cet étude on tachera de obtenir des conclusions concernant les affinités des institutions d'enseignement des deux pays, ainsi que des ressemblances d'un ordre plus général relatives à l'influence du paradigme français dans la culture scientifique du Portugal.

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THE ROLE OF THE JAPANESE CULTURAL BACKGROUND IN THE FORMATION OF ENGINEERING EDUCATION: IN THE CASE OF THE IMPERIAL COLLEGE OF ENGINEERING, 1871-1886

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After the Tokugawa shogunate opened the country to the rest of the world in the 1850s, Japan aggressively absorbed knowledge from the West through its foreign employees and students it sent abroad. One of the typical institutions that promoted Westernization was the Imperial College of Engineering (ICE) in Tokyo, founded in 1871. I focus specifically on the cultural and political backgrounds of the Japanese participants during the development of the ICE. In particular, I am interested in how non-engineering factors affected the development of engineering education in early Meiji Japan.

This paper argues that the Japanese cultural background, exemplified by the samurai, provided an ethos for development and Westernization at the ICE. Furthermore, it highlights that the former samurai saw modernization as an inevitability. I emphasize the importance of the question "why they had to Westernize the nation," rather than "how they achieved industrialization." The leaders at the college and the Ministry emulated Western technology to maintain the superiority of their former feudal clan and the nation—this was their grandest motivation.

The Westernized program at the ICE was a consequence of political strategies among the Japanese participants of the college. The course of the ICE's development reveals that non-engineering motivations shared a mutual relationship with engineering education at the ICE. In the development of the ICE, we can see two levels of politics involving the former samurai: relations with their former feudal clan, and the traditional class relations. In either case, the ethical standard among samurai, such as loyalty, rivalry, and the spirit of independence, was the ethos of their behavior in the Meiji period.

In addition, I will offer a new viewpoint of Henry Dyer, the first principal at the college, as an observer of social and cultural backgrounds of people in Meiji Japan. Through the observant eye of a Scottish engineer, Dyer stated frankly his impressions of the students. Dyer devoted himself to realizing his ideal of engineering education in Japan, but without understanding the social and cultural situation of students in Meiji Japan. He had not been aware of their determination, and the fact these students were placing their society and values before anything else. Later, Dyer recognized their strong patriotic spirit, and their loyalty to the nation as greatest factor contributing to the quick success of industrialization in Japan.

MOSCOW SOCIETY OF THE FRIENDS OF NATURAL SCIENCES, ANTHROPOLOGY AND ETHNOGRAPHY AND POPULARIZATION OF SCIENTIFIC KNOWLEDGE IN THE 19th CENTURY RUSSIA

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The Society of the Friends of Natural Sciences, Anthropology, and Ethnography (SFNS), organized in 1863 in Moscow, had developed from a circle of naturalists, both professional and amateur, who concentrated around A.P. Bogdanov, professor of zoology and director of the Zoological museum of the Moscow University. SFNS was the first learned society in Russia that was organized according to the 1863 University Statute (later on societies of this type appeared in all Russian universities) and the first to publish its proceedings in Russian. According to the Statute of the Society, it was aimed at advancement of natural sciences and popularization of scientific knowledge in the Moscow School District, but very soon its activities overgrew the limits of the district.

SFNS was the first in Russia to adopt scientific exhibitions as the main form of popularization of scientific knowledge in wide social strata. Among the most significant exhibitions, organized by the Society there were the four: the All-Russia Ethnography Exhibition (1867), the Polytechnic Exhibition (1872), dated for the 200th anniversary of Peter-the-Great, the Anthropologic Exhibition (1879), and the Geography Exhibition (1892). Less known are exhibitions on applied zoology, beekeeping et al. These undertakings of SFNS, organized almost without any governmental support were a success due to great managerial talent of A.P. Bogdanov. Besides that Boigdanov worked out the strategy of the Society, which helped to attract to these exhibitions people with different social and educational background. The basic ideas of his strategy, realized by the Society, may be described as follows:

1. SFNS attracted to the spade work as many people, interested in a certain field of knowledge, as possible. Although the exhibitions were held in Moscow, the Society managed to recruit and instruct people from far-off regions of the country to collect the necessary exhibits.

2. Before and during the exhibitions high-level lectures on the topic for educated public were combined with gratuitous scientific demonstrations and lectures for people with lower educational level.

3. Each exhibition was accompanied by important scientific or cultural events (congresses, scientific conferences on the topic et c.).

4. Exhibited collections were used to organize in Moscow new museums or museum collections, university or public (the Dashkov Museum of Ethnography, the Museum of Applied Knowledge, better known as the Polytechnical Museum, the Anthropology Museum of the Moscow University et c.).

LEARNED SOCIETY AS PROMOTER OF EDUCATION AND INTELLECTUAL ACTIVITY: BALTIC CASE

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The history of 20th century Baltic States shows that initiatives for statehood and cultural activities originated through organizations created by educated persons. Their purpose was to shape the inhabitants for concrete action in directions which were particularly needed: for the spread of education, for development of political and civic consciousness. The causes and motives for the appearance of learned societies in the Baltic countries were similar; however, the Lithuanian experience was most distinct for its universality. Therefore the suggested theme will rely upon data from Lithuanian history.

In the first decade of the 20th Century two organizations were created - Lithuanian Learned Society (LLS) and Lithuanian Society for the Arts. They sought to affect the country's societal movements in the direction of demanding cultural and political autonomy within the framework of Russian Empire. This was only an initial step of the coordinated activities of above mentioned organizations. The initiative was carried on further by LLS seeking no longer only autonomy but also status of an independent state which appeared as something politically realizable during the First World War. The political, scientific and cultural leaders of future national state matured and gained experience in this organization. LLS based its activity on the thesis that education and competence is the foundation on which the institutions for realization of statehood must rest. Within the core of this thesis rested the founders' conviction that (a) education ads meaning to the person's authenticity when the results of his creativity rest on ethnic culture and its values - language and traditions, (b) the idea of a national state constitutes a value and a powerful motive among educated people as something to be sought. Namely, these values became activity factors in the liberation of Baltic States at the end of 20th Century – during the collapse of the Soviet Union.

After having defined the historical factors it becomes possible to distinguish four stages of education and scientific development characteristics which determined the activities of LMD. Two significant merits of the Learned Society will be discussed: 1) the national system of education and learning, 2) Lithuanian Academy of Science. The text of the report will present the results of all analyses that have been collected. Comparing them with the particulars of societal changes of attitude will reveal the influence of LMD actions upon the maturation of civic society.

Regular Session T15
Art and Science

ART AND SCIENCE IN A SPLIT CULTURE–A GENERAL OUTLOOK AND A CASE STUDY: BREAKING LEONARDO'S VITRUVIAN "CODE" AND THE GOLDEN SECTION WITH LESS "GOLD"

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Art-science connections may play an important role in modern culture. The specialization in the last centuries led to various disciplines, while most problems are complex and require interdisciplinary approaches. This author suggested speaking about "split culture", using a metaphor from brain research (D. Nagy, 1989, 1996), instead of the widely used term "two cultures" (C. P. Snow). According to this interpretation, we have just one culture, but it has two "hemispheres" that should cooperate via some bridges (*corpus callosum*). Our terminology was also introduced and discussed by T. Avital's monograph (*Art versus Nonart*, Cambridge University Press, 2003, pp. 34-35; Chinese translation, Beijing, 2009, p. 53).

The usage of art-science connections may appear at various levels:
(1) Strengthening interdisciplinary thinking in general.
(2) Helping education by presenting new connections (e.g., "beautifying" science education and giving new "outlooks" in art education).
(3) Presenting exact methods for artists and new fields of application for scientists.
(4) Giving new inspirations to artists and scientists by a broader scope.
(5) In some special cases, helping the solution of concrete problems (see, e.g., the reconstruction of Bach's *Kunst der Fuge* by W. Graeser; the recognition of a mistake in the crystallographic tables by analyzing M. C. Escher's periodic drawings).

Interestingly, the related literature overemphasizes some topics in art-science connections and uses just a limited set of examples. For example, in the case of the Golden Section, some incorrect statements were repeated so many times that became well-know "facts". We demonstrate that the surviving documents on the proportional systems of Polykleitos, Vitruvius, and Dürer, respectively, cannot refer to the golden section, and Leonardo's "divine proportion" is not an expression for the golden section (this encompasses a new dating of a section of Leonardo's *Trattato della pittura*). We present our reconstruction of Leonardo's "Vitruvian man", which gives evidence that it is not based on the golden section. On the other hand, we give some important sources related to the golden section, including documents by composers (Liszt, Sabaneyev, Bartók). We also study the formation of the first terms that refer to gold, *der goldene Schnitt*, and its Latinized version, *sectio aurea*, in the German mathematical-educational literature of the 19th century. While many historians of science and linguists refer to M. Ohm's book (1835) as the first known appearance of the new term in a printed work, we give earlier examples in F. Wolff's textbooks.

In the case of discussing crystallographic symmetries, we suggest widening the scope: we should use not only the patterns of the Alhambra and the periodic drawings designed by M. C. Escher, but also the rich set of ornamental art and the related ethnomathematics in various regions from the Middle East to Oceania, from Africa to the Americas (see ISIS-Symmetry's congresses and the journal *VisMath*).

POST-WAR BIOLOGY, AVANT-GARDE ART AND THE SOCIAL LIFE OF SCIENTIFIC IDEAS AT THE FESTIVAL OF BRITAIN 1951: LL WHYTE, D'ARCY THOMPSON AND 'FORM'

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The paper considers the social life of D'Arcy Thompson's biological concept of form, discussed first in 1917 and in the first edition of his book *On Growth and Form*, in post-war Britain, and in the shaping up of an interdisciplinary domain of research that manifested as a network comprised by scientists as well as avant-garde artists. The discourses by post-war scientists, such as L.L. Whyte and C.H. Waddington, but also art historians, such as Rudolph Arnheim, as well as avant-garde artists, such as Richard Hamilton, in the context of the Festival of Britain, alluded, for example, to Thompson's theoretical concept of 'form' as the novel privileged site for interdisciplinary research. Both the symposium which Whyte organized and edited under the title *Aspects of Form* and Hamilton's 1951 ICA show On Growth and Form provide two examples that illustrate the social life of Thompson's concept of 'form' in post-war Britain and in the domains of art and science, that attest, as well, to the changing direction in research in science and art in the same period.

If post-war science and avant-garde art in the given social context privileged Thompson's concept of form as the new site of interdisciplinary research, Thompson's presence in post-war science coincided, as Whyte's texts make clear, with a turn to the idea of complex as opposed to linear phenomena that an increased emphasis in biology as opposed to physics entailed. Thompson's concept of form, as a concept that described an irreducibly dynamic entity, signaled also modern science's encounters with the idea of complexity. The presence of this idea additionally in avant-garde art and architectural discourses of the same period might be seen to point, in conclusion, not to the causal relations between post war science and avant-garde art in the 1950s but to the role of scientific ideas in post-war Britain as agents active in shaping up relationships and networks that transcended at the level of the social pre-existing disciplinary boundaries, such as the ones of art and science.

CARNAP'S UNIVERSAL METAPHOR: ART AND STRUCTURAL OBJECTIVITY BETWEEN THE WARS

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In 1937 Rudolf Carnap's *The Logical Syntax of Language* was published as part of C.K. Ogden's 'International library of psychology, philosophy, and scientific method'. Carnap outlined a meaning-neutral symbolic language for the purification of empirical science, and dealt with methodological questions such as the possibility of purifying language *with* language, the limits of scientific discourse, and so on. This was the culmination of more than a decade of the influence in England of logical positivism, much of which was due to Ogden's ambitious series.

As in Germany, logical positivism was not confined to purely technical logical questions. On one hand, the movement sought to redefine the kind of enquiry proper to philosophy, strongly demarcating its boundaries; this had implications for non-scientific disciplines. On the other hand, the structuralism of Carnap's analysis could be applied as what I term a 'universal metaphor'. In this way, radical movements in art, architecture, politics, and various sciences emerged across Europe, all using the arguments and terminology of logical positivism.

In part, the applicability of Carnap's doctrine to other disciplines was predicated on its strong ideological underpinnings. The progressive rationalism it implied dovetailed neatly with the socialism of the British intelligentsia in the '30s. My analysis deals with the two seemingly unrelated disciplines of architecture and anthropology, focussing on the year 1937. In that year, English architecture was on show at the Museum of Modern Art, New York, and the functionalism and unit-construction model pioneered at the positivist-influenced Bauhaus was prevalent. At the same time, Mass-Observation was formed — a surrealist anthropological movement, with close links to positivist literary criticism. Linking my account to recent work on the rise in the period of 'structural objectivity', I argue that, through its links to science, modernist aesthetics in England between the wars was based on a structuralist 'episteme'.

IMRE LAKATOS' AND EMMANUEL LEVINAS' APPROACHES TO THE NATURAL AND HUMAN SCIENCES

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During the 20th Century, methodological challenges presented by Modernity and trends toward Postmodern ideology led to a philosophical culture riddled with what Lakatos describes in the Philosophy of Science as the problem of demarcation. This dissertation will highlight areas in philosophy and theology that suggest for scholars a methodology for research programs concerning both the natural and human sciences. Since the pre-Socratics, ongoing aporias of Modernity in the natural and human sciences, and their role in society reflect as unfinished products of Modernity to which Levinas ascribes a bourgeoning sense for responsibility in the form of ethics and human action. By establishing some conceptual affinities between Lakatos and Levinas in a dialogue and drawing on their philosophies it is possible to reconstruct a history of the natural and human sciences that repositions Modernity. These separated aspects to the history of philosophical reasoning, the natural and human sciences, underpin the very identity of Western Culture that today is crumbling under the force of its own liberalism. The problem of demarcation reflects as the result of canonized concepts of methodological reasoning peaking during the Enlightenment and the following 20th Century: a time of metaphysical misinterpretation and hasty methods of applying empirical critique in the natural and human sciences. The ways scholars interpret the relationship between the natural and human sciences underpins much of our methodological thinking in the West today. By examining Modernity in the context of a transhistorical process I argue that it is possible to better conceive methodological action. A conversation between Lakatos' demarcation and Levinas' responsibility highlight areas to establish connections for the natural and human sciences. A continuing need for the regulation of knowledge acquisition and its application to the world, calls for a way back into Modernity therefore, that accounts for a methodology based on grounds for the completion of the unfinished products of Modernity, and humanity richer for deeper self-understanding.

BRINGING THE LABORATORY INTO THE MUSEUM OF FINE ARTS

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During the decades after World War I, scientific laboratories were set up in many European and American museums for purposes of conservation and restoration. Although the first such laboratory was installed as early as 1888 in Berlin, the developments were greatly accelerated in the 1920's when the British Museum set up a laboratory to treat the art works which had suffered badly from their emergency storage during the war. In 1928 the Harvard Fogg Art Museum set up a laboratory, which would soon become a leading research center in the emerging field of conservation and restoration science, through the publication of the first scholarly journal in this new field: Technical Studies in the Field of the Fine Arts.

The introduction of scientific expertise in the world of art connoisseurs, collectors and curators was not a simple matter. First of all, the field of conservation science was not unified: it consisted of chemists, physicists, professional restorers, painters and artists. The results of chemical analyses or x-ray radiographs were not easy to understand, and were not always considered to be important or relevant to art criticism. Scientists were expected to limit themselves to the material conservation of artifacts, but to stay clear of aesthetic interpretations.

Yet, in many cases, scientists were demanding a greater share of expertise. Laboratory experts pointed to the possibilities to uncover the working methods of famous artists by looking at the radiographs, or by analyzing the pigments used. When it came to the detection of forgery, scientists were invoked to give testimony on the authenticity or falsity of works of art, although art historians pointed out that master forgers could just as well use the scientific information for perfecting their forgery works, making judgments based on scientific analysis less trustworthy. In particular restoration practices generated many tensions. Although every one agreed that the responsibility of deciding on restoration operations could not be left to uneducated restorers, it remained a matter of conflict and controversy whether scientists were to be heard when deciding on the 'true' intentions of the artist.

In this paper we will look at the different arguments and strategies used in the implementation of two particular techniques: the x-ray analysis of pictures and the microchemical analysis of pigments. X-rays represented a new, innovative technology, harmless to the artifact and yielding new pictures for the art connoisseur to interpret. Chemical information on the other hand was more of a technical nature, out of the grasp of the art connoisseur, and based on a material sample taken from the original work. Comparison of both technologies may give a better understanding of the way science was perceived in the cultural environment of the humanities.

L'ARCHITECTECTE, LE DESSIN ET LA SCIENCE, FORMES DU SAVOIR DANS LA CONSTRUCTION

Huyghues des Etages Nathalie

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Parmi les différents aspects qui caractérisent l'art de la Renaissance, la définition de l'espace et la construction de la perspective artificielle (linéaire) par Brunelleschi et ses disciples n'a jamais cessé d'être considérée comme la manifestation la plus exemplaire de la symbiose qui aurait existé à cette époque entre l'homme de science et l'artiste. Même si cette vision est aujourd'hui contestée, la perspective linéaire continue d'intéresser les scientifiques, notamment les psycho-physiciens et les neurologues, car les mesures précises de la physique ne correspondent pas au fonctionnement de notre système perceptif. Nous trouvons semblables des choses qui sont physiquement dissemblables et différentes des choses physiquement similaires. Le fonctionnement de ces rapprochements et de ces dissemblances reste encore très mal connu, que ce soit du point de vue de notre équipement sensori-moteur, ou de leur fonctionnement au niveau cognitif, en dépit des progrès des neurosciences cognitives et de l'imagerie cérébrale. Dans le cas de la perspective, c'est l'usage d'un certain type de raccourcis visuels qui permet de suggérer un espace. Ces catégories perceptives, sont difficilemente accessibles à l'analyse car elles sont le plus souvent le résultat d'acquis culturels, et d'un dressage précoce et une fois ces catégories perceptives acquises sur la base de la sélection de certains indices physiques parmi l'infinité de ceux possibles, elles deviennent automatiques et irrépressibles, ce qui leur donne un caractère de "naturalité" et "d'universalité". C'est pourquoi l'analyse du fonctionnement de la perspective, de sa diffusion et de son assimilation à l'échelle collective ainsi que son intégration dans les processus techniques peut aider à la compréhension de ces phénomènes.

C'est sur la correspondance de l'ordre visuel avec l'ordre constructif que se base le postulat de l'architecture classique et qui a assuré la légitimité et le fonctionnement de la division du travail entre l'architecte/concepteur/projeteur et le chantier. C'est le sens de la trilogie vitruvienne *firmitas,*, *utilitas*, *venustas*. (Vitruve I, III, 2).

Nous nous proposons donc de montrer comment, en l'absence de connaissance mathématisée de la statique, la correspondance d'un ordre visuel géométrique avec l'ordre constructif a permis l'établissement du dessin comme fondement de la construction et l'établissement d'un consensus entre les architectes, le chantier et le commanditaire et le fonctionnement de l'activité de construction, l'essentiel de celle-ci reposant sur le savoir-faire empirique et le jugement des maîtres-maçons. Nous analyserons ensuite le processus qui voit, à partir de la deuxième moitié du XVIIIème siècle, suite aux progrès de la statique, le remplacement du dessin par le calcul pour certaines parties du bâtiment, la vision d'ensemble du système (l'ensemble des structures) et la conception restant dominée par le dessin. Nous verrons ensuite comment le calcul envahit la conception des composantes du système, la géométrie cédant la place à une formalisation mathématique du comportement des pièces. Enfin nous montrerons comment au cours du XXème siècle le développement de la formalisation mathématique permet de développer la modélisation de parties de plus en plus large du système et comment les changements rapides liés aux technologies de pointe et l'intégration machinique de la production dans le cadre de la Conception-Fabrication-Assistée par Ordinateur qui conduit à intégrer de plus en plus des systèmes d'évaluations humains basés sur l'expérience et la géométrie dans les capacités nouvelles des systèmes machiniques informatisés.

Cela nous conduira à nous interroger sur le rôle et le statut des neurosciences cognitives dans ces transformations.

NEW RESULTS OF THE RESEARCH OF ART HISTORY INTO THE RENAISSANCE FRESCOES OF ARCHBISHOP JOHANNES VITÉZ'S STUDIOLO IN ESZTERGOM /HUNGARY/

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During the outstanding restoration-work performed by ICCROM-graduated chief restorer Zsuzsanna Wierdl the *original details* of the mural decoration of the famous European humanist Johannes Vitéz' Studiolo came to the light. This work of art is very different from the pictures known formerly as they are of a much higher quality.

The report presents some results of the research of art history that allow to date the murals and to attribute them to the painter.

RESTORATION OF THE RENAISSANCE MURAL PAINTING „VIRTUES", IN THE STUDIOLO OF JOHANNES VÍTÉZ, AT THE CASTLE MUSEUM OF ESZTERGOM – RECENT RESEARCH AND RESULTS

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Scientific research into, and restoration of, the most significant Hungarian renaissance frescoes started in 2000. Restoration was made very difficult by the fact that the mural painting had undergone numerous kinds of different interventions. During the cleaning the original layer was discovered. The painting is now is quite different from the one that could be seen earlier, and of much higher quality, It permitted the art historian to discuss about the possibility that the work had been actually painted by Sandro Mariano.

PROSPECTIVE DWELLING: FROM UTOPIAN TO ICONIC HABITATS

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In the 1950s and 60s innovative proposals, such *New Babylon*, by Constant, a Dutch artist linked to the Cobra and the International Situationist groups, *La Ville spatiale*, by the French architect Yona Friedman, and *Plug-in City*, by the British Archigram Group, challenged the functionalist views of Modern architecture and post WW II urbanism and, instead, conceived utopian habitats that intended to promote creativity, autonomy, and mobility. Although different in their conceptions and theoretical justifications, those proposals had the common feature of articulating different instances like architecture and engineering, scientific ideas and socio-political transformations, innovation and environment, in ways that explored alternative scenarios to the world of consumerism and socio-political stratification. This paper will address the ideas and instruments used on those proposals and their resurgence and transformations in the context of Contemporary architecture. The analysis will include the International Space Station, the projects for permanent settlements in Mars, and the iconic "eco-cities" and "generic cities" that Norman Foster's and Rem Koolhass' OMA's offices are currently designing for the United Arab Emirates, Abu Dhabi and Dubai.

AN EXHIBITION ON THE HISTORY OF THE INTERRELATIONSHIPS BETWEEN MATHEMATICS AND MUSIC

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In this presentation, we propose the use of an exhibition to approach historical and didactical aspects of the relationship between mathematics and music. In establishing a context for teachers to experience activities of culture and extension to their curricular activities, one values the history of mathematics particularly concerning its relationships with music, making accessible the historical context in which such relationships emerged. One proposes the experience of situations historically contextualized involving simultaneously mathematical, physical and musical concepts, be it directly, be it by means of analogical reproductions that intend to unchain the interest and reflection for its study.

Under a historical-didactical perspective, this presentation proposes the exhibition by means of eight parts that intends to transmit central ideas of the relationship between mathematics and music: 1) Motivation for the understanding of the Harmonic Series; 2) The experiment of the monochord: ratios x musical intervals in the mathematical systematization of the scale; 3) Renaissance: the relationship mathematics-music as experimental science; 4) Mathematical systematization of scales and temperament: ratios, irrational numbers and logarithms; 5) Harmonic Series/Fourier Series; 6) Consonance and dissonance: from arithmetical symbolism to a physical conception; 7) The sound of the planets; 8) From speculative mathematics to empirical mathematics: a scientific revolution in music.

THE ART, SCIENCE, AND TECHNOLOGY OF ELECTRIFYING MUSIC

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A major revolution process involving art, science and technology has taken place since the end of the nineteenth and the beginning of the twentieth century, with the progressive introduction of electric-based technologies into the realm of music.

On one hand, capturing, processing, recording, and playing music by means of electric and electronic devices and instruments have unveiled new ways of composing, performing, distributing and listening to music. Electricity has not only favoured but actually permitted the emergence of new musical genres and styles, and of new professional figures. On the other hand, specific technological solutions have been developed in response to the demands posed by the evolution of musical forms. Thanks to widespread, relatively affordable, and easy to manage electric-based technologies, the roles of composer, sound engineer, producer, and performer have gradually merged and nowadays they are all often represented in the same person, with important consequences on the artistic control over the final product. Arts like cinema and theatre have been deeply imprinted by the employment of sound processing techniques in plays' and movies' soundtracks. Electricity has also had a tremendous impact on music dissemination and popularization, both among musicians and listeners, due to the introduction and development of new media of diffusion and distribution (from the radio to the mp3).

Digital technologies have especially been responsible for shaping music production and music enjoyment at the turn of the twenty-fist century. The personal computer has by now become the pivot of recording studios and, often, of public live music performances, and also the most popular device for listening to music. In the course of the twentieth century private listening has undergone a gradual reshaping from the introduction and diffusion of analog home and car audio players until the recent advent of digital portable players. Last but not least, music industry has been greatly affected by the powerful distribution and dissemination possibilities offered by the Internet.

The paper is an attempt at giving an overview of the 'electric revolution' in music in its relationship with twentieth and twenty-first century culture and society.

A LITERARY FIGURATION OF ALCHEMY; NOVELIST PARK, SANG-RYOONG'S 'A STUDY OF DEATH'

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The novelist Park Sang-ryoong created a very rare literary world in his works, which had no precedent in Korean literary history. His novels are representing metaphysical world and enigmatic like puzzles that is highly difficult to understand to the ordinary readers. He showed a unique narrative technique in his works based on religions such as Buddhism, Daoism, Christianity, and shamanism, and integrated these with material from myths, folktales, Gnosticism, alchemical philosophy, the science of divination(æ¶ùÊ) etc. Among these materials that he used, the alchemical philosophy is the pivot to understand his idea and the plot which was structuralized at his works. I will trace how his understanding of alchemy is intertwined into his literary figuration and transformed the original concepts of Western alchemical philosophy and Oriental philosophy that was represented in his novels. These two different philosophical trends are encountering and deliberately intertwining in his works. Park's novel, A study of Death, is the rare case.

Also I will explore on the role of Gnosticism in his thoughts and his creation of a unique artificial language in his novels, his narrative method, his choice of female characters - they are usually described as prostitutes; his borrowing of a concept of salvation from the Bible, and his experimentation with genre in his attempt to combine the essay, the novel and poetry. The process of combining of alchemical philosophy for literary figuration is directly connected to the salvation of characters. Here I will trace the meaning of salvation which was represented in his literary works, by the combination of alchemy and its transformation and appropriation.

CARAVAGGIO'S "BOY BITTEN BY A LIZARD", AN EPILEPTIC CONTAGION BETWEEN HISTORY OF MEDICINE AND FOLKLORE

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One of Caravaggio's first pictures, the *Boy bitten by a lizard*, known in two copies (London and Florence), iis an enigmatic painting, which has puzzled art historians for ages. Many different interpretations have been given to this picture, trying to explain it as one of the five senses (touch), as homoerotic image, as a study of affections, as an allegorical figure for love bites. Unfortunately no one of these interpretations fits really well with the painting, because none before thought about it with an historical point of view. If we look for the concept of lizards bites in the Renaissance, we can easily find that it is related to the idea of contagion. People who were bitten by lizards (tarantula) were believed to be affected with epilepsy (tarantolati). The genre figure of the *Boy biitten by a lizard* is therefore a painting portraying an epileptic boy. This new interpretation will be explained through the aid of herbals (Mattioli and others), teratises of herpetology (Aldrovandi and others), art treatises (Lomazzo and others) and natural magic treatises (Cardano, Della Porta and others) with a bulk of informations which will bring us to demonstrate that this painting is something more simple than it was believed to be, and that its sense was lost in modern oblivion. In this case History of Science will help us to understand Art, as a part of it, in fact during the Renaissance period and especially in Caravaggio's times Art and Science were strictly related.

HISTORY OF BOTANY AND SCIENCE - NATURE - CULTURE RELATIONS; INTERDISCIPLINARY SYMPOSIA IN CRACOW (POLAND)

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One of maladies of present day natural sciences is disintegration of particular branches, loss of contact with the humanities and lack of general view on nature. Botany, the science of plants, is divided into many disciplines and specializations. There is necessity of general insight on plants and also on, changing in times, relations Man – Nature. In last decades in different places in the world were organised conferences, which main aim was to establish dialog between natural sciences and humanities (including arts), and also discussing, in historical aspect, the Man – Nature relations.

An example of such interdisciplinary meetings are symposia organized in the Botanic Garden and the Botanical Museum with J. Dyakowska History of Botany Research Unit of the Jagiellonian University in Cracow (Poland). In these meetings took part representatives of many disciplines and specializations, as botany, history of botany and pharmacy, ethnobotany, ecology, geography, history of art, literature, linguistics, architecture, technical and agricultural sciences. The titles of the symposia and of the symposial volumes published in English or in Polish (with English summaries) are as follows:

Studies on the history of botanical gardens and arboreta in Poland (1993), *Studies in Renaissance botany* (1998), *Science – nature – culture. Humanistic context of natural sciences at the beginning of 21st century* (2000), *Scientific botanical schools in Cracow – traditions and new tasks* (2007), and *Science – nature – culture II. In search of unity of science and art* (2008). The next symposium: *Science – nature – culture III. Vanishing landscapes* is planned in 2010.

We hope that these symposia even a little contribute to overcome an intellectual border between science and art. They also remind how multidimensional are relationships between Man and Nature. The understanding and conscience of these relations is, in our opinion, basic for contemporary nature conservation, and, in result, for survival of our civilization in future.

Regular Session T16
Science and Society

PRELIMINARY NOTES FOR A HISTORY OF THE POPULARIZATION OF QUANTUM PHYSICS IN SPAIN

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The popularization of science is an essential task that should accompany any scientific enterprise. Magazines on science aimed to the general public have played a fundamental role in this task, and study its contents is thus an essential tool for the study of social dissemination of knowledge.

Ibérica. El Progreso de las ciencias y de sus aplicaciones was created and published in Spain during the early twentieth century. Its aim was to promote and disseminate scientific and technological knowledge, and the publication became one of the first of these characteristics in Spain(1). From the pages of *Ibérica* the new physics spread and the meaning of the quantum revolution was discussed, bridging in this way the gap between science and society.

Scientific development experienced a big boost in Spain during the first third of the twentieth century, after the establishment of the "Junta para la Ampliación de Estudios e Investigaciones Científicas", JAE, in 1907(2). The work of physicists like Palacios, Catalán y Cabrera, would give an impetus to the Spanish physics that would be timely reflected in the pages of this magazine. The aim of this paper is to collect published articles on quantum and atomic physics until 1936, when the Spanish Civil War (1936-1939) interrupted the editing of *Ibérica*, and to analyze the communication of science to the general public in this period of time.

References

(1) Maria Genescà i Sitjes, "Ibérica: Primera revista de divulgación científica i tecnològica de l'Estat, editada a l'Observatori de l'Ebre (1913-1925)", *Actes d´Historia de la Ciència i de la Tècnica*, Nova època, vol. 1 (1) / 2008, pp.377-386.

(2) José M. Sánchez Ron, "Física, Química y Matemáticas en la España contemporánea", *Un siglo de ciencia en España*, Publicaciones de la Residencia de estudiantes, Madrid, 1998, pp. 114-139.

SCIENCE AND SOCIETY IN THE CONTEXT OF CONTEMPORARY SOCIO-ECONOMICAL AND ECOLOGICAL PROBLEMS

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It is indisputable that many advanced achievements of the modern society result from scientific progress. Thanks to science, the majority of the population of planet Earth lives in more or less comfortable conditions and is not planning to give them up voluntarily in the nearest future. The only exceptions are the very few tribes, which still live in very primitive (practically primeval) conditions and that is only thanks to the fact that civilization did not reach them.

The present day state economy is unthinkable without well-developed industry and agriculture. And achieving high results, doubtlessly, requires introduction of latest scientific achievements. Presently, it is hard to imagine factories without necessary technological equipment, electronics and qualified specialists. It is difficult to imagine present day agriculture without introduction of scientific ideas, which contribute to creation of new types of products. And public health is inconceivable without complex equipment and medicines, which contribute to recovery (it has to be mentioned that many contemporary illnesses directly result from the modern environmental conditions and the level of living).

However, despite all the positive things that come out from introducing scientific achievement, the anthropogenic landscapes (such as cities, industrial centers, agricultural landscapes, etc.) and similar territories are featured with some unfavorable problems. They manifest themselves through instable ecological conditions, degradation of agricultural fields in the result of improper irrigation or overuse of fertilizers, etc. The environment (and/or the surroundings, the landscape area), including the people themselves, especially those residing in urban conditions, experience enormous levels of negative impact.

Resolution of many contemporary problems (both socio-economic and environmental and others of the kind) is unimaginable without application of scientific knowledge.

Contemporary environmental problems in the republic are directly related to the problems of the society. Despite its insignificant area (approximately 15.5 thousand km^2) before the war the republic used to hold a specific place in Russian economy. Diversity of climatic conditions, landscapes, specialized agriculture, as well as presence of natural recourses determined the significance of Chechen Republic as a part of Russian Federation. Economic substantiality of the republic was to a great extent determined by the fact that the republic used to execute intensive extraction and processing of resources, especially oil. And science was assigned a significant role in this process. However, since the beginning of 1990s, when the republic as well as the rest of Russia stepped into the stage of economical and ecological instability, the science lost its significance.

Using the example of Chechen Republic, the changes in the environment and the society caused by the events of last 15 years are reviewed. Such crisis periods are always followed by changes, which reflect both on the society and the environment. The events that took place in the republic in 1994 in the previous century caused changes, which resulted in a distinctive attitude in the society towards the environment. Such attitude does not promote, but alternatively excludes the possibility of using scientific approaches in resolving environmental protection issues. The level of development (both cultural and educational) of the society in the republic is at the stage, which at the present moment does not cultivate a perception of science as an essential part of a developed society. It has to be mentioned, that a developed society also implies an environmentally educated society.

The level of development and technological provision of the society is closely related with the scope of environmental impact, including the impact on humans and nature. The changes that took place in the republic after 1994 can be used as an example. The environment, as well as the society, went through the processes of destruction, transformation and fundamental reorganization.

The commercialization of the society, and market relations have changed the views (or actually have turned around such the views) in the direction of extraction of material values, without taking into consideration the limited capacities of the environment.

Contemporary social and economic problems in Chechen Republic have generated such an attitude in the society, where its representatives are forced to survive through their own (frequently predacious) means, which consider neither scientific approaches, nor environmental values, in the framework of which it is necessary to preserve stabile conditions of the environment and rationally use natural resources.

An example of such survival activities in Chechen Republic in 1990s was the private extraction and primitive processing of oil products. Such extraction processes reflected on useful lands, which had been polluted with extraction and processing wastes, and resulted in losses of lives and health of people, which were involved in such activities. Landslide cases, which in the last couple of years appear on a regular basis in the republic, are a consequence not so much of natural factors, as of the anthropogenic impact, in particular, of uncontrolled timber harvesting on the shoulders of the mountains. Such consequences are not in any way related to science. In order to resolve those consequences, some scientific principles ought to be followed, and an environmentally educated society has to be raised (even if it sounds a little primitive). Such a society implies presence of necessary educational and scientific skills, which together with an environmental culture can ensure establishment of well-educated personalities.

THE PROFESSIONAL AND PUBLIC RECOGNITION OF SCHOLAR

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The problems of forming of scientist's image and criteria of the professional and public recognition of scholar are considered. Such quality of scientist as reputation prestige is of great importance for his career. These characteristics forms the image of scholar.

There is a number of methods to determine the current image of scientist.

a) the method of valuing;
b) the methods of citation index, impact factor (forming the rating of the professional activity);
c) the sociological methods of questioning the public opinion;

The main attention is paid to such important indicator as a citation index. Most of the Ukrainian and Russian researchers think that their methods can't be defined only right.

There are some factors which diminish the truth of such criteria:

1) dependence on conjuncture;
2) dependence on the citation index, public relation of a scientist's activity.
3) excess of the quoting;
4) problem of authorship;
5) administrative influence;
6) language barrier.

Besides the access to the base of the data of the Institute of Scientific

Information (ISI) is limited. For example, now quota of American and British periodical issues in the ISI is accordingly 40 and 20 per cent. But only 12 journals of Natural and Technological Sciences (about 0, 2 per cent) were presented in the base of data of ISI.

Important for forming of scientist's image are indexes of informative activity of research workers, which aim to promulgate the ideas, openings and developments through mass media.

Speech goes about an amount and effectiveness of publications in general lines mass, on radio and television, in the Internet. About sufficiently low media activity of scientists of NAS (National Academy of Science) in Ukraine is testified by the following information for 2003: there are 103 publications on 183 academicians, and on 324 correspondents - only 30.

ORGANIZING NORDIC EUGENICS IN THE 1920s

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Sweden pioneered the organization of eugenics research through the creation, in 1922, of a government-sponsored institute for "race research". This paper will deal with another aspect of the organization of eugenics around 1920, namely that of meetings and organisation on the Nordic level.

The so-called Scandinavian science meeting ("Skandinaviska naturforskarmötet") had been held regularly, every five years, since the 1830s, with an intermission between 1898 and 1916 caused by the crisis in Swedish-Norwegian relations in connection with the break-up of the union between these countries (in 1905). When a new meeting was held in 1916 "hereditary research" first appeared as a discipline on the conference programme. After the First World War leading Swedish scientists, working in genetics or eugenics, thought that eugenics also ought to become part of the programme of these conferences, which it indeed did, from 1923.

At the same time Scandinavian eugenicists thought about creating their own conference and possibly their own organization. A meeting was held in Uppsala, arranged by the Institute of Race Research there, in 1925. It included scientists, mostly in medicine and anthropology, from Sweden, Norway, Denmark, Iceland, and Norway. One discussed problems of standardization in anthropological measurement and also the need for promoting eugenics in politics in order to gain support for this science in a general sense and also in order to be able to influence policy, e.g. in social matters. The agenda was strongly coloured by the notion of Nordic racial supremacy. By the end of the conference a Nordic organisation for "race research" was created.

The paper will examine this organisational drive among Nordic eugenicists in the 1920s. It will also discuss the media representation of the conferences and other organisational activities and compare it with that of other sciences, where a broader international agenda was promoted.

THE INSTITUTE OF RACE BIOLOGY IN SWEDEN – SOCIAL NETWORKS AND MEDIA STRATEGIES

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This paper focuses on the history behind the state funded Institute for Race Biology that was opened in Uppsala in 1922. Early Mendelian research within Swedish plant breeding was translated to apply also to human beings, and substantial cultural and economic results were expected of an increased research activity in eugenics. In this paper it is discussed how Mendelian principles were used as a powerful rhetoric tool among the advocates of race biology (even though the methods of eugenicists were often anthropological).

To launch the Institute of Race Biology, several years of intensive lobbying was demanded. This lobbying was made primarily by a race-biological network, based on two scientific societies: the Swedish Society for Race Hygiene and the Mendelian Society, founded in 1909 and 1910, in Stockholm and Lund. The network, thus formed during the first decade of the 20th Century, intensified its efforts after WWI. The paper examines the key members of the network, its regular activities and its publications, as well as its more spectacular media campaigns and strategies towards politicians, the press, and the public. It also deals with the visions and attitudes concerning race-biological questions spread by the network's members. In examining this, it is made clear how the network could gain such an influence over Swedish politics and the Swedish public opinion.

Applied eugenics, or race biology, became a prism where many of the important questions of the period could be reflected. Therefore it could gather political support from the right to the left. Representatives of different ideologies were able to find relevant promises in the visions of a fitter population. This is clearly visible in the race biological network, which consisted of Conservatives, Reactionary Modernists, Social Democrats and Liberals, men as well as women that represented different professional interests. They came from disciplines such as medicine, zoology, botany, physiology, anthropology, political science, philology, history and physics.

Even if the race-biological questions to some extent were controversial (especially when it came to sterilizations), a large parliamentary majority came to view race biology and Mendelism as effective and tools for modernisation. A political majority was convinced that an increased research activity in eugenics would help stave off threats against the nation such as degeneration, alcoholism and emigration. These were seen not only as questions for the Swedish nation, but for all Western European cultures. Measures to improve as well as increase the white populations were thought necessary in order to secure continued European world domination. This aspect was stressed after WWI, when race biology, in the rhetoric of the network, was considered an essential tool in the rebuilding of Europe, where countries like Sweden, which had not participated in the war, should lead the way.

A SURVEY OF OBJECTIVE TRANSFER OF SCIENCE AND TECHNOLOGY POLICY IN EUROPEAN UNION

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Since 1980s, the objective of science and technology policy in European Union has changed greatly. This thesis tries to investigate the objective transfer of science and technology policy in European Union, and to summarize its general tendency. The study will mainly focus on the development of Framework Programme.

ROLE OF NANOTECHNOLOGY IN OPTOENGINEERING DEVELOPMENT

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Already in the end of XIX century one of the important problems of optoengineering was to work out technology of coating the clarifying coverings on a surface of optical lenses in the form of a thin film. In XXI century this problem has received qualitatively new decision, by using nanotechnology.

Optical features of nanomaterials have allowed to create in the end of XX – the beginning of XXI centuries clarifying coverings for the optics, almost excluding incident light reflexion in all range of lengths of waves (including infra-red and ultra-violet ranges). Such materials have allowed to create new antiglares coverings, capable considerably to improve the characteristic of optical systems of different function (especially multielement).

Other potential application of nanotechnology in optoengineering is connected with . creation in the end of ÕÕ century the new generation of light-emitting diodes and solar batteries. Last began to absorb more light and became more effective than the existing one. The solar batteries, created by nanotechnology, and placed in space(cosmos)might become a new powerful energy source on the Earth, that in contemporary conditions of deficiency of natural energy carriers (oil, gas) is rather actual.

In the beginning of XXI century scientists from the Californian university in Berkeley had developed optical "superlens" for image reception nanoscale. When the wave reaches an external layer of a superlens, the image amplifies and can be imaged by means of usual optical lenses on the remote screen.

Thanks to practical application of nanotechnology in optoengineering, soon there will be a new generation of ultrafast optical computers with huge productivity of calculations.

The basic lacks of optofacilities are low accuracy of data presentation and rigidity of architecture of optical systems. Therefore they can be competitive in the market of computing services only as specialised computers, with limiting high efficiency. Unique technology of hardware realisation of the new generation of optosystem , capable in the future to come instead of traditional optics and optofacilities, is the use of nanotechnology.

THE NOBEL PRIZE COMPLEX IN SOUTH KOREA : HISTORICAL AND SOCIOLOGICAL CONSIDERATIONS

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In 2008, three Japanese scientists received the Nobel Prize in physics and chemistry. Korean newspapers and other media publicized this news with such a headline as "Why Japan got so many Nobel Prize, whereas Korea got none?" One newspaper lamented that "Korea was lagging behind Japan by a score of 13 to 0." Various analysis of the strength of the Japanese scientific tradition, as well as the weakness of the Korean scientific infrastructure, were proposed. The Korean government, with the help of some Korean scientific communities, immediately started a "Nobel Prize Project." However, it was not the first time that the Korean government launched this kind of project. In 2005, the government also planned to establish a project to make Dr. Hwang Woo Suk a Nobel laureate. This project was severely criticized after Dr. Hwang's research turned out to be a fraud.

The Nobel Prize in science has been a dream award to the Korean public for a long time, but from the 1990s on, it became Korea's dearest wish. My paper will show that the image of the Nobel Prize changed radically in Korea during the 1990s from a honor of individual scientists to a pride of the nation, and that the Korean scientific community, which helped to promote this new image, used the "Nobel Prize complex" to initiate big research programs funded by the government. Scientific and political ambitions were fused into one in the craze for the Nobel prize in Korea.

TRANSITION TO POST-ACADEMIC SCIENCE: PERFORMANCE INDICATORS AND TRUST IN SCIENCE

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Science is in transition from the academic to the post-academic phase. It is one of the characteristics of the post-academic stage that science becomes more and more business-like. Scientists start behaving like entrepreneurs offering research services on an intellectual market. (e.g. Ziman 2000, Gibbons et al 1994) The other side of this coin is that the world outside the academy tends to behave like business owners and costumers towards academic institutes. I will examine this latter process and its consequences. Customers and shareholders have attitudes toward a service provider that are different from the attitudes of the former sponsors of academic science. Customers, for example, want to get the best value for their money and they should not relay simply on the suppliers' word that they will get it. It will be argued that the widespread use of science performance indicators is mainly the result of this kind of mistrust. Customers use science performance indicators to make sure of the value they get for their money. It will be also analyzed whether this strategy is successful from an epistemological point of view.

Gibbons, M. – Limoges, C. – Nowotny, H. – Schwartzman, S. – Scott, P. – Trow, M. 1994. *The New Production of Knowledge.* London: Sage.

Ziman, J. 2000. *Real Science, What it is and what it means*. Cambridge: Cambridge U.P.

THE ARCHITECTURAL HISTORY OF A CHINESE VILLAGE

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This paper focuses on the study of Shicang Village in Songyang County, Zhejiang Province, China, where over thirty houses from early and middle Qing Danasty are well preserved. With colleagues studying Chinese immigration history, the author did a long-term research there and gathered lots of original folk documents from the local villagers, and interpreted why and how these magnificent houses in this village were built.

By analyzing the case of Shicang Village, the author tries to probe a new way for house study by cross discipline in this paper. Basing on architecture-oriented multi-discipline investigation, material collection and researching of a region or a village, the paper reveals a whole or part of house building environment, feature, and related natural and social life in a certain time and space; Basing on the background of Chinese traditional village culture, this paper analyzes and researches house building culture, historical significance and development process. The author studies architectural history on the background of social economy, meanwhile he also gives attention to the social development of architectural history.

Shicang Village in this paper is a typical example of ancient villages in northwest of Zhejiang Province. It possess rich research materials and is regarded as a village with the most historical folk covenants in China by modern historical experts. What's more, there are well preserved buildings from Ming Dynasty to modern time, exhibiting houses with different features in different times. The village itself is an architectural development history, significant for the research of regional architectural history.

NOT ONLY FERMI. EDOARDO AMALDI AND THE REBIRTH OF THE ITALIAN PHYSIC

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Starting from the 30's, in Italy, was born a very important group fixed to the physical research, both theoretical and experimental, working in Rome. Under the guide of Enrico Fermi, called the "Pope", the group was composed of the best Italian researcher. Among there we remember Edoardo Amaldi, Franco Rasetti, Emilio Segré, Bruno Pontecorvo, Ettore Majorana and Oscar D'Agostino (famous as "I ragazzi di via Panisperna"). This was one of the best researcher group, in physic, of the world and in 1938 Fermi won the Nobel Prize for the discovery of the "slow neutrons".

But the Italian fascist racial laws (the worse than Nazi German racial laws), publishing in 1938, hits hundreds of thousands of innocent people and, at the same time, opened a very difficult period for the Italian research (not only for physic but also for mathematics). Also the famous group called "I ragazzi di via Panisperna" was hit from the new laws and the group started to fall to pieces; a lot of the most important physicist of the group was forced to start from Italy to have save their life. So Fermi, Segré and Pontecorvo (after a period in Paris) was emigrated in United States, meanwhile Rasetti in Canada.

Not all the physicist, however, were forced to move from Italy. Edoardo Amaldi, a member of the group, decided to stay in Italy, with the goal to give a future to Italian physics, after the end of the war and the expected falling down of the fascist regime.

But during the war the condition of life was very difficult in Italy because both of the frequent bombing and of the lack of all the staple commodities. For example, the constant bombing of the Italian cities made very difficult and very dangerous the execution of the experiment both for the experimenter and for the devices involved.

Coming back from the war Edoardo Amaldi restart with physical research, but due to the very difficult condition of work and the total absence of money he was forced to renew the subject of the research. He decided to leave the nuclear research in favour of the research of cosmic rays that was free of charge and not needed a complex instrumentation to work.

Starting from the end of second world war, take place, in the meantime, a constant and gradual return to the excellent level of research that have distinguish the Italian physics; all this would be true under the enlightened leadership of Edoardo Amaldi.

It's very important underline that we are not talking about a reconstruction (such as the case when one person starts again and continues the precedent work), but we are talking about a new and original redefinition "ex novo" of the theoretical and experimental work, first of all in Italy and, after that, in Europe. The line guide tracks by prof. Amaldi was been, and in a lot of case, are at the present time, the polar star of the physic. Special attention is given in the present article on the age between 1945 and 1954, in order to analyze the principal aspect of the (re)building of the Italian physic. Furthermore will be analyzed the contribution due to Amaldi in the building of the CERN in Geneva, with the collaboration of Pierre Auger.

Last but not list the present work would underline the role played by prof. Amaldi in the field of peace and disarmament, with the institution of the Italian arm of the Pugwash movement.

THE BIODIVERSITY AND ECOSYSTEM FUNCTION RESEARCH FIELD: INTERSECTIONS BETWEEN SCIENCE, POLITICS, AND THE PUBLIC

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Why do we have a Convention on Biological Diversity (CBD), but not one on "Clean Air" or "Adequate Waste Management"? Environmental issues require more than relevance to become conventions. They also require scientific back-up, media coverage, and economic and political incentives. Around biodiversity we find all the necessary ingredients and thus the issue illustrates the intricate interweaving of practice, content, and context of science.

Particularly, in the case of the biodiversity and ecosystem function (B-EF) research field, the interplay between science and society has significantly influenced fundamental aspects of science such as the definition of research agendas, the scope and definition of terms and concepts, and the ways of establishing causal relationships. I show how, in contrast to a logic- or curiosity-driven research agenda, research in the B-EF field has been focused on answering what is biodiversity good for, why should we care for it, and what would be the consequences of its loss. These concerns find their way into proper scientific questions like: is there a linear relation between biodiversity and ecosystem functional properties (e.g., productivity or content of nutrient in the soil)? As a consequence of the formulation of this kind of scientific questions, biodiversity becomes the cause and ecosystem properties the effect. This conflicts with previous understandings of biodiversity as the consequence of environmental gradients and ecosystem processes instead of their cause. Not surprisingly this causal shift has generated important controversies among ecologists.

Based on the analysis of how the B-EF research field developed during late 20th C., I argue that the study of science in context needs to go beyond the identification of bi-directional influences between science and society. Instead it should serve to widen our understanding of science *as social*, and not just of science *in the social*. Along this trend, models such as the self-vindication model of science or the actor-network theory might be more insightful than the classical contextualist models.

PUBLIC CONCERN ABOUT ANIMAL EXPERIMENTATION AND THE RUSSIAN ACADEMY OF SCIENCES IN 1904-1906

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The Society for protection of animals in Russia was found in 1865, and its activities were very diverse, but it was not before 1880ies when the issue of using animals in scientific experiments began to attract attention of its members.

In contrast to other European countries and America the antivivisection movement in Russia did not separate from the mainstream animal protection movement, and special society was never formed. The public information and the dialogue with scientific community were sanctioned by the Steering committee of the Society and most of the polemics took place in the pages of the Journal of the Society. These debates finally gained academic attention in early 1900ies but public controversy started already in 1880ies. Thus the history of antivivisection movement in Russia can be divided in three periods: 1) 1865-1881; 2) 1882-1901; 3) 1902-1909.

The "case" of the Russian Academy of Sciences belongs to the third period of public antivivisection activities which was inspired by the new Chairperson of the Steering committee of the Society, the Baroness Vera Meyendorf. In 1902 she took this position and in 1903 she already prepared the draft low which she presented to the mother-empress Maria Feodorovna. After approval by the mother-empress the draft was forwarded to the Ministry of Education from where it was sent out to all the Universities and Medical Schools of Russia for feedback. By the year 1904 the feedback was received in the Ministry. All the documents were then sent to the Academy of Science. The draft and the open letter by Vera Meyendorf were discussed in the session of the Physics and Mathematics Department of the Academy (where also natural science such as physiology and biology belonged). Ad hoc committee was formed in 1904 with the academician F.V. Ovsiannikov as a chairperson. This committee made a report only in 1906, however it was very short and their attitude to the draft was negative. Most interesting in this case is the reaction of some other members of the Physics and Mathematics Department of the Academy, especially academician B.B. Golitsyn who blamed the commission for being prejudiced against the Baroness Meyendorf and asked academician F.V. Ovsiannikov to take more time for discussion and conclusion. The commission came back with the detailed report which considered all the points presented by antivivisectionists, and nevertheless their conclusion was negative to all points, and this conclusion then was sent to the Ministry of Education where every hope of Baroness Meyendorf of success was dashed.

Thus, the initiative of the Society for protection of animals did not succeed. But the discussion about animals in science influenced scientific community and some scholars as we saw on the Academy case, took the side of antivivisectionists. In general these activities affected the public attitude to animals, and more people began to look at animals as subjects of the society not just objects.

WOMEN AND CIVILIZATION IN THE THOUGHT OF EDVARD WESTERMARCK (1862–1939)

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Edvard Westermarck (1862–1939) was a both nationally and internationally well-known Finnish philosopher, sociologist and anthropologist. He was not only scientifically active, but also took part in contemporary social and political debates. He was a keen critic of Christianity and - what has so far gone almost unnoticed – also active in women's liberation movement. He used his anthropological knowledge as an argumentative resource in his contemporary social debates on women's position. I argue that Westermarck's scientific knowledge played a significant part in his social opinions.

In 1904, Westermarck gave a presentation at the opening meeting of the Sociological Society (London) concerning the position of women in early society. The presentation was also published as an article in the American Journal of Sociology. In 1905, he presented a paper on the same subject at the Finnish Feminist Association Unioni's Soiré. This presentation was published in the Union's journal Nutid in 1906.

I analyse the construction of gender in these presentations and ask how it is connected to the (1.) views of gender in contemporary anthropology and sociology and (2.) the political and social discussion on gender and women's rights? Special emphasis will be on the scientific belief that women's position correlates with the grade of civilization in a given society. I discuss Westermarck's view on this claim and its influence on his stance on the question of women's emancipation.

INVESTIGATIVE REPORT OF STATE-OWNED COAL MINES FOR THE PURPOSE OF UNDERSTANDING THE RELATIONSHIP OF SCIENCE AND SOCIETY IN MAINLAND CHINA

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It is of utmost importance to enhance science literacy among coal mine workers in order to help prevent tragic accidents that have frequently occurred in coal mines. Coal miners need to understand the relationship between science and society, which is a very important part of science literacy. This paper utilizes data compiled from an investigation concerning science literacy related factors among coal miners in China's main coal mining producing areas of Shanxi ,Shan Dong, Hebei, Sichuan, and Heilongjiang provinces, and was based on the analysis and research of the science literacy related factors. A questionnaire and multi-stage sampling method was employed in order to investigate the following 3 aspects:1)The basic situation of the coal miners ,i.e. educational background, age, etc. 2) There were many kinds of fetishes and superstitions in China, this paper chose the five main kinds of fetishes and superstitions which often appeared as items in the questionnaire, and 3)Understanding the relationship of science and society from the perspective of different age groups and different educational levels .The sampling was 5003.

Key words: coal miners, science literacy, the relationship of science and society

THE ROLE OF SHIPBUILDING AND NAVIGATION IN THE DEVELOPMENT AND EXPANSION OF MANKIND CIVILIZATION.

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The shipbuilding appeared in ancient times. Outstanding Russian mathematician, engineer and shipbuilder, L.N. Krylov wrote " The beginning of the art of shipbuilding appeared in ancient times, in the times of the Assyrians, Babylonians, Phoenicians, and Ancient Egyptians, and preceded the culture of civilization ". It is confirmed by archeological excavations which were made by the group of scientists headed by professor Thomas Jacobson in 1971. "The great hour for the Mediterranean sea area had come 4000 years before the pyramids were built." - French writer Jorge Blan used to write. The famous Russian explorer of the Atlantic ocean, Alexander Condratov spoke about the same fact. He thought that the shipbuilding and the navigation on the Mediterranean sea had begun 7-8 or 10 thousand years ago.

When people went out from the caves, they settled as a rule, on the sea-shore or on the bank of the river. There they were able to find food and water. Making themselves fit into the situation, a man, became curious of the space around and, thus, began trying to overcome water barriers, to get to the other shore and find out what and who was there. People used different sail-devices (trees, bunch of reeds, etc), but soon they began to build boats (simply hollowed out from wood using a stone) and later – boats made by an axe. People began to boat using sculls, oars, and under the sails. A Norwegian scientist Tur Heyerdal approved the possibility of sailing on the papyrus boat. "People learnt how to set a sail before they learn how to straddle a horse" – a British historian and physicist, John Bernal writes. The energy of the wind was used in the navigation 6 000 years ago, and only after 5 000 years it was used on land. It is considered that a first windmills appeared in Persia in A.D. 915."

So, shipbuilding and navigation was one of the most important lever of the development and expansion of civilization all over the world. The ancient Russian water way "From Barbarians to Greeks" was a very progressive factor in the history of our country. Christianity came to our country by sea and changed heathen religion. It is well known fact that shipbuilding in the times of Peter The Great played a very important part in the changing of the social appearance and renovation of our country. Until XVIII century our country was separated from seas and Europe. This fact explains the backwardness of Russia in comparison with Europe. It was exactly the shipbuilding that helped Peter The Great to provide the way to the seas, to the European Civilization

THE ROLE OF SCIENCE-DOCUMENTARY MOVIES IN THE 1930s' IN HUNGARY

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In this paper I would like to analyse the role of documentary films (especially science documentaries) that were made in the 1930s in Hungary. I will emphasize how important this genre was as both cultural and scientific educational instruments. In keeping in step with European countries, Hungary recognized the importance of these films, which promoted the establishment of and the financial foundation for governmental educational film institutions. These films were important in that age not only as educational aids but also as special tools of science communication.

To understand this time period, one must be familiar with the role of Kuno Klebersberg, who, as Minister of Religion and Education, established the Department of Cultural Films within the Ministry. This led to Hungary accepting the goals of the international congress of Haga regarding the importance of educational films. Our country teamed up with the International Educational Film Institute of Rome and this partnership gave birth to the Educational Film Factory. Although Hungary did not produce a numerous amount of educational documentaries during the early part of this relationship, the country assumed a prominent position in the progression of European documentaries during that time.

Later, with the introduction of sound films, documentary films became an integral part of the primary and secondary school education system. With the help of these films, several learning processes were made easier (for example, memorizing letters or learning the basics skills of mathematics). Several special technical effects were already used in these early sound films, such as animation, trick shots, etc.

One can see the role of educational films and their impact on society during this time from the journal (*Filmkultúra- 'Film Culture'*), which was published in the 1930s by Andor Latja. Each issue of *Film Culture* had a section dedicated solely to educational films, which allowed readers to see how widespread and in how many different educational fields these works were used and screened. It was obvious even then that there were several different kinds of films: medical, ethnographical, geographical, and natural, in addition to industrial and commercial documentaries, which were used as educational aids. In categorizing the documentary films of these years, we can distinguish them into several groups, such as: *popular science films* (audience- wide public; place of screening- cinemas), *science documentaries* (audience- wide public with educational purposes; screening- cinemas and scientific presentations), *educational films* (audience- elementary, secondary, and higher education students; screening- in schools), *documentaries* (audience- interested in the sciences, professional specialists; screening- at conferences) and *research films* (audience- field specialists; screening- conferences, universities).

In the final part I analyze educational films from an international perspective, using the structure I outlined above. This allows us to see documentary trends in the West (with a special focus on nature films) and to compare them to the films that were made in Hungary at that time.

A COMPARATIVE HISTORY OF THE FORMATION OF PASSIVE BUILDING TECHNOLOGY

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Energy and environmental issues have attracted world wide attention since the latter half of the 20th century. To cope with these issues, we need both technological and socio-institutional countermeasures. In Europe, decision has already made to cut CO2 emission (and thus energy consumption) by more than 20%. In contrast, Japan is very slow to take such measures.

From this perspective, we are interested in the way how each nations and areas deal with the reduction of the energy consumption (and CO2 emission). We especially interested in energy-efficient building technology. This presentation will be dedicated to the comparative studies of historical formation of it, especially that of the passive building.

In the United States there was a passive solar house movement as early as in the 1940s. The houses exploited direct solar gain by using a lot of south-facing windows. However, full-fledged development of passive house came in 1970s, forced by the oil crisis in 1973. Variety of research institutes performed research on passive solar system, such as Los Alamos Scientific Laboratory, Solar Energy Research Institute, San Diego Gas & Electric and so on. J. D. Balcomb of Solar Energy Research Institute set the standard of passive solar house technology. In 1980, The first National Solar Conference was held. Even after the oil crisis, the passive solar house technology was further developed in various areas of the United States and Canada.

In Europe, although each country has its own historical trajectory, the origin of the current-type passive house is the one build in 1989 by “Passivhaus Institut Darmstadt.” This institute established the standard of “Passivhaus,” and now it is widely accepted as *de facto* standard in Central and North Europe.

Though the formation of the passive building technology in the West is comparatively well known, in contrast, the origin and the formation of that in Japan remains unknown. And its relation with the history of American and European counterparts remains vague. In addition, we found out that the relation between American and European history is not clear, either.

In this presentation, we will argue the formation of Japanese passive solar technology, and will relate it to the history of American and European predecessors. By our preliminary study, the formation of Japanese passive building seems to be more strongly affected by American than European. We plan to argue the details in the presentation, and will also partly discuss the relationship between American and European passive solar building.

We believe that such a historical study will serve to the future development of energy saving technologies.

THE RELATIONSHIP BETWEEN SCIENCE JOURNALS AND THE MEDIA: A LASTING MARRIAGE

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Science journals have played an important role in spreading scientific information, providing authorship to new developments and discoveries and improving science throughout its history. Publication has been increasingly a demand on scientists’ career and, therefore, the impact index of journals has become an important tool in the publication decision process. Publishing on the pages of journals as the centennial *Science* and *Nature*, considered two of the most important publications of multidisciplinary sciences in the world, can be a turning point for a scientist work, as it provides recognition in a local, national and international level, and it is a chance to put one’s research in the spotlight, improving one’s networks and financial support, as it has been recently showed in a case study with scientists in Brazil.

This paper aims at demonstrating that the journals have widened up their role as a means of communication among scientists by improving their relationship with the media. We will do that by using data from papers published on *Science* and *Nature* by scientists in Brazil in the last decade, and checking if they have appeared on the pages of the national newspaper with the largest circulation, *Folha de S. Paulo*, which has first pioneered a science section in 1989. We will compare the citation index of papers that have and have not appeared on the media. In 2007, *Folha* published 1247 science news, 239 of which mentioned *Nature* and 87 *Science*. Together they represent more than 26% of all science news in this newspaper.

This case study intends to show that in order to get a high index of impact it is most useful that the paper is read, noticed, and cited by as much scientists as possible. To do that, the media plays an important role both for the scientist-author, whose work becomes known, and the journals, whose papers are read by a wider audience –citing their content and contributing to their index of impact, aspects which certainly guarantee sales, financial support and status.

The relationship between journals and the media is the perfect marriage since the latest looks for visibility and the previous for interesting and legitimate science news to publish. As the media seems to have inspired the editorial board of both journals, the papers selected by *Nature* and *Science* should contain unique, outstanding and controversial discoveries reported on attractive and simple language to a wide range of readers – usually scientists, but also policy makers, financial supporters and the general public – who can get the results and developments of science, in Brazil mainly supported by the government.

Brazil is on the 15th rank of production of papers in the world and has only published 214 papers (articles, reviews, letters) on *Nature* and 153 on *Science*, from the 1930's until 2008. Only in the last decade, has Brazil contributed with more than half of this number and its contributions is increasing annually.

SOCIAL PHENOMENON OF CONTINUITY OF SCIENTIFIC SCHOOLS OF STATISTICAL PHYSICS IN UKRAINE

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In 2009 100 years from the date of a birth of the known mathematician and the physicist-theorist, the academician of National Academy of sciences of Ukraine N.N.Bogoljubov are celebrated, in many respects thanks to whose works the statistical physics became the fundamental theory of modern natural sciences, forming probability style of scientific thinking. He has offered the new approach to the statistical physics on the basis of key idea about hierarchy of relaxation times in nonequilibrium processes, has created microscopic theories of superfluidity and superconductivity, and has predicted effect of superfluidity of a nuclear matter. He has also developed axiomatic construction of the quantum field theory, for the first time has strictly proved dispersive parities, irrespective of others has offered new quantum number which has been named further by color.

Bogolyubov's works, and also his intensive pedagogical activity promoted formation at the Institute of Theoretical Physics (Kiev) created by him, Institute of Mathematics (Kiev), the Lvov University and Institute for Condensed Matter Physics (Lvov), the Kharkov Institute of Physics and Technology of the big groups of followers. They have generated the centers of two authoritative scientific schools of statistical physics in Ukraine led by academicians I.Yuhnovsky and S.Peletminsky.

At I.Yuhnovsky school results in the field of the condensed matter, phase transitions and the critical phenomena, the statistical theory of liquids, solutions of electrolytes, disordered systems are received. The method of collective variables in classical and quantum cases, the statistical theory of phase transitions of the second sort, the microscopic theory of solutions of electrolytes was constructed.

On the basis of the reduced description method S.Peletminsky school made the considerable contribution to the statistical physics of irreversible processes and a problem of nonequilibrium entropy, and also application of these methods to superfluidity, superconductivity, theory of plasma, the magnetic and spin phenomena in firm bodies.

CRITICAL ASSESSMENT OF NIKOLA TESLA'S LEGACY FOR CONTEMPORARY SCIENCE AND SOCIETY

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The present paper is aiming towards a new approach for the critical assessment of Tesla's legacy within the scope of modern science and society. Tesla was a great experimentator in the fields of physics and electrical engineering, but at the same time a philosopher whose moral concepts seem not have been evaluated yet completely. In the very early 20th century Tesla devoted much effort toward design and construction of the grand power to transport electrical power over long distances, which becomes popular today as the wireless power or energy transfer in science. Tesla's apparatus was essentially described and witnessed by the United States Patent Office via three Tesla's patents, for the period 1900 ? 1914. However, historians of science are still convinced today that Tesla's system was not explained experimentally in details. The moral concepts on the wireless energy transport, Tesla published in his fundamental philosophical-engineering paper "The Transmission of Electrical Energy without Wires as a Means for Furthering Peace" (Electrical

World and Engineering, January 7, 1905). His original concept of the “Universal Peace”, based on his proposal of transmitting of electrical energy by means of the terrestrial stationary waves, rather stands closer to the Russell’s logical view on the “world of universals” than to the Kantian idea of the “eternal peace” (1795). Tesla proclaimed a postulate for the universal peaceful relations through the three aspects as “dissemination of intelligence, transportation, and transmission of power”. A moral outlook from Tesla’s papers stands as a global compass even for the accelerator megascience in physics at the LHC today, till to the sophisticated investigations of the emergence of life at the nanoscale of a single cell in biology and/or genetics.

Presentation for the 23rd ICHST in Budapest 2009 will be focused on the new roads towards a new technology within the framework of Tesla’s legacy. Over than 100 patents in Tesla’s opus constitute his contributions not only in area of electrical engineering but also for numerous contemporary technologies (high frequency illumination, X-ray technique, cosmic rays, television, till to the Internet and the cell phone). In branch of superconducting radiofrequency technology a new development is occurring in our times at Cornell, JLab or CERN achieving the maximum possible gradient (in units of MV/m, megavolts/meter) of an electron beam through the accelerator cavities, obtained using the Tesla transformer method (the best Cornell result of 46 MV/m, in 2005). An entirely new break through into the wireless energy transfer today with respect to the old Tesla’s model is connected with an approach of M. Soljaèiæ et al. (MIT, 2008). Soljaèiæ‘s theoretical model of non-radiative energy transfer (of making no waves) consists of the two self-resonant copper coils (antennas) at the very close mutual distance of ~ 2m in order to minimize the power disperses as waves. Transmitting power efficiency is ~ 40 % so far at the waves of 10 MHz of about 30 m of the wavelength. Nevertheless, the analytical calculations and phenomenological data for the “T” bar antenna at the tip of Tesla’s transformer were recently obtained at the University of Zagreb, in order to demonstrate Tesla’s currents in physics lectures.

THE ROLE OF THE REFEREE IN ROYAL SOCIETY OF LONDON AT NINETEEN CENTURY

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The aim of the Royal Society of London, like in every scientific society, is to “organise” the Science, within the certain, in time and place, context. In order to do that, the “society” uses the judgment procedures and structures for every single theme it is submitted. Within the Royal Society of London the referees decide about the works which they are going to publish. The decisions of the referees are submitted to the authority of the council for the final approval. In fact, the decisions of the referees determine the “co-optation” (D’Ambrosio, 2005) or the exclusion of proposes in the sciences field.

I study the relation between the subject itself and its “administration”. I use the term “administration” to mean “the structures are responsible for the subject publication”, e.g. responsible to plant it in the social order.

It is clear the prestigious scientific institutions are responsible to decide about the “knowledge” and they do it usually based on a collegiate (Weber, 1978) and referees, it is also clear the subject has its history or histories. What is not clear is the relation between judgment of a subject and a subject itself.

The judgment of a “pseudo-knowledge” imposes a “decision” upon it. The “decision” is linked in a regular sense to a collegiate (Weber, 1978) that means the discordant opinions “can” take part on the decision about what will be or not “knowledge”, therefore the final decision must be submitted to the “committee”. Sometimes the vote is needed.

In the present work I fix Royal Society of London and a paper of the mathematician Arthur Cayley published on 1854 in *Philosophical Transactions* as an example. This paper was the first from a series of memoir on quantics where the author developed part of the Invariant Theory.

To relate usual History of Mathematics and documents related to the process of publication it is possible to find disconcerting results. According to the documents quoted and the Statutes of Royal Society, William Thomson was who knew that “…branch of the Science” (1847, p.21) because he accepted to judge the paper. Robert Perceval Graves did not give his opinion. The conclusion is based only on the formal rules of Royal Society, e.g. Statutes and referees. It is not possible to assert that Thomson was more capable than Graves to judge “An introductory memoir upon quantics”. However if we focus to the work of Graves and Thomson, it sounds that Graves fits more to Cayley’s work than Thomson. Disconcertingly the documents attest that Thomson used his authority and guaranteed the publication and Graves declined on it.

I do not propose to answer why this theory come out in 19th century and how mathematicians in Britain turned upon it, it is not the case to describe or to find the motivation, but to understand how much the “administrative” order play on the recognition process, consequently play upon a “reason” that makes a subject becomes a theory.

IMAGE, SCIENTIFIC EXPEDITION, THE PUBLIC, AND NATION IN BRAZIL (1870-1930)

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In the field of social sciences, there is a series of studies that relates iconography and the creation of nationality. My objective is to analyze the images (lithographs and photographs) produced in scientific expeditions and published in widely circulating magazines like illustrated periodicals. Generally, one studies the reports of these expeditions, paying little attention to the images that jointly circulated to the public. Therefore, it is important to analyze the images that were propagated in publications directed at the general public. The function of these images was to introduce to the urban public the distant regions of the Brazilian territory, like, for example, the Amazon or the Central High Plains. Keeping in mind that at the end of the monarchy and the beginning of the Brazilian Republic, the territory wasn´t known in its totality; the first national map dates from 1922.

After the 1870s, with the intensification of steam navegation and the telegraph, communication between the countries of Latin America and Europe grew. This exchange of ideas materialized in the circulation of magazines and books. Consequently, Brazilian intellectuals read with great interest what was published about Brazil in other countries. Recently, I have been working with images of the Amazon, published in the *Revista Ilustração Brasileira* (*Brazilian Illustration Magazine*) (1876-1877), derived from the expedition of Franz Keller to the region in 1867.

There is a large tradition concerning studies of the relationship between iconographic production and the nation. The subject of scientific expeditions has been already exhaustively analyzed. The main point of this research is to analyze a series of lithographic and photographic productions from scientific expeditions (especially in the Amazon) and see how intellectuals that seldom traveled interpreted those images. For example, Machado de Assis, a 19th century Brazilian intellectual and literary author, never left the city of Rio de Janeiro. The illustrated magazines that began to circulate in the city are an important locus where the public could see the images generated by the expeditions. These magazines published the works of men from science and literature. Thus, it is possible to understand the relationship between these two fields, science and literature, and to improve the understanding of the role of science in Brazilian culture.

THE 1853-1856 CHOLERA MORBUS EPIDEMIC IN PORTUGAL AS SEEN BY THE PRESS

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This research is part of a larger project focused on producing a History of the Popularization of Science and Technology in Portugal. The goal is to find out how scientific knowledge reached the common people in the nineteenth century, using newspapers as the main source of information. Keeping in mind the population's limited access to written material, nevertheless each newspaper could be read daily by an estimate 30.000 people in Lisbon, which places this source as probably the most widespread vehicle to divulge the latest scientific news at the time to an unspecialised audience. With a cholera morbus epidemic which affected the second largest Portuguese town and all the northern regions, as well as the Algarve, news and reports on its evolution were considered essential. A large database was built in order to analyse the news concerning this disease in 1855 and 1856, especially the ones about prevention and treatment. These are the ones that give us real information on the scientific knowledge of the time and the way it was used by society.

Regular Session T17
Science and Culture

MEASUREMENT OF TIME, LENGTH AND AREA IN SOUTHERN INDIA AROUND 10th CENTURY AD

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It is a matter of great interest that the ancient monuments in India were portals of measurements apart from centres of religion. Here we describe several monuments where standards of measurement of length, area and time are prescribed. Such ideas have been almost rediscovered in the context of a loss of authentic records of over thousand years.

We restrict ourselves to South India, which saw the rise and fall of many dynasties. With the advent of every new dynasty a new scale was incorporated. The stone inscriptions and markings on several temples provide evidences of the scales and the corresponding time. The measurement of time and the preparation of calendars also saw several modifications. Again, in the absence of a systematic record, these small jottings at the edge of a wall or on a rock near the monument serve as useful clues.

The choice of the scale interestingly points to the same standard as deduced in original Sanskrit texts dated 4th or 5th Century or even before. However, the difference shows up in the ingenuity of choosing the smaller units of measurements.

LABORATORY CULTURE IN ACADEMIA

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In the second half of the nineteenth century Belgian universities became more and more concerned with experimental science. Practical courses were added to the curricula and laboratories were built. These laboratories symbolized the objectives of the university as a true centre of research and education. By the end of the century these two goals met in the construction of big scientific institutes by al four of the Belgian universities in Brussels, Leuven, Liege and Ghent. In a few decades the laboratory became an essential pillar of academic scientific education and research, although it still had to struggle for its existence by a continuous lack of means, only to be solved in the late fifties of the 20th century.

This paper wants to focus from the inside out on the advent of the laboratory in academia and the developing laboratory culture that went whit it. The physiology and pharmacology laboratories of Jan Frans and Corneel Heymans in Ghent will be the focal point to discover what this laboratory culture was and how it developed throughout time.

In 1890 J.F. Heymans was appointed to the newly created chair of pharmacology and therapy. He only accepted on the condition that he would get his own laboratory. The first years he had to work in a few spare rooms at the faculty of arts and his laboratory animals, mainly dogs, drove his colleagues crazy. In less then fifty years everything changed. Corneel Heymans – who shared his fathers' interest in pharmacology and physiology – had been rewarded with the Nobel Prize for his research on the respiratory system in 1939 and they could work in a big and fully equipped scientific institute.

By studying the daily laboratory practice, based on the extensive Heymans-archive and on interviews with surviving laboratory personnel, it will be possible to reveal the internal hierarchy, the role of the laboratory instruments, routines, traditions, scientific networks and many other factors that compose the laboratory culture. During the period studied in this paper, roughly between 1890 and 1960, the authority of science grew in Belgium. Hence this paper wants to link an evolving laboratory culture to this changing authority by studying the academic and scientific context.

This empirical research is situated on the cross-section between university history, science studies and cultural history. The development of a central concept 'laboratory culture' will enable further research on academic laboratories and it will be possible to cross boarders between scientific disciplines or academic faculties.

NARRATING THE BEEHIVE

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For centuries the bees served as a model for how a well-run social polity might function. But over the course of the twentieth century, the moral and political bee gave way to the communicating bee largely due to the work of the Austrian-born bee researcher Karl von Frisch (1886-1982). Von Frisch – who together with Niko Tinbergen and Konrad Lorenz shared the 1973 Nobel Prize in Physiology or Medicine – discovered that the bees communicate the distance and direction of food sources to their hive mates by means of their dances. The news that a lowly insect communicates symbolically caused an international sensation and strained contemporary notions of the animal-human boundary.

In this paper, I explore how the communicating bee functioned in the hive. In particular, I examine experiments performed in the 1920s and 30s by von Frisch and his student and assistant Gustav Rösch and Katharina Berger, respectively, to test the division of labor among bees. The experiments explored how the bees responded when the social order of the hive was placed under extreme demographic stress. In particular, Rösch and Berger used beekeepers' techniques to separate the hive into a young and old *Volk*. The role of craft knowledge on the work of members of von Frisch's laboratory is largely omitted in von Frisch's own writings. Here, I recover this influence and focus on how these three scientists (von Frisch, Rösch, Berger) narrated these experiments and events in the hive in the context of the demographic crisis in interwar Germany. In so doing, I explore the parallel hierarchies of labor in von Frisch's laboratory and the beehive and revisit the problem of agency in historical examinations of animal behavior studies.

CREDIT FOR IDEA, CREDIT FOR EXPERIMENTS: THE AUTHORSHIP OF THE DOCTORAL DISSERTATION IN LABORATORY SCIENCES IN THE EIGHTEENTH CENTURY

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The doctoral dissertation was often penned by the supervising professor in 18th-century Germany (and many other places in Europe), but the credit for the published thesis was usually shared by the supervisor and the degree candidate. Such was the practice in all disciplines in the university.

Experimentation introduced an element that was not found in other disciplines, that is, labor in the laboratory. This paper takes as an example Albrecht von Haller, who was one of the first academics who regularly made his MD students participate in his experiments. Collaboration between him and his students in laboratory complicated the authorship practice. Haller chose to let his student enjoy undivided authorship of the dissertation and its experimentation in a way that he could retain the credit for his idea of irritability and keep the room in which he could disagree with the degree candidate on the theoretical interpretation of the experimental finding. Haller's choice set an example for the dissertations in laboratory sciences and would become the norm of future practice.

This paper thus investigates the authorship of an important genre of academic writing, the institutionalization of disciplinary difference in practice, and the structure and development of scholarly culture.

SPINOZA'S PLACE IN THE GENESIS OF EARLY MODERN PSYCHOLOGY

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I'd like to discuss the proposed Summer School theme within the context of Spinoza's reception of Descartes' philosophy of mind. In general outlines, the Spinoza's answer is well-known in the history of philosophy: Spinoza introduced the exact parallelism between the order of ideas and the order of things. For human being this theory meant parallelism between ideas and bodies. Still, recent studies reveals much more complicated picture of Spinoza's "psychology".

Spinoza, like Descartes, saw science according to the ideal of unified science, construed in the systematical way. Thus Spinoza and Descartes agreed that an ethics was to be considered as the highest part of the science. But for Spinoza the content of "ethics" was differed from Descartes' views. For Spinoza, the ethics as the "theory of the good for men" (Curley, *Behind the Geometrical Method*) included and nearly linked with an epistemology and a psychology. In his epistemology Spinoza developed the method of an "autocorrection" or "autoemendation" of our knowledge, i.e. as reciprocity of ideas.

The theory of emendation of intellect formed the foundation for Spinoza's psychology in the *Ethics*, III and IV. Affects aren't destroyed in the course of the intellective achieving of the adequate ideas, but reciprocate and correlate between themselves. The theory allowed to consider affects as an expression(s) of Nature (*Natura Naturans*). Spinoza didn't reduce thought to mere syllogistic reasoning (especially abstract one): he explored epistemic equality and reciprocity between ideas and affects.

Spinoza explained in his psychology that origins, changes and interactions of affects were to be sought in the natural causes. Simultaneously, Spinoza didn't identify the causes with bodies, but explained that an idea and any psychic "state" (occurrence) related to body's affections that included affections of other bodies. So for Spinoza a psychic state (affect) was related to a complex individual, and hence was to be considered as a complex phenomenon. I believe that the issues above to be studied prove truly innovative intentions of Spinoza's philosophy of mind.

LA FEMME ET L'UNIVERS VÉGÉTAL DANS LA BOTANIQUE MISE À LA PORTÉE DE TOUT LE MONDE AU TOURNANT DU 18e SIÈCLE

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À la fin du dix-huitième siècle la botanique est bien à la mode. Après la publication en 1781 des *Lettres élémentaires sur la botanique*, écrites par Rousseau à son amie Madame Delessert, l'industrie de l'édition du livre fournie aux lecteurs une ample collection de titres visant rendre la botanique plus facile et séduisante. À cette fin, les auteurs appliqueront plusieurs mesures telles qu'emploi d'analogies, procédés narratifs, incursions romanesques et références historiques et mythologiques.

Le phénomène de « la botanique mise à la portée de tout le monde » obtient un succès immédiat parmi les divers secteurs de la société du dix-huitième. Les jeunes femmes se montreront sensibles à la prolifération d'un gendre mi-littéraire, mi-scientifique conçu notamment pour elles. La langue de la séduction et de la galanterie, une prose languissante et souvent mielleuse, reflètent le regard de l'homme sur la femme. Sa beauté occupe une place de choix. La fleur et la femme sont deux natures semblables : toutes les deux partagent les traits de la beauté soulignés par Burke dans sa *Recherche philosophique sur nos idées du sublime et du beau* (1756) : la légèreté, la délicatesse, la douceur des formes… Les auteurs invitent le public féminin à connaître la flore, à visiter les jardins et pratiquer la culture des fleurs. Une botanique « d'alentours » et proprement domestique s'offre aux femmes, dont leur tâche consistera à se servir de leurs connaissances végétales pour veiller leur maris et leurs enfants. Enfin, sous prétexte d'une ressemblance corporal, l'homme esquissera une morale fondée sur des préjugés de genre.

VISUALITY AND PORTENTOUS WEATHER IN EARLY MODERN CULTURE

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Portents and prodigies played a prominent role in 16th and 17th century European culture. Conjoined twins, bearded grapes and blazing stars appeared and were discussed all over Western Europe. The culture of portents was socially widespread as well: academic scholars, courtly circles, and the uneducated common folk all had their beliefs about the causes and meanings of portents. In general, portents were considered as products of the collective sinfullness of the mankind. They were God-sent warnings and premonitions for impending calamities, with which He was liable to punish people unless they rectified their moral behaviour.

Various strange weather phenomena, such as rains of blood, wool or metal, mock suns, armies fighting on the sky, etc. played a major role in the field of portents. Real natural events were undoubtedly behind many reports of strange weather phenomena, but the objective of this study is not to find out, which phenomena recognised by modern science would best match the sightings in the 16th and 17th centuries. Rather, in this paper I shall treat strange weather phenomena as artefacts produced by the interplay of nature and human culture. Whether real natural events or visions produced by an agitated imagination, strange weather phenomena became cultural artefacts for two reasons. Firstly, the phenomena were understood and interpreted in terms which involved current apprehensions of history, morality and religion. Secondly, the functions and uses of strange weather phenomena in early modern culture were deeply contextual.

In this paper, I study how trange weather phenomena became cultural artefacts in the crossroads of textual, visual and oral traditions. A special emphasis will be laid on visuality, which was a quintessential characteristic of the existence of strange weather phenomena.

EPISODES IN THE HISTORY OF COLLECTING SCIENTIFIC INSTRUMENTS IN MID 19th CENTURY ENGLAND

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I examine a number of episodes related to the collecting of instruments in mid 19th century England. A wealth of social and cultural agents, such as the private collector, the donor, the instrument maker, the marketplace and international exhibitions constituted a cycle where scientific instruments were transformed into objects with a social life. Gentlemanly culture expressed great interest in things scientific. Such a fashion was manifested in a wealth of material statements, which defined the space for science in places such as the private cabinet, the amateur's observatory, and the library of a country house. A micro-cosmos of men of science/collectors is revealed.

JAPANESE CHEMICAL INDUSTRY AND THE "CHEMICALIZATION OF EVERYDAY LIFE" IN EAST ASIA, 1895-1945

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Chemical industry, as the engine of second industrial revolution, is undoubtedly one of the most important sectors in modern economic system. The development of organic and inorganic chemistry, together with the petrochemistry derived from 1920s, supply bountiful daily necessary, from fertilizer, comestibles, soap, plastic, textile and dyeing, printing, paper-making, not to mention pharmacy and drug. Chemical products permeate daily life and dramatically trans/form our material culture and attitude toward body. Being mantled by this "chemicalization of everyday life", we need pay more attention on the history of chemical industry and its role in modern world.

In East Asia, the Japanese eagerly devoted themselves to developing chemical industry from late Meiji era. They saw chemical industry not only as symbol of modernization and industrialization, but also criteria for competing and even overtaking their Euro-American counterparts. With the ever-flourishing development of chemical industry in the first quarter of the Twentieth-Century, Japan gradually became the biggest exporter of chemical products in East Asia.

In the empire of Japanese chemical industry, China, Taiwan and Southeast Asia play important roles of both consumers and suppliers for the basic row material of Japanese chemical industry. Before 1920s, most of the camphor for world celluloid production was supplied from Taiwan, while rubber for plastic production from Southeast Asia. After the outbreak of Sino-Japanese war in 1937, Taiwan became the military base for Japan Empire "marching to the South". For predominating the military and industrial resources, Taiwan and its southeast Asian neighbours were all integrated into and identified by the Japanese as "the South of the Greater East Asia Co-prosperity Sphere". How did this "Co-prosperity Sphere" construct and operate? What were the routes flowing in these networks, and what was the division of labour in different regions allocated? What kind of chemical knowledge and technology was transmitted and translated into these "Sphere" under the need for maintaining its operation? Did the Asian produce the same chemical products by the same technological and social base as their Japanese counterparts? Did they share the same aspect of these products as the Japanese? Did the knowledge of chemistry transfer concurrently and similarly in the empire wide of Japan, or would there be any block of this technology transferring for keeping the predominance of the empire? These are the issues I will try to resolve in this article.

THE FORMER HEADQUARTERS OF THE BOARD OF PUBLIC HEALTH – DGSP (DIRETORIA GERAL DE SAÚDE PÚBLICA) - AND ITS ROLE IN SANITARY REFORM AT THE BEGINNING OF THE 20th CENTURY, IN BRAZIL

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In 1902, Rodrigues Alves was elected president of the Republic of Brazil, and, in a speech to the nation, emphasized the need for sanitation in the then federal capital of Rio de Janeiro, and his administration´s commitment to this task. The city administration placed engineer Francisco Pereira Passos in charge of urban reforms, while the young doctor Oswaldo Gonçalves Cruz was to coordinate the sanitation reforms. As Director General of Public Health, he was charged with the eradication of the three principal endemic diseases in Rio do Janeiro, yellow fever, bubonic plague and smallpox.

The article seeks to analyze the importance of the former headquarters of the DGSP, constructed at the initiative of Oswaldo Cruz and designed by the Portuguese architect Luiz Moraes Júnior, in implementing and institutionalizing public health policies in Brazil.

To achieve these objectives, Oswaldo Cruz considered it essential to reform the sanitation services, reorganize legal regulations so as to increase the power of the sanitation authorities, and to restructure and give powers to those infrastructures designated to implement his new public health project. His plan was to establish an up-to-date model of public health which aimed at breaking the insalubrious reality inherited from Imperial Brazil by constructing buildings that obeyed the “modern precepts of the most secure hygiene”, in various points of the Federal Capital, “to promptly meet the needs of the other Sanitation districts”. After 1892, as member of the District Council of Municipal Hygiene, Oswaldo Cruz proposed a “division of the urban areas in the Federal Capital into five large districts, in each of which would be placed a public disinfecting chamber, with complete equipment, ambulance for the sick, transport vehicles for material and personnel, and the transport of clothing and objects, thus, all the necessities for a well-organized establishment; with disinfecting annexes, bath rooms and incinerators”.

The following aspects of the old headquarters of the DGSP are examined: the original site: economic and technical means used in construction; the reasoning, programmes and purpose behind its use; economic, physical and conceptual limits and conditions of space; the creators, their ideas and programmes; the architects, their training, works and methods; the architectural firms employed and the ways of contracting services, the buildings and their environmental surroundings throughout the 20th century; physical, functionary and visual relationships with the City of Rio de Janeiro.

The article also deals with the current initiative taken by the Instituto Nacional do Câncer - Inca- of the Health Ministry, current owner of the property, for the restoration, reuse, preservation and appreciation of the former site of the DGSP, a reference point for the origin, evolution and institutionalization of the Brazilian public health policies. A modern scientific education and research centre for researchers, health professionals, doctors and residents, as well as the general public is to be installed in the buildings.

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BIOPOLITICS AND CULTURAL HERITAGE IN BRAZIL: THE NATION VERSIONS BETWEEN WORLD WARS

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The objective of this paper is to present how Brazilian intellectuals from different fields understood the concepts of health, archive and heritage, while developing a biopolitics to the country from their interpretations of its population. For this analysis, the author uses the works of Freud and Nietzsche, as well as the reception of these authors by Brazilians.

The presentation will explore the path opened by Foucaultian tradition on biopolitics. It will also use the works of brazilian social sciences that demonstrate the impact that issues as disease and public health had in debates about nation’s projects and in the construction of the Brazilian State in the years of 1920 and 30. It intends therefore to show the connections between the themes of culture, health and nation and, at the same time, to extend the scope of the interpreters of Brazil, using as interpreters not only the best-known essayists who write explicitly a history of nation and propose a project for the country.

Indeed, even in the travel reports on proposals for sanitation and hygiene texts it's possible to notice interpretations of Brazil. As well, the vanguard literature authors as Mário de Andrade and Oswald de Andrade bring to light not only questions about what was the Brazilian culture, but also propose an interpretation of the country and even suggest a way the Brazilian could connect with the past. So, this analysis takes the perspective of biopolitics, establishing a relationship between memory, archive, heritage and health.

Following this idea, the concept of construction of Brazilian nation was established forged in an active way by different actors, knowledge and institutions, and thus, essayists of Brazilian Social Thought, as well as other groups of interpreters from Brazil are considered, whether hygienists, eugenists, psychiatrists and psychoanalysts (as Renato Kehl, Júlio Porto-Carrero, Durval Marcondes, Osório César, Medeiros e Albuquerque, Neves-Manta e Arthur Ramos) or writers (as Antônio Alcântara Machado, Monteiro Lobato, Mário de Andrade, Oswald de Andrade e Prudente de Moraes Neto). Overall, the goal is to develop an analytical framework of the various diagnoses and projects of nation. At the same time, this paper shows that health is often seen beyond the biological issue, being understood in its connections with the memory and, accordingly, with the relationship between the individual and nation.

HUMANIST SCIENCE

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It is natural to want to consider every field which uses reliable and informative methods to be scientific as it is to want to hope or believe that there is a single methodological approach that is suitable for all fields. But unfortunately, the two goals are not always compatible. Science based on pursuit of laws and on pursuit of truth are different as are underlying assumptions about meaning, logic, and causes. Truth as correspondence with reality requires an assumption or belief about reality, since what is real is normally understood to determine what is true. But differences about such matters can be respected if needed for different types of problems.

Most humanists who engage in extensive, detailed research tend to believe that they are being scientific if their results are true and informative beyond a reasonable doubt, like Caesar crossing the Rubicon, Columbus the Atlantic, but not so sure that Cook or even Peary actually reached the North Pole. We also think it is possible for humanists to discover truths which are more reliable and less ambiguous than most laws, be they empirical, statistical, or deterministic, especially in a world where machines can increasingly discover differences within types, such that many laws become "ideal laws" like those of Boyle and Charles which give way to new laws or understanding which take more variables into account. Hence, we think it is time to allow for two different types of science: law-based and truth-based with natural science including both and humanist science the latter.

Admittedly, most of the humanities do not seem to have found a consistent method to discover truth, but there is one exception: extensive historical research where simple description based on weight of evidence and where authors and readers only believe only as strongly as the weight of evidence justifies. Even this method does not guarantee truth, but if the conception of reality is reasonable and realistic, it can make truth so probable as to deserve being called a scientific method.

The fairest way to reconcile physical science and the research-based humanities is to change classification and call them both sciences, that is, reconciliation won by respecting plurality of sound methods where assumptions about meaning, logic, and causes are different. What are those differences? First we must learn to appreciate both Language-Determined *and* Intent and Assumption-Determined Meaning, second, Logic as Pure-Reason i.e. formal or mathematical) *and* Practical Reason i.e. inductive logic when properly qualified, cause-and-effect logic when we understand that only a totality of relevant factors can fully determine anything, and means-end logic, where means and ends are both ethical and effective and both side- and after-effects of a bad kind are very unlikely. And third, and most important we should learn to honor both law and truth as scientific goals, and learn where each approach is possible. Generally, what is very small or very distant where it is hard to notice exceptions or discrepancies are subject to understanding by laws and what can be almost exhaustively researched in a careful and non-idealized manner can make the search for truth suitable.

SCIENCE IN CULTURE AND CULTURE IN SCIENCE: INTERTWINING EXPERIENCES FOR STIMULATING CURIOSITY IN CHILDREN

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The paper presents a comprehensive history of established connections at SRC SASA, the eminent Slovenian research institution, between natural, social sciences, and humanities on the one hand, and cultural institutions, such as museums, archives, libraries on the other. By comparing similar examples of cooperation the paper focuses on the problematic, the good solutions and particularly the benefits of such activities for the general public. For a long time, the results of such cooperation have been mostly directed at older public, usually academics, and contributed to mutual enhancement of these institutions. Regarding the rather limited public, the impact of the scientific work remained limited as well; on the other hand, cultural institutions, rarely active outside their premises, also applied standard research methods and their representation. Thus, until recently, both the scientific and cultural institutions were mostly unattractive for the youngest visitors, whose curiosity potential and hunger for knowledge was mostly limited to the former rather than the latter. Quite understandable: when compared to research institutions, the museums, galleries, and libraries have had a longer tradition of communication with elementary schools. Nevertheless, the stereotypical representations about dull visits to museums and incomprehensive scientific research became firmly embedded in juvenile understanding of culture and science.

Only in the last decade are such stereotypes gradually becoming substituted by new juvenile understandings resulting from new approaches toward presentation of educative content, particularly in museums; at the same time, science remains still more or less secluded in the ebony tower. The author, a researcher ethnologist takes the example of *Research playshops SRC*, an ongoing project first organised during the 2004 summer holidays (for children, aged between 7 and 14), to demonstrate an innovative approach in cooperation between the scientific and cultural institutions. The principle of this cooperation is based on the premises that it is essential to bring science and culture closer to children – closer to the potential bearers of future development in both realms – by stimulating and encouraging their curiosity. The lack of curiosity results in insufficient interest in science and culture, which yields no new realisations, no desire for making new discoveries, and also poor awareness of national identity.

The *Research Playshops*, know under the motto *Let's play science!* have in the last five years introduced a new way of cooperation between cultural and scientific institutions in Slovenia. Significant interest among the participating researchers, custodians, librarians, archivists, members of NGOs etc., results in outstandingly heterogeneous and variegated programme which is based on familiarising children with real methods used by scientists and cultural workers alike. Each day is devoted to a specific topic – one scientific discipline – one activity. And it is precisely such activities that necessitate the most pronounced interest of children in science and culture. To be concrete: under guidance, children are actively (in a lab or in the field) led to comprehend the results of a particular research, they do the tests themselves, note it down and finally relive it through research of thematically related exhibitions, archives, libraries in Slovenia. Thus a synchronisation of research content and exhibitive activities between research and cultural institutions is gradually being established. This is partially reflected in ever more enhanced synchronisation of programmes for children in Ljubljana during the summer vacations. Having for the first time established connection between most of the participating institutions, the *Research Playshops* have definitely contributed significantly to promotion of these activities. The *Playshops* attracted custodians of the Ljubljana City Museum, librarians from the National and Study Library, custodians of the National Gallery and from additional 24 museums from all over Slovenia, 15 culture and science associations, 2 computer centres, and several renowned Slovenian artists, and also 25 researchers, 16 of them from the SRC SASA. The *Research Playshops* project evolves continually, inter-institutional cooperation deepens, and children's curiosity remains as boundless as ever.

THE LANGUAGE OF SCIENCE IN A GLOBALIZING WORLD

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Currently, globalization is an attribute of our difficult time. Global peace - it is a holistic, unified, open international system. In a world where diversity is beginning to realize by socially significant problem, linguistic phenomena, including the terminology and processes of science should be regarded as components of habitat. For the philosophy of science dealing with the theory of scientific knowledge, logic and methodology of scientific research, the language is interesting, not as object but as a means of learning, v.f. interesting: as evidenced by the language, how to determine the means and results of cognition. In the overall context of globalization is the formation of a new thesaurus of the language of science, which is capable of functioning in the global information systems.

Existing linguistic forms of natural languages evolved in the overall fragmentation. The countries were less dependent on each other. This allowed not only to create a unique language for each word, word, and the terms of science, but also to preserve information and cultural diversity in a globalized world for choosing a new direction of development of society. The main question that arises when considering these provisions, is perhaps how and in what form is carried out (and whether at all!) Terminological exchange between different disciplines, and how it ultimately affects the science.

Born in an era of conflict between thought and speech, passed further step of ascertaining the ratio of words and concepts, the problem is already in our time has been redefined in terms of the role of language in cognition, which, in turn, gave rise to the variety of colors and approaches to its interpretation. One of them expressed a desire to create for learning a particular language of science, free from defects of natural. This raises the question of «natural boundaries of the scientific accuracy of the term» and highlights the very existence of such boundaries. But whether there are such boundaries in an era of globalization?

The language of science to be exact. But the reality is that this does not occur. Scientific terms - words that are used are not all native speakers, but only part. This often serves as a baseline prerequisite for understanding the terms as a special «type» or «class» word of the exact «the language of science».On this subject written by a lot of interesting, often controversial research books and articles which can be summarized in the conclusion that at any time have their own favorite scientific terms, the line of which you can trace the history of society. The word has, above all, helpful information. It captures all changes in society, which the latter is undergoing. For this reason, to study this phenomenon, v.f. character display and translate the concept into the structure of the language of science, we need a special research unit - the ideology, methodology and technology research. Because with all the diversity of approaches to the language of science, all researchers agree that the problem is linked primarily to the interpretation of maps «conceptual» in linguistic structure, in particular, signs and symbols.

ANTI-SCIENCE: ITS HISTORY AND FEATURES

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In human history, roughly speaking, there are two waves of thought that lead people rethink and explore the harmonious relation among human, nature and society in order to answer what is right or wrong and what is good or bad. Besides scientific wave of thought that is familiar to us; the other is non-scientific or parascientific wave of thought. Until now science is discussed as much as they can do, but as an important member of non-sciences, anti-science has been ignored for a long time.

As a opposite of science, anti-science develops from some scattered, individual views and words to continually a powerful and dynamic movement that are took part in by the public to a large scale. Until now, because of global problem appearing, anti-science has been paid attention to widely. What kind of role anti-science plays during the process of the emergence, development of science? Does it do harm or good for science, or other else? In the research of external history of science, science was demonstrated from the social, historical, cultural perspective. However, if from the angle of anti-science, we will have better understandings for science.

This paper will comb the history of anti-science of pre-scientific period, anti-science of modern scientific period (the 15th Century-the 19th Century), anti-science of modern scientific period (the 20th Century–in the middle period of the 20th Century) and anti-science of postmodern scientific period (After 1970's), generalize their features and look for the logic clue of the development of anti-science by analyzing differences between science and anti-science in order to advance some new insights that are useful for our comprehension of science and clarify relationship between science and society better.

BRINGING SCIENCE COMMUNICATION TO PUBLIC BEHAVIOR

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With the development of population and industry, Human beings are faced with many severe problems, such as exhausting resources, deteriorating ecological environment, threatening health problems. The role of modern science and technology is more and more fully recognized by the public. However, referring to above problems, does science and technology get ready?

Scientists in global are not self-confident to say “yes”. Indeed, these problems could not be solved by single side in short time. Science communication, as a bridge between scientists and the public has come to the stage and made great effort to promote the understanding. Some exciting results were reported by the mass media, which shows the positive effect brought by science communication.

In the year of 2007, the national scientific literacy leading group of China decided to carry out science communication with the focus on saving energy and resources, protecting biological environment, safeguarding health and security. The challenge of the theme science communication lies in that how to let the public turn their correct consciousness into social behavior. In order to reach this goal, much more should be investigated from the angle of the public or so-called “receptor”. For example, Maslow’s hierarchical demand theory should be studied in the context of theme communication. The citizen’s consumption habit in modern should be considered, too.

Some case studies show directly the key points in the theme science communication. The related study is under going.

Keywords: Science communication, Public behavior, Scientific literacy, Receptor

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Trans-cultural Diffusion of Science

TRANSFORMATION AND ASSIMILATION: THE RESPONSE OF CHINESE LITERATI TO WESTERN CRYSTALLINE SPHERE IN THE LATE MING AND EARLY QING PERIOD

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The Western crystalline sphere, which was mainly based on Aristotelian doctrines and was introduced by Jesuits in late Ming and early Qing China, had a great impact upon Chinese literati since then. Many scholars, to take some typical examples, Wang Yingming (juren, 1606), Xiong Mingyu (1579-1649), Fang Yizhi (1611-1671), Jie Xuan (c. 1620-1703), You (c. 1614-1684), Wang Xichan (1628-1682), and Mei Wending (1633-1721) were very interested in this kind of knowledge, as China had not such a concrete cosmos model. Transforming crystalline sphere based on Confucian learning was their main approach, so that they constructed a Confucian cosmography that integrated western learning.

In this paper, I will focus on Chinese literati's response to Western crystalline sphere, with particular reference to Jie Xuan, to illustrate how they assimilated it into Chinese views of nature, in varying degrees of transformation. Unlike Wang Yingming's and Xiong Mingyu's accepting without much criticism, Fang Yizhi's "from interest to indifference," and You Yi's hesitation, Jie Xuan's attitude toward this model was very unique. With the seeking for *suoyi ran*», he critically pointed out disadvantages of Western learning and *lixue* as well, and constructed a cosmology with special emphasis on *yuanqi xuanwo* theory. He not only presented a clear model of cosmos, but also formulated a definite dynamics of heaven. In addition, by reconstructing the crystalline sphere, he indicated that Venus and Mercury had special revolution around the Sun, which was something like Capellan System.

CULTURAL CONTROVERSY IN 18th CENTURY ENGLAND: THE TRANSMISSION OF VARIOLATION

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The transmission of variolation, a preventative technique for smallpox, from Turkey to England in 1721 created political, medical and religious opposition. Paramount in the controversies were the sermons and tracts of the church. Religious rhetoric was based on ethnic grounds but primarily on the perception, still widely held today, that this medical intervention was a practice of the heathen 'Turks', and should not be practised in a Christian country on Christian people: in consequence, thousands died unnecessarily of smallpox. Ironically this perception was a fallacy.

Research into archival material written by long-term resident Franks, and books by Ottoman subjects in Constantinople, Smyrna and Aleppo in the 18th century presents cogent evidence that variolation was mainly practised by Christians, and that in general Muslims did not accept it due to the tenet of predestination in their religion.

Thus this cultural controversy in England, which possibly originated from the Eurocentric references in speech and literature to 'Turkey', instead of to the Ottoman Empire, peopled by 'Turks' and synonymous with Muslims resulted in delay in the wider adoption of a life-saving medical technique, the first immunization.

THE INTRODUCTION OF THE SMITHSONIAN METEOROLOGICAL SYSTEM IN JAPAN

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Between 1849 and 1861, the Smithsonian meteorological project, directed by Joseph Henry, served as the national center for meteorological research; it provided standardized instruments, uniform procedures, and free publications. After 1865, the war-damaged Smithsonian system was gradually rebuilt. In 1870, a meteorological department was established by the U.S. government under the Signal Office of the War Department. This paper explores the process involved in the introduction of the Smithsonian Meteorological System in Japan, a topic that appears to have been more or less neglected in former studies.

The points of discussion are as follows:

1. Joseph Henry's interest in meteorological observation in Japan

Joseph Henry had an interest in the process of modernization in Japan. He supported Arinori Mori while Mori worked as a charge d'affairs in Washington, D.C. When Mori was leaving the United States in March 1873, Henry encouraged him to collect any existing records of meteorological observation available; they would attempt to acquire accurate ones later.

2. B.S. Lyman's activities at the Kaitakushi (Hokkaido Colonization Office)

"Oyatoi gaikokujin (hired foreigners)" of the Kaitakushi in Hokkaido, a northern island of Japan, believed that meteorological observation was crucial to colonization. Joseph Henry was asked to recommend suitable engineers for the Kaitakushi. One of his recommendations was B. S. Lyman, an American geologist who arrived in Japan in January 1873. In March 1874, the head of the Kaitakushi asked Lyman to order seven sets of meteorological instruments through Henry. In November 1875, Lyman was asked to request Henry to send them seven copies of pamphlet 148 of the Smithsonian Miscellaneous Collections (Directions for Meteorological Observations).

3. William Wheeler's initiatives at Sapporo Agricultural College

Sapporo Agricultural College was founded in Hokkaido in 1876. In as early as September1876, William Wheeler, an American civil engineer, set up a small meteorological observatory with a full set of instruments and made meteorological observations according to the standard system of the Smithsonian Institution. His complete report appeared as an appendix in the first annual report. Based on Wheeler's proposal, the Kaitakushi adopted the standard system of the Smithsonian meteorological system all over the Hokkaido in 1877.

4. Translation of the Directions for Meteorological Observations

The Imperial Meteorological Observatory at Tokyo was founded within the Ministry of Interior on July 1875. It was believed that the non-American "oyatoi" at the observatory did not adopt the Smithsonian meteorological system. However, in July 1880, the Ministry of Interior published a translation of Directions for Meteorological Observations and the Registry of Periodical Phenomena. According to the preface, the original document is the Smithsonian Miscellaneous Collection printed in 1872; further, it states that its points are clear and that the intention of the translation is to provide observers with direction and to help them make their techniques accurate.

DES OBJETS AUX GESTES: UNE ARCHÉOLOGIE DE L'ÉCOLE DE PHARMACIE DE L'OURO PRETO, MINAS GERAIS, BRÉSIL: 1890-1920.

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D'un côté l'École de Pharmacie de l'Ouro Preto, Minas Gerais, Brésil garde un des plus importants fonds sur l'enseignement et la pratique scientifique au Brésil. Nous pouvons illustrer sa richesse par l'indication d'une collection de plus de huit cents objets et d'une vaste collection de manuscrits, cahiers des enseignants, commandes des instruments et de substances avec des justificatives de l'achat, notes, listes d'emprunt a la bibliotheque, registres d'examens et des concours. Par la lecture des manuscrites l'historien peut tracer l'histoire institutionnelle par différents volets, soit-il financier, disciplinaire, pédagogique ou administratif.

De l' autre côté dans cette communication nous explorons la portée d'un projet d'indexation de ces sources et la possibilité ouverte de croiser les informations extraites des textes et des images sur les humains (éleves, professeurs et fonctionnaires) et les non-humains (objets - livres, cahiers, instruments, substances), et ce faisant de récupérer la vie de l'école et du savoir pharmaceutique en circulation par le proces de montage d'une banque des données et des outils dynamiques de recherche. A l'occasion du congres nous lancerons le site que donnera acces a la banque des données (http://www.arq.ufmg.br/nehcit/efop). A partir des informations récupérées les internautes pourrons détruire la fausse idée diffusée dans l'historiographie de l' histoire de la science au Brésil selon lesquelles il n'y a pas eu de production technique ou scientifique au Brésil dans le domaine pharmaceutique concernés par la période 1890-1920.

LES ENJEUX D'UN MÉDIA VISUEL DANS L'ENTRE-DEUX-GUERRES.

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L'entre-deux-guerres est une période charnière dans la mise en place de rapports entre société, sciences et médias. En Italie, notamment, se crée en 1924 « L' Unione Cinématographica Educativa » (LUCE), première organisation ciné-éducative sous contrôle direct de l'Etat, dont la principale activité est la production et la diffusion des films culturels, didactiques et scientifiques. En Allemagne naît aussi, en 1930, à Berlin, le *Reichsanstalt für Film und Bild* d'où naîtra, après la 2e guerre, l'*Institut für den Wissenschaftlichen Film* (I.W.F.), à Göttingen. L'*Institut de Cinématographie Scientifique* (ICS) est quant à lui le premier organisme fédérateur en France, soutenu lors de sa création en décembre 1930 par de nombreux scientifiques. Une dynamique s'installe par ailleurs au niveau international, via l'Institut international de coopération intellectuelle de la Société des Nations, pour développer les rapports entre les hommes de science et la diffusion de leurs recherches par l'image.

Quand, en avril 1934, se tient à Rome le *Congrès International du Cinéma d'éducation et d'enseignement,* le rôle du cinématographe comme agent de formation morale et intellectuelle des peuples et comme moyen de favoriser leur compréhension mutuelle est alors mis en relief. L'appel est donné aux divers gouvernements pour développer les films scientifiques à l'usage des organisations intéressées, mais aussi en direction de la masse populaire. Comment va être pensée cette collaboration entre cinéma et science dans les différents pays ?

Entre éducation populaire, média et propagande, les enjeux sont en effet multiples à l'aube de la seconde guerre mondiale. La *Revue internationale du cinéma éducateur* donne à ce titre de multiples indications. Notre étude portera également sur la place et le rôle du cinéma scientifique, français et international, lors de l'Exposition Internationale de 1937 « Les Arts et les techniques dans la vie moderne », qui se tient à Paris de mai à novembre. Le cinéma y est annoncé comme « l'un des plus précieux auxiliaires de la Pensée », rôle loin d'être négligeable au sein d'une Exposition placée sous le signe de Descartes, symbole du rayonnement de la pensée française. La science est alors l'objet d'une nouvelle stratégie de diffusion culturelle en direction du grand public, au sein de « La croisade pour la science pure » menée par Jean Perrin(1870-1942) et qui aboutira à la création du CNRS en 1939. L'image animée aura un rôle central dans la diffusion d'une « science vivante » dans le cadre du Palais de la Découverte, Palais qui deviendra par la suite un référence internationale en termes de muséographie scientifique. Mais le cinéma apparaît aussi comme le média au service de la science, un média sur lequel s'appuient les scientifiques pour faire reconnaître l'utilité des sciences par le grand public et faire ainsi pression sur les pouvoirs politiques pour structurer la recherche en France.

PARADIGM OF TRANSFERENCE OF SCIENCES FOR EXAMPLE ANDALUSIA IN FINAL OF MEDIEVAL

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Objective: History of community in reality is the history of knowledge. Undoubtedly analysis and explanation the method of transference of science and thought between nations is the most important phenomenon in history of science. This fact is the body of sociology of knowledge civilization. Transference the thinking of man is historical experience because the social fusion of culture and wisdom of nations depends on special condition of community.

The Islamic and European scientist try to explain the relation between knowledge and various social classes. Islamic scientist in medieval rank the community by their ability of understanding of truth. They relation between classes of mind and social classes.

Result: this article was studied the process of science from Andalusia and sicily and Maghreb to Europe in medieval and also was studied the sociological and philosophical framework of transference scienc, the question is that: what is the causes of exodus arab of history and civilization and entrance Europe to history of science and civilization?

Metodology: using descriptive analytic method, works of kant agust kont, poper, schelder , Michael fokault, maxweber, hegel, ibn khaldun and others were studied, and their opinion was analized about how science transferring and thought evolution are in society? Also was analyze historical reality of coming and falling of lslamic civilization which had experienced two transferring.

Concolution: The transference of Islamic science is obvious historical phenomenon. If this transference in medieval was occur upon special paradigm and what was the ideological and social framework and social impression of this phenomenon? This phenomenon must be researched by opinions of Hegel, Kant, popper, schelder, Manheim, max Weber, Foucault…

Key words: Fall of Andalusia, fast of science , republic of science, pure spirit, determination, ideological forms, Hafsid kingdom.

LA GÉOLOGIE EN ALGÉRIE (FIN XIXE-MILIEU XXE SIÈCLES) : ORIGINES ET DÉVELOPPEMENT D'UNE DISCIPLINE AU SERVICE DE L'ÉTAT EN CONTEXTE COLONIAL

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En Algérie, à la fin du XIXe siècle, les travaux des premiers géologues explorateurs ont contribué au processus d'institutionnalisation et de développement de la géologie en contexte colonial. Très vite, les géologues ont su se constituer un réseau académique et scientifique et se mettre en même temps au service de l'État colonial.

Tout d'abord il s'agira de rappeler rapidement les contextes sociaux, politiques, économiques et institutionnels qui ont favorisé l'émergence de cette discipline localement avant d'en analyser le processus de développement. Nous pourrons examiner tout particulièrement quel a été le rôle des universitaires et chercheurs métropolitains dans le développement d'une discipline et d'une profession très tôt liées au pouvoir colonial et aux enjeux stratégiques suscités par l'élaboration de la Carte géologique de l'Algérie et plus tard par le développement économique local et métropolitain. Prenant appui sur la biographie de quelques figures de proue, nous nous intéresserons tout particulièrement à leur rôle et leur contribution au processus d'industrialisation en Algérie. La voie des premières études et découvertes est ouverte par des géographes et des géologues universitaires tels Meyendorff et Menchikoff, Roubault ou des baroudeurs tel Kilian et par des serviteurs exclusifs de l'État qui vont chercher à convaincre et à associer les hommes d'État aux chefs de file de la prospection (industriels, banquiers, techniciens). En septembre 1952, l'Université d'Alger accueille le 19ème Congrès géologique international qui réunit près de deux mille congressistes métropolitains et internationaux. Des personnalités scientifiques tels Paul Fallot, prennent une part active à l'organisation et au déroulement du congrès.

La géologie a joué un rôle incontestable dans l'exploitation des recherches pétrolières et les enjeux politico-économiques qu'elles suscitèrent. Le Sahara, resté véritable *terra incognita* jusqu'au milieu des années 1950, va devenir un enjeu politique et économique pour les pouvoirs en place à partir de cette date. Au même moment, Alger devient le lieu d'une grande animation scientifique.

Suite aux premières études géologiques de reconnaissance initiées en 1946, au lendemain de la Deuxième Guerre mondiale, les années 1950 constituent un tournant puisque les compagnies d'exploitation et de commercialisation pétrolières s'engagent de manière radicale sur le terrain, malgré un contexte politique local et central peu propice au développement économique et industriel de la région.

Regular Session T19
Technology Transfer

THE US FOREIGN POLICY IN THE EARLY PERIOD OF THE COLD WAR AND THE INTRODUCTION OF TELEVISION BROADCASTING AND ATOMIC ENERGY TO JAPAN

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This paper discusses the relationship between the US foreign policy toward Japan and the activities of *Yomiuri Shimbun*, a private daily owned by Matsutaro Shoriki, based on the newly released US documents relating to the introduction of television broadcasting and atomic energy to Japan from the occupation to independent periods and the files of Hidetoshi Shibata, Shoriki's right hand.

The US government utilized television as a means of psychological warfare for the military purposes against communism in the early period of the Cold War, and regarded Japan's adoption of its TV standards as an important part of its strategy for building a strong Japan-US alliance after the end of its occupation of Japan.

The US government also used as a part its foreign policy "the peaceful utilization of atomic energy," which became popular with President Eisenhower's "Atoms for Peace" address at the general assembly of the United Nations in December, 1953. The Bikini incident soon after that made the US government fear the emergence of anti-US campaigns in Japan. To counter these campaigns, it offered to help with the utilization of atomic energy for peaceful proposes. General Dynamics Corporation, a large US corporation, was also active in introducing atomic energy to Japan independently of its government.

In Japan itself there was a strong desire for the introduction of atomic energy. Shibata contacted Daniel S. Watson, a member of the Department of Defense after the Bikini incident and asked him to arrange an "Atomic Energy Peace Mission" to Japan. *Yomiuri Shimbun* invited John J. Hopkins, President of General Dynamics Corporation, Nobel laureate Ernest Lawrence from the University of California at Berkley, and Lawrence Hafstad, director of the division of reactor development of the American Atomic Energy Commission as the mission. It now appears, however, *Yomiuri Shimbun* group's activities were in fact supported by the US government, and were done within the framework of the US foreign policy.

DIGITIZATION LIKE SCIENCE

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In many countries digitization is basically perceived just as a practical field of activity and it is executed only practically as well. Much more suitable are broader approaches when we could search for a scientific character of digitization, is empirical and experimental fixing of objective phenomenon of reality that could be investigated by the new science. In this paper discussing about digitization like science, but not like practical field of activity.

Purpose of paper - give the answers to the following questions: can digitization be comprehended in a sense of scientific research?; What is possible object of scientific research on digitization is?; Can the science of digitization have peculiar terminology and methods?

Digitization is considered to be a method suitable for documentation, storage, scientific research, communication. If digitization is considered to be a method then, next to its practical application, it can also be comprehensible in the context of scientific research where the basis of scientific research is a method theory. For instance, such method as mathematical statistics is already included into the European Classification of Study and Research Areas, Fields and Branches.

Other opportunity, where we could search for a scientific character of digitization, is empirical and experimental fixing of objective phenomenon of reality that could be investigated by the new science. In such a way the sciences originated from practical activity of memory institutions – librarianship, archivistics, museology – are defined. Nowadays they are also acknowledged as independent research disciplines and objects of academic studies.

Object of digitization researches may be called emulativity. In digitization it is a specific relation between a man and reality when people, basing on criteria, select from reality or/and artificially generate the objects, on the basis of which they create emulative systems in digital environment emulating and imitating the activity of natural systems operating in reality (that operated in the past or will operate in future). Emulativity is a specific phenomenon induced by digital technologies, virtual world and Internet and that may be studied in many senses up to personality psychology inclusive.

Emulativity phenomenon may be studied in different aspects – historical, philosophical, sociological, psychological, fundamental, applied, etc. This lays the foundations for systematization of digitization like science.

TECHNOLOGY TRANSFER CONSTRAINTS AND THE PORTUGUESE POLYMER INDUSTRY

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The technology transfer processes are complex and conditioned by several technical, cultural and economic factors, for which several theories and models are developed and available to study it. The purpose of the paper is to analyze the nature and the process of technology transfer in two portuguese polymer industries (PVC and TERYLENE). The introduction of both polymer industries took place in the 1960s, by means of foreign technology, imported from Japan and Great Britain.

We intend to focus on the transferred technology originated from technologically advanced countries like Europe and Japan and its adaptation to the specific conditions of the recipient country. Considering the technology transfer as a mechanism for increasing the rate of economic growth in less developed countries, we'll discuss the forms that technology transfer has taken as well as the problems associated with technology transfer from developed to less developed countries. Also, the workers mobility as a channel of technology transfer, the changes in those industries and related firms caused by such transfer will be examined. Other research questions are raised: what kind of technologies was used in each industry? How were the technologies transferred? Were there any differences on the technology transfer mechanisms between those countries?

MERCURY AMALGAMATION IN HISPANIC AMERICA: GLOBALIZATION OF A MINING TECHNIQUE IN THE SIXTEENTH CENTURY

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During the XVI and XVIII century two methods for refining silver ores were used in Latin America: smelting by fire and mercury amalgamation. Amalgamation replaced smelting by fire, after the *beneficio de patio*, the invention by the *miner of Pachuca*, took over. In the mid-1500s, Bartolomé de Medina carried out in the silver mine of Real de Purísima Grande many experiments involving the use of mercury and large quantities of salt and *magistral* (a copper-iron sulfate) mixed with finely-ground silver ores. German miners were very familiar with this technique. 'As time passes', a German miner explained to Medina, 'the mixture should darken as silver minerals are decomposed by salt and the silver forms an alloy with mercury.' Then, according to the German miner, one had to 'wash out the spent ore in water, retort residual amalgam; mercury is driven off and silver remains.' From Mexico, and with incessant experimentations because the amount of mercury varied according to the nature of the local ores, this technique spread to Peru, through Álvaro Alonso Barba and Pedro Fernández de Velasco. Mercury amalgamation became in Hispanic America a new industrial mining technique.

Although destined to suffer modifications, German techniques had an enduring impact in the development of mining in the New World. Spanish and Portuguese engineers spent time at the most famous university for the instruction of mining science, the *Bergakademie* of Freiberg. The Spanish colonies still remember the names of Fausto d'Elhuyar and Andrés Manuel del Río, trained at the *Bergakademie*. The Iberian crowns subsidized study tours that included fieldtrips to the mining districts of Saxony, Bohemia, Hungary, Russia, Sweden, Norway, and England. Did German mining techniques represent diffusion of European science into the mines of the New World? Was mercury amalgamation

adapted to the New World following the role of German financiers in the Iberian Peninsula? Is it simply a question of technology transfer, from a higher, sophisticated level of production, to a lower level? Are mining techniques transformed from industrial to domestic relations of production, at times when mineral production ceases to be at the core of the global economy? The paper discusses the above mentioned questions drawing upon a succinct survey of the history of mercury amalgamation in the New World.

Keywords: mercury amalgamation, silver, Potosí, Agricola, scientific mining, Hispanic America

HOW A GUILD APPRENTICE BECAME AN ARCHITECT IN THE 19th CENTURY? - ON THE EXAMPLE OF JÁNOS PROKOP'S JOURNEYS

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As a result of the industrialization the fall of the guilds has been beginning in the 1800s but also in Central-Europe. While the vocational education has not adapted to these changes, the frame of the guild system has remained as a practical training provider. After the schooling period the guild apprentice has risen to the level of a journeyman, who has travelled across Europe and has gained experiences – transferring new building methods, new technologies and new materials.

János Prokop (1825-94, chief engineer and architect of the Hungarian royal town Esztergom and of Archbishop of Esztergom) as a journeyman 1843-1849 has obtained his experiences in West-Europe. Studying his architecture and his numerous remained buildings the interference of the different technical knowledge of each region can be observed.

ANALYSIS OF THE SOVIET TECHNOLOGY TRANSFER IN THE DEVELOPMENT OF CHINA'S NUCLEAR WEAPONS

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Some people consider that Soviet technology transfer meant a lot to China's nuclear weapon program. This paper analyzes what kinds of nuclear weapons technology the Soviet Union transfer to China, what type of the role the Soviet technology transfer played in China's nuclear weapons program, how long it would have taken China to build its first nuclear bomb if it did not receive relevant technology from the Soviet Union, and why the Soviets held so different opinions from the Chinese.

First, this article attempts to ascertain the content, range, and depth of the nuclear technology transfer from the Soviet Union and tease apart the technology contribution of the two countries. It summarizes the extent of the Soviet Union's fulfillment to each project dictated by bilateral agreements and analyzes the importance of the technology transferred from the Soviet Union to China.

Second, this paper analyzes and lists the key issues solved by the Chinese themselves when China developed its first atomic bomb. It summarizes three features of Soviet activities of technology transfer: they covered a wide range but lacked detailed information; the Soviet experts were pushed to transfer more to China and they did so reluctantly; and these activities were supported by the non-nuclear technology transfer. This paper then makes a comment on the Soviets' and Chinese assessments on the role of the Soviet technology transfer. It also discusses how long it would have taken China to build its first atomic bomb if it did not receive relevant technology from the Soviet Union, and draws a conclusion that China could have exploded its first atomic bomb by the end of 1964 even without such technology transfer. But it also would be true that China would have mobilized more scientists, technicians and workers from civilian fields for building its first atomic bomb, which would have produced great negative effects on civilian fields.

Thirdly, this paper puts forward the following four factors to help explain the two nations' different attitudes toward the nuclear technology transfer: the assimilation issue after technology transfer, the complexity of a large-scale project, the gaps between scientific theory, technology implementation and engineering practice, and the importance of tacit knowledge to nuclear bomb development. These factors also can be applied to explain a more general phenomenon: Each nuclear power denies the value of nuclear weapon technology coming from other countries to some degree. After all, technology transfer is quite complicated. It is not just buying and then knowing, or training and then knowing.

Regular Session T20
Gender in Science and Technology

WOMEN INVESTIGATORS AT THE INSTITUTE FOR HEREDITY RESEARCH IN BERLIN 1912-1928/33; FIRST RESULTS

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The dawn of the twentieth century witnessed the birth of the new discipline of genetics. An important aspect of the early establishment of genetics is the large number of women who contributed to early research.

In 1912 the first *Institut für Vererbungswissenschaft* (Institute for Heredity Research) in Germany was founded in Berlin as part of the *Landwirtschaftliche Hochschule* (Agricultural College). Erwin Baur (1875-1933) became the first director of the institute and a professor of genetics. In the first period of this institute many female scientists were working here, first of all Elisabeth Schiemann (1881-1972) and Paula Hertwig (1889-1983), furthermore the assistants Luise von Graevenitz (1877-1921), Emmy Stein (1879-1954) and Gerda von Ubisch (1882-1965).

Stamhuis will study the history of this institute from various perspectives; a.o. from the point of view of the kind of genetic investigations that were executed and of the division of labor between men and women. How can we understand this large number of women in this institute? To explain this, the various biographies of these women; the situation of women scientists in Germany, or ore specifically in Berlin, the situation of the new field of heredity research, must be taken into account. It will be relevant to compare the outcome with published comparative results of other clusters of women in early genetics: in Cambridge around William Bateson.

The paper will present the first results of her investigations, which she undertook in collaboration with Annette Vogt.

WOMEN SCIENTISTS AND THE CULTURE OF DIFFERENT LABORATORY PRACTICES - FROM THE INDUSTRY TO THE KAISER WILHELM SOCIETY AND VICE VERSA

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In the last decades in the history of science important progress has been made towards a deeper understanding of the role of women scientists in different scientific disciplines, not only in sciences. Some progress has also been made towards a deeper understanding of the role of various laboratory practices and instrument making (for example, in chemistry and microbiology, in physics and technology). More investigations are neccessary about the development of different laboratory practices in relation to women's roles in it (of different disciplines), and studies about the situation of women scientists in different laboratories, the existence of boundaries or various degrees of openness related to women scientists in these laboratories. The paper will focus on the situation of those women scientists in Germany who were employed in scientific institutes of the Kaiser Wilhelm Society (1912-1945) as well as in different laboratories of the industrial research. First, the paper describes (summarize) the situation of women scientists in institutes of the Kaiser Wilhelm Society, compared with institutes of the German universities and the Academies of Science. Second, the paper analyze a sample of in total 18 women scientists who were employed in laboratories of the Kaiser Wilhelm Society as well as in different laboratories of the industrial research, for example in the enterprises AEG and Telefunken in Berlin, IG Farben in Ludwigshafen and Krupp in Essen. Third, the paper compares the different laboratory practices.

WOMEN-SCIENTISTS AS AN OBJECT OF THE GOVERNMENTAL PROPAGANDA IN SOVIET UNION BEFORE THE WORLD WAR II

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During the second half of the 19th century and the first decade of the 20th century in Russia women were unsuccessfully struggling for the right to get the higher education. In 1918 the Bolsheviks Government passed the law that gave women equal rights in all spheres of life. Thus after fifty years of struggle soviet women received an access to the university education and to the research and academic positions in the scientific institutions and universities as well.

New authorities were seeking for the supporters and women who before the Revolution were considered, as 'second-class' citizens were good candidates for that role, especially women who obtained a rare, prestigious and very 'male' profession of a scientist. So in 20-30th years of the 20th century soviet popular and mass papers and journals used to publish articles about outstanding women-scientists, and statistical data with the growing number of female students and women who were taking positions in scientific institutions. Some of these publications were intended not only for Russian people but also for foreigners as a good example of the soviet achievements. In 1936-37 conferences of women-scientists were held on Moscow and Leningrad as well as in some other cities with the main aim to report about the success of the governmental policy in the field.

One could think that the authorities so interested in the loyalty of women and so preoccupied with the propaganda of equality would give its backing to female students and scientists. For example they could assign some quotas for female students and professors, gave some privileges to women-mothers and so on. But a careful investigation didn't find anything like this. Using an image of a soviet woman-scientist like a proof of the advantage of Soviet regime the government didn't do a single thing to support such women in reality leaving them to pass their way through the labyrinths of scientific life alone.

THE CURRENT SITUATION OF FEMALE RESEARCHERS IN JAPAN

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In 2005, I was invited to the International Workshop on Women in Physics at the ATCTP Headquarters in Pohang, Korea. This experience inspired me to organize an "International Workshop on Women and Science/Technology (S&T) Network in Asia" in Nagoya, Japan, in 2006. In the next year, a follow-up opportunity for discussion supported by the APEC Fund was offered by a Korean professor. It was followed by International Conference of Women Scientists held in Yang Ming University in Taipei, Taiwan in 2008. Gender in S&T is now the hot topic in the Asian region.

Japan is one of the most famous countries for its scientific development. Despite of this fact, the rate of female researchers in Japan is very low. Among OECD countries, Japan is ranked at the bottom. Japanese Government's Third S&T Basic Plan FY 2006-2010 has proposed further utilization of female researchers. Following this Plan, the Ministry of Education, Culture, Sport, Science, and Technology (MEXT) launched, in 2006, a big project as the centerpiece of its endeavors to increase the number of female researchers. The project, entitled "Developing Model Systems for Supporting Female Researchers," funded by the Special Coordination Funds for Promoting S&T, selected 10 proposed programs submitted by universities and research institutes in Japan, and awarded each organization 40 million yen (almost $400,000) a year for up to three years in order to encourage female researchers to continue working in the event of childbirth or childrearing. By fiscal year 2008, total thirty three universities and institutes had been selected and started innovative programs. These programs aim to promote vigorous actions to increase the number of female researchers and S&T-orientated women in various ways. My university, a small local national university, became one of the implementing universities last year.

Showing many line graphs, I would like to introduce the situation of female researchers in Japan from viewpoints of horizontal segregation as well as vertical segregation and to explain current changes in MEXT, EPMEWSE (Equal Participation of Men and Women in Science and Engineering), and SCJ (The Science Council of Japan), and also to draw attention to a problem that has newly arisen with the increase of female researchers. Especially, I would like to raise the issue of the so-called "Two Body Problem", or "Dual-Career Academic Couple Problems." In the United States, many universities routinely grapple with this problem but in Japan the significance of the problem has not been fully recognized yet. The marriage of female researchers with male researchers is common. If universities and research institutes are keen to give female researchers a chance to fulfill their abilities, it would not be advisable to leave this problem to continue unchecked.

GENDERED ELEMENTS IN CHEMICAL THERMODYNAMICS: A MODEL FOR CONCEPTUALIZING GENDER IDEOLOGY IN THE CONTENT OF THE PHYSICAL SCIENCES

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Feminist science criticism has overwhelmingly concerned itself with biological theories about sex, sexuality, and men and women. This line of inquiry has convincingly demonstrated how human values and interests influence not only the focus of inquiry in scientific research but its outcome as well (see, for example, the work of Ruth Bleier, Ruth Hubbard, Anne Fausto-Sterling and the early work of Donna Haraway). Biological theories such as the parental investment theory, evolutionary biology, animal behaviour studies, and neuroendocrinology mirror and endorse widely accepted views about gender. This kind of infiltration of social values and interests into scientific theories has been extensively documented by historical studies and analyzed by philosophical ones (most significantly in the work of Sandra Harding, Helen Longino, and Lynn H. Nelson). Although there is now a growing body of research on the gendered *professional cultures* of physics (for example, the work of Sharon Traweek, Maria Rentetzi, and Margaret Wertheim), few attempts have been made to analyze the *content* of the physical sciences (sciences which study non-living systems) from a gender perspective. How is gender ideology (a set of beliefs which legitimate unequal gender relations) expressed in these fields, if at all?

I intend to explore the above topic by analyzing one particular chemical theory: chemical thermodynamics as presented in Atkins' *Physical Chemistry*, a prestigious and widely used textbook in tertiary science education. Illustrated by examples drawn from my analysis of this text, I propose different ways in which the impact of gender ideology on chemical theory can be conceptualized, and discuss the methods in which they lend themselves to investigation. The first issue is disciplinary identification, or how the boundaries of chemical thermodynamics are constructed through the definition of its subject matter. This in fact translates to the relation of chemistry to physics, or the autonomy of chemistry, arguably the most important topic in the emerging discipline of the philosophy of chemistry. The second line of my inquiry concerns the conceptual structure of chemical thermodynamics. Core concepts such as the perfect gas, the dichotomy of heat and work, state functions, and most importantly, entropy, are being structured by binary oppositions and influenced by the gender connotations of these.

Finally, what relates my work to (epistemologically relevant) history of science is the analysis of the broader set of assumptions and hypotheses, ontological in nature, that underlie the theories of chemical thermodynamics. As with physical chemistry in general, these are the mechanistic, the thermodynamic, and the quantum mechanical paradigms. Elizabeth Potter and Evelyn Fox Keller have argued that the triumph of mechanism over the Hermetic tradition at the birth of modern science was linked to the intention of its advocates to re-establish hierarchical social relations in the aftermath of the English Revolution. I will argue that the thermodynamic paradigm grants nature some of the agency that it has been deprived of by mechanism, and make an attempt to link this change to 19th century developments in gender relations.

A GENDER PERSPECTIVE ON RESEARCH CAREERS IN SCIENCE AND TECHNOLOGY DURING THE ECONOMICAL TRANSITION IN RUSSIA

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During the transition from an economy directed by the State to a market economy in the early '90s, many factories and technological research centres and universities experienced difficulties, especially in science and technology departments: federal funding dramatically decreased when usual relationships between the industry and R&D were destroyed.

This paper is based on the outcomes of a research study conducted at Orel State University in 2008 in collaboration with Prof. Dr. Vera Uvarova with the financial support of RUSERA-EXE European fellowship. The aim of the study was to explore the differentiated career strategies and motivations of men and women academics in science and technology departments after the economical changes in Russia during the 90's.

The study collected quantitative statistical data on the situation of the S&T disciplines and its evolution during the '90s till now. The data is combined with qualitative biographical data from interviews with researchers and academics who have experienced the transition period. The interviews are based on their biographical experience and life story telling. The sample includes men and women who quit academia, who come from another sector to become academics or who stayed in the academia. They were asked about their own situation and motivations and their colleague's situations. They were invited to compare the situation of men and women during that period.

During the most critical period —early nineties— women seemed to better resist to the dramatic changes they experienced at that time. Anyway, when the system returned to a more stable situation, men tended to restore their dominant hierarchical position in higher education.

The paper will explore the different strategies of men and women, their attitudes towards the changes, how it changed their careers, with a specific attention to the impact of new economical conditions and new rules on gender relationships in the academia.

EMPOWERMENT PROCESS IN THE RURAL WOMAN PROMOUTING BY PUBLIC POLICIES

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Today the women have become the point of attention of the public policies, to consider them a vulnerable group; most of these policies are designed to cover the practical needs with the women without questioning the generic inequality. In spite of that some programs have managed to impel in the women the management capacity, the participation and the development of abilities. Of the interest in this work to analyze there if the public policies generate conditions to foment empowerment processes between the women of two groups: San Marcos and San Sebastian located at the center of Mexico. Questionaries were administrated to identify the transformations that they impel at a personal level, group and in the generic relationshiops, using etnomethodology perspective and qualitative techniques to understand the empowerment process.

The results of the investigation show that the social programs do not lower the inequality of sort when focusing in their practical necessities and to reinforce their traditional role like women; but it creates conditions of possibility for the empowerment if on a par external factors to the program arise that foments it. In the 62,5 % testimonies it was observed that the organization of the women through program caused empowerment at personal level that were reflected in greater self-esteem, security and self-confidence; in the collective dimension and of the near relations the process is incipient by the conflicts between groups and the resistance to the change of the traditional role of sort. Finally to impel the empowerment process from the public policies it is necessary to design them and to implement them under the cross-sectional of sort in the joint search of strategies that allow the transformation of the generic rolls.

Key words: Women Empowerment Process, Public Policies, Gender Role.

PAIN AND CHILD BIRTH: A JOURNEY THROUGH THE HISTORY OF OBSTETRICS' ANAESTHETICS IN THE 19th CENTURY

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Pain, even though subject to different interpretations and subjectifications, is one of the most basic human experiences. But to "feel pain" is not only to perceive a set of physical responses to an injury. The experience of pain entails a subject, who through the experience of pain is transformed, transfigured. Hence, pain, as a human experience, is differently sensed and understood from individual to individual, and from culture to culture. Pain is a powerful part of humanity, and "no matter whether the culture is ancient or modern, pain and illness cannot be disentangled from complex social and personal systems"[1] and they have built the history of man.

An historical account of pain is necessarily limited in its path trough the different perceptions and understanding of pain of the different periods that have built the western culture, but it has to comprehend simultaneously an account of the science involved in its knowledge and management. But even to glimpse a little of the history of pain is to create a chronicle of mankind. Therefore, in this paper I propose an enquiry through the history and culture of pain, with a special focus in the history of obstetrics anaesthetics. Labour has been portrayed one of the most painful, and therefore, fearsome events since the earliest recorded history and has held that status until the last century. When the anaesthetic effects of ether and chloroform were discovered, in the mid 1800's, and with them the first use in child birth, and era of controversy and debate arose. Groups pro and against for 'adapting pain-free childbirth', reflect the changing attitudes of the Victorian Era towards pain and especially towards women.

The history of pain is a difficult account, many times told through the history of science developments and history management. Moreover, it is usually an account that disregards the history of one of the most feminine of pains – the pain of child birth. I will focus primarily in the late 19th century, which was marked by the discovery of anaesthetics. While on one hand, the new scientific developments led to an era that the main belief was that disease and pain are biologic processes subject to study and control by new methods of science and technology; on the other hand, a different group believed that all manner of calamities -disease, drought, poverty, and pain - signified divine retribution inflicted as punishment for sin (especially childbirth pain). A change in public attitude in favour of obstetric anaesthesia marked the culmination of a more general change in social attitudes that had been developing over several centuries. Anaesthetics were subsequently used increasingly for labour pain, and the concurrent drop in mortality and morbidity in both mother and infant were attributed, in part at least, to the absence of pain which permitted the midwife or obstetrician to work unhindered in difficult labours.

1. R. Rey, *The history of pain*, Harvard (Cambridge and London, 1995), p.34.

GENDER, CULTURE AND POWER IN THE SOCIAL CONSTRUCTION OF MENOPAUSE

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The scientific thought about women's body has been changing over time it has been being influenced by the cultural images of each epoch. The construction of the menopause by science as a medically shaped disease reflects many of these cultural metaphors. Even so scientific discourse owns authority in our western society, it is socially legitimated and widely spread as a nonnegotiable truth.

Western women from developed countries who have more access to scientific information are those who state to suffer more from of menopause symptoms, moreover they show a huge support to Hormone Replacement Therapy (HRT), even when there are still a lot of controversies over its adoption. On the other hand within other societies menopause symptoms are not felt in the same intensity or when felt are considered to be part of the natural process of ageing. Within the eastern world the menopause phenomenon is practically unknown to the point that there is no name for this period in women's life.

This scenario seems to show that the idea of menopause as a disease and its symptoms are not the same in all societies. Within this context we aim to analyze the constructions of western scientific thought about menopause and its treatments with reference to the Social Studies of Science.

The analyses proposed by this work may be more complex than what a simple dualistic separation of the world in sex/gender, reality/socially constructed or nature/culture can offer. Knowledge about reality or nature, usually within the scope of scientific knowledge, does not exclude the interference from what is constructed or cultural in its conception.

Keywords: science, culture, menopause, women body.

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Science and Political Context

OTTOMAN DECADENCE REFLECTED IN DR. ESSAD'S OPHTHALMOSCOPE

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The period beginning with the Berlin Congress of 1878 on the 'Eastern Question' and culminating with WWI marked the end of the Ottoman Empire. These decades coincided with a momentum in the admission of contemporary technology into Turkey, and the establishment of the new institutions of learning, paralleled with a surge in numbers of Ottoman young professionals trained in the West. Students who attended European centers of research were stimulated by the activities they participated in, and endeavoured to publish scientific papers. Others tried to patent novel methods and instruments for which they expected to be rewarded by the Sultan. Dr. Essad (Esat Isik) was a military physician who succeeded in his enterprise.

Esat Isik (1865-1936) graduated from the Military Medical Academy in Istanbul in 1889. He specialised in ophthalmology in France, working with Profs. Photinos Panas at Hôtel-Dieu, and Félix Despagnet at the Faculty of Medicine in Paris. His fellow residents included Drs. Constantinos Tahinzis, Alexios Trantas, and Ananias Gabrielidčs, all of whom were to hold key medical positions first in Istanbul, and subsequently in Athens. Dr. Nicolaki Vassiladčs, a lieutenant in the Ottoman army like Dr. Esat Isik himself, was also training in ophthalmology in Paris.

During the course of his studies, in 1893, Esat Isik developed a reflecting ophthalmoscope which came to be known as the 'Ophtalmoscope Essad' or Dr. Essad's Ophthalmoscope. This is a simple and convenient instrument with a pair of plane and concave pierced mirrors mounted back to back on a springed frame allowing for rotation, and alternative employment for ophthalmoscopy and sciascopy. The original model of the Essad Ophthalmoscope was commissioned to the Maison L. Giroux (Paris), and has double mirrors of 39 mm diameter with a central circular aperture of measuring 5 mm. The brass frame has a foldable handle. There is a modified version with larger mirrors (44 mm) and a smaller sight-hole (3 mm), which has been reproduced by various manufacturers in Europe, and remains in use to-date.

Esat Isik returned to Istanbul in 1894 with his ophthalmoscope. He was duely decorated by Sultan Abdulhamid II, and appointed professor at the Gülhane Military Hospital where he established a separate ophthalmological clinic. He served at the Imperial Children's (Hamidiye Etfal) Hospital, and the Nursing Home (Darülaceze). Favoured by the Sultan he received the title of Pasha, but eventually sided with the constitutionalist movement that lead to the revolution of 1908. Esat Isik was appointed Deputy Minister of Health in 1912, after which he was involved in the creation of a number of political and social organisations, including the Red Crescent. Dr. Isik became an active member of the Committee of Union of Progress which governed the Empire through the Great War. He collaborated with the nationalist movement through the allied occupation. Prof. Esat Isik tutored at the Darülfünun Medical Faculty for another ten years after the founding of the Turkish Republic. His name remained associated with his ophthalmoscope, which was an instrument for his initial promotion, and allowed for his retreat to clinical practice in the face of political impasse. In this piece of historical background the Essad Ophthalmoscope became a singular Ottoman contribution to the modern medical arsenal.

HISTORY OF SCIENCE AND NATION-BUILDING: IDENTIFYING THE "TURKISH CONTRIBUTIONS TO SCIENCE," 1870-1950

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This project is an analysis of how histories of science inform processes of nation-building. I examine the question within the context of the disintegration of the Ottoman Empire and the formation of the Turkish republic through a narrative on how it became so crucial to identify the ethnic identity of Muslim philosophers and scientists for Ottoman and Turkish elites.

The intersections between state formation and scientific practice have attracted considerable interest recently. There also exists a significant literature on how scientific research has been integral to imperialist as well as nationalist projects. But there are few works that focus on how ideas appropriated from histories of science were integrated into the very building of nations. A question that deserves more attention concerns how "contributions to science" became an essential ingredient for the writing of the official histories of "imagined communities." As the Ottoman and Turkish experience shows, this is a particularly interesting question in the case of peripheral countries that imported European histories of science along with European science itself.

19th century Ottoman authors wrote many texts on science, as they tended to see it as the sole reason behind European progress. A major source of this notion was the books they read on European civilization that also focused on the history of science - works by authors such as Renan, Draper and Le Bon. These works exhibited the influence of orientalism on the historiography of science: the acknowledgement of the contributions of Muslim scientists in the "Golden Era" of Islam. This narrative emphasizes how Muslims constituted the link between Greek Antiquity and European Renaissance, but it regards Arabs as the representatives of Muslim glory, and Turkish ascendancy as the onset of Islamic decline. We observe in the writings of Ottoman Turkish authors an unease about this narrative after the 1870s: while they continued to refer to Arabs as the "Noble People" and espoused the discourse on "the Islamic origins of modern science," in their discussions they started to underline that Turkish scientists had also contributed to science. In the end, around the end of the 19th century, some writers started to refer to Ibn Sina (Avicenna) and al-Farabi as Turkish, rather than simply Muslim, scientists.

The establishment of the Turkish Republic in 1923, however, constituted the real turning point and proving the Turkishness of these figures became a conscious aim. The multi-ethnic Empire had collapsed, and the official discourse on the "timeless" Turkish nation was in the making. The purpose was to show that Turks, like Europeans, were noble and civilized; the Ottoman / Islamic past regarded as deplorable was shunned from official history and the imagination of the nation. A new generation of scholars helped the emergence of this new history: a history where the ethnic identity of Ibn Sina was a matter of life and death.

"FOR PAUPERS ONLY!" THE GENERAL POLICLINIC VIENNA: POLICY LABORATORY AND COUNTER UNIVERSITY

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In 1872, the General Policlinic was founded by twelve associate professors from the Medical Faculty of the University of Vienna. It was financed from personal resources and generous donations of mostly Jewish citizens and noblemen and was therefore not dependent on the government. With the motto: "For the paupers only and completely free of charge", the outpatient system enabled impoverished patients treatment who could not afford a longer stay in hospitals. The Policlinic had departments from practically all the disciplines at its disposal and worked inter-disciplinarily. With physicians such as the gynaecologist Carl von Rokitansky, the surgeons Johannes von Mikulicz-Radecki and Anton Wölfler, and also the laryngologist Johann Schnitzler, the institution reached an exceptionally high standard in medical treatment and research. Following the example of this first social medical center in Europe, further clinics were set up in other European cities, the U.S. and in Cairo, Egypt.

The stock market crash of 1873 strengthened the competition fears of the Medical Faculty professors towards the Policlinic professors. The successful clinic was turned into a counter-university. While the Medical Faculty was striving increasingly strongly for social and national elite in the choice of its academic staff, the General Policlinic remained open to different ethnoses, denominations and social milieus. The alleged threat posed by the over-representation of Jewish doctors was instrumented politically with increasing nationalism and anti-Semitism and used for political-science propagandas. 'German' doctors were directed against the collective of the 'Jewish' doctors with a specific exclusion policy. Marking off had become an accepted political category. Modern anti-Semitism legitimized the endeavours to make the Polyclinic 'free of Jews'. This set the direction of a new political "movement". While Erich Deimer recognizes a "delay of the further development" for the clinic after the First World War due to the economically bad situation, he interprets the political and economic results of the years 1938 to 1945 as a clear "break". With the 'Anschluss' of Austria to the German Empire, the clinic lost not only its "autonomy", but a large part of its intellectual potential. All Jewish doctors were forced to leave the Policlinic.

This paper analyses the differences in the development of the two medical institutions in a time of economic crises and radical social changes. Different (medical) cultures arise, where putting up delimitations becomes more important than cooperation. The Vienna Medical Faculty and the General Policlinic differ not only in their understanding of organization and leadership, their approach to patients and use of latest technologies and therapy forms, but also in their understanding of performance, power and national elite. With the 'Jewish' Policlinic being declared the concept of the 'enemy', a knowledge transfer is prevented with the Medical Faculty and the international reputation of the Vienna Medical School weakened generally.

DID G.MENDEL'S POLITICAL INVOLVEMENT INTERFER WITH HIS SCIENTIFIC ACHIEVEMENTS DURING THE PERIOD 1853-1865?

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Between 1853 and 1865, Mendel has conducted the experimentation which was going to be described in 1865 in his lectures on the hybridization of plants. He did so during the post-revolutionary period, where heavy political tensions were existing in the neo-absolutist Habsburg empire. According to V.Orel (1) this period was particularly difficult for the Augustin monks of Brno. Although H.Iltis (2) did not mention it. We have already tried to show that politics has played an important role in Mendel's life (3,4,5,6).

Presently we are willing to discuss if and how, the political context has interfered with Mendel's scientific projects.

1) Orel,V. Gregor Mendel, The first geneticist. Oxford : Oxford University Press, 1996
2) Iltis,H. Gregor Mendel.Leben, Werk und Wirkung.Berlin:Springer, 1924. English translation : Life of Mendel.London: Allen and Unwin, 1932. 2nd ed.New York : Hafner, 1965.
3) Nivet,C. 1848 : Gregor Mendel, le moine qui voulait tre citoyen. Med.Sci.(Paris) 2006; 22: 339-446.
4) Nivet,C.Une maladie énigmatique dans la vie de Gregor Mendel. Med.Sci.(Paris) 2004; 20: 1050-3.
5) Nivet, C. 1848, Gregor Mendel, the monk who wanted to be a citizen. 2nd International Conference of the European Society for the History of Science. September 6-9, 2006, Krakow, Poland.
6) Nivet,C. Was Gregor Mendel a clandestine student at Vienna University in 1851 ? 3rd International Conference of the European society for the History of Science. Vienna, September 10-12, 2008

SCIENCE, NATIONALISM AND (MULTI)CULTURALISM IN THE LATE HABSBURG MONARCHY 1848-1918: A PRELIMINARY OVERVIEW OF THE ISSUES

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The nineteenth century is often presented as a time of emerging nationalism as well as a period of growing international cooperation. Science as a cultural activity and resource was also strongly influenced by nationalistic and internationalist discourses. The sciences and higher education policy in the late Habsburg Monarchy were battlegrounds for varied nationalisation projects. Germanisation of the 1850s was followed by polonisation (of Ukrainians) in Galicia, magiarisation in Hungary and conflict between Czechs and Germans in Bohemia. These polarisations impacted the natural as well as the social and human sciences. Contacts between emerging national scientific communities were restructured according to new political schemata. At the same time, a program of antinationalist positivism also received political support.

Related papers in this section will examine the influence of nationalism on science and cultural transfer in East Central Europe, questioning both the thesis of the free flow of knowledge and the claim that science and knowledge transfer were driven entirely by political considerations. This paper presents some aspects of the complex background against which these conflicts and tensions could be viewed, under three headings: (1) infrastructures of modernity – higher education reform, disciplinary differentiation, networks - "centres" and "peripheries"; (2) levels of science transfer – or insularity; (3) sciences as/in cultures – beyond "Vienna 1900".

Literature:

Mitchell G. Ash, Wissens- und Wissenschaftstransfer – Einführende Bemerkungen. *Berichte zur Wissenschaftsgeschichte* 29 (2006), 181–189.

Tatjana Buklijas und Emese Lafferton, Science, medicine and nationalism in the Habsburg Empire from the 1840s to 1918, *Studies in History and Philosophy of Biological and Biomedical Sciences* 38 (2007), 679–686

Ralph Jessen & Jakob Vogel (eds.), *Wissenschaft und Nation* (etc.). Frankfurt/M., 200x

Deborah Coen, *Vienna in the Age of Uncertainty: Science, Liberalism and Private Life*. Chicago 2007

COMPLEMENTARY OR COMPETITIVE? NATIONAL AND INTERNATIONAL SCIENCE IN 19th CENTURY HABSBURG MONARCHY.

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The process of "imagining community", characteristic for 19th century Central Europe, means creating an own interpretations of regional identities and imposing one's own cultural definitions on the boundaries with other communities. The scientific landscape of the monarchy was not merely included in the process of impoverished emancipation which was led by several nationalists and not uncontested in other milieus. Rather, it was in fact one of the most vivid places of cultural conflict. However, in the "post république des lettres" period, nationalisation stood against the understanding of science as an international project, which grew even stronger at the end of 19th century following the growing number of scientific periodicals and conferences.

Though most of the conflicts around science were fought over resources like universities and academic chairs, the national narrative influenced and was influenced by the scientific demarcations – the importance of language, the usage of national stereotypes in research, and the "national mythologizing" of scientific achievements. Looking at several examples, the confronting positions between nationalism and internationalism in the academic community and their interlinkages with public discourse appear quite clearly. Developing the current results on the sciences in the Habsburg Monarchy, the main point is the plurality of contesting positions and thus of epistemic interests. The relations with the national and international narrative will be shown as well in the humanities as in the sciences and medicine, thereby also posing a question of different strategies/possibilities of nationalisation and internationalisation.

(The paper shall be part of the group coordinated by Univ. Prof. Dr. Michell G. Ash)

‚STAATSNATION', ‚KULTURNATION', ‚NATIONALSTAAT' CHANCES OR RISKS FOR SCIENCE AND SCHOLARSHIP IN THE LATE HABSBURG MONARCHY?

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If historians ask for the relationship between science/scholarship and politics, it makes sense to treat the Habsburg Monarchy as a special case. In the course of the ninetheenth century the field of academics had to deal with three political concepts: the ‚Staatsnation', the ‚Kulturnation' and (after 1918) the ‚Nationalstaat'. However: If scientists and scholars took the chance to use these political resources to establish themselves and their academic disciplines, they ran the risk of being taken in three (more or less) diametrically opposed political projects.

The paper will show exemplarily how the Austrian academic community of the nineteenth and early twentieth century tried to meet this challenge. It will answer several questions:

What strategies individual scholars and scientists persued when acting in the scientific field?

What typological positions of political involvement can be determined and how did they change after the transformation of the transnational Habsburg Empire into nation states?

If it is possible to distinguish between those who were acting absolutely autonomous and those who did not hesitate to promote political aims, then it is appropriate to question whether there is a third way of dealing with politics and if so, how could it be specified and how it becomes manifest in scientific practice?

SCIENTIFIC NATIONALISM: HISTORICAL APPROACH TO NATURE IN THE LATE 19th CENTURY

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The cultural fertility of the Austro-Hungarian dual Monarchy extended to the natural sciences. In both part of the Monarchy a number of important results were achieved and influential scientists worked. However, the political position of the two parts, Austria and Hungary, was not symmetrical. This asymmetry was reflected by the continuation of Hungarian nationalism born in the late 18th, early 19th centuries. Nationalism was a characteristic feature of Hungarian culture, literature, music, and science. Compared with the Austrian universalism, Hungarian scientific thinking was local, practical and historical. The scientific controversies at the Hungarian Academy of Sciences argued for the importance of national science. In addition to sociological, political and linguistic endeavors, nationalism influenced the content of scientific research through its traditional natural historical approach. The paper details the peculiar natural historical approach and its manifestations in chemistry, biology and physics in Hungary in the late 19th, early 20th century.

PATRIOTISM, NATIONALISM AND INTERNATIONALISM. CHEMISTS IN THE CZECH NATIONAL ENLIGHTENMENT.

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The paper links to the common project with A. Kostlán by investigating the case of the lingually Czech chemistry in the Czech Lands as a representative of natural sciences in a multiethnic and multicultural space. Chemistry in the Czech Lands belonged to the leading scientific and applied branches within the whole Habsburg Empire. In the first half of the 19th century the community of chemists was of mixed ethnic origin, but with the onset of the Czech National Revival it started to differentiate into the Czech and German scientific communities. Although the “provincial” patriotism (*Landespatriotismus*) predominated, the Czech chemists, unlike their German colleagues, attempted to fulfil not only their roles as researchers, teachers or practical chemists, but also the “patriotic” goals demarcated by the Revival, that is establishing Czech scientific language and teaching and research institutions. This effort encouraged in chemical circles a gradual shift from the “provincial” patriotism to “national” or “ethnic” patriotism which for a certain time played positive role especially in creating the Czech chemical terminology and promoting teaching of chemistry in the Czech language. Since the 1860s Czech chemical instruction was introduced at the Prague Technical University (1863), the Czech Chemical Society founded (1866) and the first Czech chemical journal created (1869).

Due to basic political changes, however, the “provincial” patriotism in the society was gradually replaced by fierce national or ethnic patriotism both in the Czech and German lingual environment. This process culminated in the 1880s that is in the time when the rapid development of chemistry in Germany, England and other European countries invited to international cooperation and when isolation meant falling behind the European developments and decrease of quality of domestic research and education. The Czech chemists soon became aware of this threat, and unlike the scientists in humanities they reacted doubly. At the local scene they kept their demarcation line between the Czech and German science, but at the same time they attempted to oppose abusing science for political goals and did not identify themselves with the militant nationalism which came to control especially the Czech Academy of Arts and Sciences. In practice this meant that the barriers between the Czech and German chemical communities in the Czech Lands were not absolute. The Czech chemists nurtured their international ties and attempted to bridge the disincentives of nationalism. They often studied abroad, even in Germany, and thus the “genealogical tree” of the Czech chemistry can be derived from the Liebig School. Contrasting to the historians, they published both in Czech and in foreign languages (German, French and English) most of their crucial papers in spite of the signs of official displeasure and maintained contacts with the Austrian chemists. On the other hand, they oriented the authorized international contacts on the Slavic, French and British chemical communities.

TO BE A GOOD SON OF ONE'S NATION… CZECH HISTORIANS BETWEEN NATIONAL PROGRAM AND SCIENTIFIC STYLE

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This paper is a part of a common project with Soňa Štrbáňová, whose purpose is to investigate consequences of patriotism, nationalism and internationalism in different areas of the academic life in the Czech Lands before 1918, especially in chemistry as a field of natural sciences and in history as important part of the humanities.

If we take into consideration "science in action" or "making science", we do not limit science only to experimental work or metaphorically speaking manipulations with test-tubes and apparatuses; we take into account many other activities. Their spectrum can be approximated by a broad scale between "external" area of a credibility of science and "internal" area of a validity of science. These activities cannot be separated from the role assigned to the scientist in the national society. After all it is the society, and it is nineteenth and twentieth century, first of all the national society, which determines the scientist's chance to practice science professionally and be economically secured. As we can see, in science essentially assert themselves two concepts: the national program contra the scientific (professional) style, and both enforce on science their value systems.

In the last third of the 19th century and the first half of the 20th century the relation between the German and Czech production of the Czech historians markedly changed. This can be documented if we compare the numbers of books in the two languages issued by two foremost Czech historians – František Palacký and Josef Pekař. We can see that in Palacký's bibliography the total amount of Czech and German books is approximately the same, but Pekař published his larger and smaller books principally in Czech and later in some rare cases also in the German version. The Czech historiography diligently drew on the existing European historiography, but did not give back anything in return due to the language barrier.

Although publications in German and other European languages never fully disappeared from the Czech historians' bibliographies, their function changed in the last third of the 19th century and at the beginning of 20th century quite substantially. Non-Czech publications were assigned to fulfill only supporting tasks: articulate apologetic standpoints in face of the foreign attacks against the historical worth of the Czech nation, or try to bridge the information gap caused by the fact that most historical production was only published in Czech. Only then as some supplement came into question "real" publications of historical studies in German, French or another European language, but principally only in cases when the Czech professional community decided that other works could offer the foreign community a false picture of a Czech nation.

RACIAL SCIENCES IN HUNGARY IN THE DECADES AROUND 1900

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By outlining the history of eugenics and related racial sciences in pre-World War I Hungary in a comparative European framework, this paper raises questions about national traditions or models in the way science is pursued, institutionalised, and employed in order to fulfill certain social and political ends. Within the context of turn-of-the-century imperialism and nationalism, it focuses in particular on how the ethnically diverse nature of the Hungarian Kingdom both determined the kind of eugenics, ethnography, and physical anthropology to emerge in the country and provided unique challenges for these disciplines to define nation and race, and make sense of the richness and complexity of multi-ethnic existence. The paper argues that the disciplinary trajectories of the 'sciences of race' in Hungary diverge considerably from the models offered by the historiography in the British, French, German, and American contexts.

ANTHROPOLOGICAL DISCIPLINES IN THE LATE HABSBURG MONARCHY

Irene Ranzmaier

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Until now, the history of anthropology in the late Habsburg Monarchy has been considered to be consistent with this field's development in Germany. Only the relatively late academic establishment of anthropological disciplines has been related to the specific political context: the lack of colonies and the government's fear that anthropological research would deepen the multi-ethnic state's problems with nationalism. A closer look on the institutionalization and academic establishment of physical anthropology, prehistory and ethnology in the late Habsburg Monarchy indicates further differences to German anthropology and therefore stresses the significance of the political context for the development of scientific disciplines.

The institutionalization of anthropology in Austria started with the founding of the Anthropological Society in Vienna in 1870. While in Germany physicians dominated anthropology, in Vienna geologists had most influence on this scientific field during the early decades. Therefore, the Society's anthropological research focused on prehistory and was more open to Darwinistic thinking. Still, the Anthropological Society in Vienna shared an inductive and empirical approach to anthropology and a liberal political stance with the German Anthropological Society. But differences in prehistory and ethnology deepened with the efforts for an academic establishment of anthropological disciplines.

The delay of this establishment in Austria was not due to the government – the Austrian Ministry of Education was willing to fund anthropological surveys and to provide for professorships – but to disagreements at the University of Vienna. Here, professors settled on philological method for ethnology and on scientific methods for physical anthropology. This decision became controversial soon and the following conflicts hindered the academic establishment of physical anthropology and ethnology for nearly twenty years. As a result, ethnology was established as a humanistic discipline based on inductive philological method and was defined as a historical discipline in the 1920s. Prehistory at the University of Vienna was strongly influenced by the humanities, too, and took a more universalistic approach than the German main stream prehistory which focused on their own people's prehistory with a nationalistic stance. This development was mainly due to individual interdisciplinary connections and to the nature of the most prominent places of prehistorical discoveries in Austria.

Andrew Zimmerman described German anthropology and ethnology as natural sciences that challenged the humanities' realm: the creation of knowledge of man. The question arises, why in Austria the humanities not only managed to stand their ground in the scientific field of anthropology but also why philologists participated so strongly in this field from the beginning. Did the political and social context of a multi-ethnic state favour approaches that focused rather on human culture than on human nature or did specific interdisciplinary connections have the most influence on the development of anthropological disciplines in the late Habsburg Monarchy?

INSTRUMENTS OF PAPER, OVERSEAS AGENTS, DISTANT NATURAL OBJECTS: ON THE SPANISH INSTRUCTIONS OF THE 18th CENTURY

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A considerable amount of the scientific evidence that Natural history needed during the 18th century come from distant extra-European territories. This evidence consisted of material objects that someone had to identify, gather and convey from South America to Madrid and consequently the transport of these objects was related to the necessary human, technical and administrative activities. For this reason metropolitan institutions created several mechanisms to look for these colonial objects and to conquer the distance between the continents. Sending "*órdenes*" and "*instrucciones*" was a protocol originally created by the Hispanic Monarchy in the 16th century which was still in use during the 18th century.

The "*instrucciones*" were a particular type of administrative document written in the secretariats, academies and botanical gardens of the Spanish Monarchy. The were an instrument aimed at directing the collection of natural objects in the colonies. In these places collecting was done by agents –Governors, Creoles and Indigenous- who possessed skills different from those of the metropolitan academicians, nevertheless this non-academic knowledge was fundamental for Natural metropolitan history.

My paper studies the type of connection defined by the "*instrucciones*" sent from Madrid in the 18th century. The "*instrucciones*" defined a strategy to connect spaces and agents at both ends of the Atlantic with the aim of transferring natural objects from the colonies to the metropolis. The study of these documents allows me to explore the communal character of Spanish Natural history which developed across different geographical and institutional spaces but connected by a same jurisdictional power which was functioning in the metropolis and the colonies.

In my perspective, the "*instrucciones*" were and administrative device oriented towards governing scientific behavior, such as the collection of curiosities and vegetable and animal specimens in the American territories. Nevertheless, as a consequence of the distance and the interests of the colonial collectors, they had only limited efficiency because the collectors developed their survey located in the margin of the guardianship of the metropolitan academicians.

VINEGAR, FIRE AND SMOKE. QUARANTINE AND PURIFICATION IN THE 1830-1851 MEDITERRANEAN SEA

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Letters crossing the Mediterranean during the 1830s were often deemed as possible carriers of plague, cholera or yellow fever. For this reason, once a letter arrived to a port it was quickly submitted to a purification process. However, purification techniques varied considerably across Europe. In Marseille, for instance, letters were dunked in chlorine; in Livorno in vinegar; in Genoa they were quickly flamed, and in Trieste and Venice they were fumed in a solution of incense, potassium and sulphur.

This paper looks at the diversity of quarantine strategies and purification practices along the Mediterranean and how the construction of an international agenda of public health was negotiated in the period between 1830 and 1851. By looking at medical publications, diplomatic correspondence, newspaper articles, and personal, diaries, I demonstrate how doctors, merchants, travellers, and diplomats perceived a heterogeneous system of quarantine and how synergies were constructed in order to coproduce a common European standard of quarantine and purification techniques.

This paper argues that, as distinct professional groups, doctors and diplomats insisted that quarantine legislation fell under their jurisdiction, excluding others, for instance merchants, from the negotiation process. Further important exclusion involved North African states in spite of the fact that experts understood this as a Mediterranean problem. Finally, I demonstrate how a Mediterranean affair of quarantine was transformed into an extra-Mediterranean diplomatic enterprise which included countries like Portugal or the United Kingdom.

NURSES DURING THE SPANISH CIVIL WAR: THE POLITICAL PARTICIPATION OF WOMEN THROUGH MEDICAL AND WELFARE CARE

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This paper analyses how the incipient Spanish community of nursing offered a space of scientific training to women during the Spanish Civil War (1936-39), in qualifying them for the labour force, as had occurred for British and French women during the Great War. Furthermore, nursing will be interpreted in this social context as one of the most relevant ways of political participation for women.

Before the war, most of the women dedicated to medical care in Spain belonged to religious orders but in 1936 they joined the rebel side because of their political affinities with the Fascist forces. Therefore, one of the fundamental tasks of the recently created *Ministry of Health and Social Care* of the Second Republic, led by Federica Montseny, was to organise a new corpse of professionals, in contrast with the old welfare model based on Christian charity. With this aim, the Government prepared intensive courses in collaboration with other institutions such as the *Spanish Red Cross* (which was divided into two head offices during the war; the Republican and the rebel side) and with the help of the different trade unions such as the A.M.A. (Antifascist Woman's Association) founded by the Communist Party and *Mujeres Libres* (Free Women) related to the Anarchist organisation CNT. Specifically, these unions made an effort to democratise medical practices for women of the working class, who at this time, were affected by a high level of illiteracy.

Nursing courses included not only a practical knowledge in anatomy, physiology, medicine, surgery and hygiene, but also training about moral character. During the Civil War this appealed to all of the different factions of the social struggle, factions which existed even between Republican nurses, according to the ideological orientation of each organisation. While the nurses prepared by the *Red Cross* had a vocational training based on the Christian ideals of *self-denial* and *sacrifice* proper to the nature of women, the new professional nurses who belonged to trade unions such as *Mujeres Libres* conceived nursing as a *revolutionary vocation* and as a way of "overcoming of the inherited personality".

Thereby, this proposal explores the ideological connotations of *vocation* between volunteer nurses from the *Spanish Red Cross* (controlled by the Republican Government on one side, and on the other side by the *Sección Femenina* allied to Franco's troops) and the new professionals linked to the labour unions. Finally, the community of care will be interpreted not only as a way to integrate women into the scientific community and the labour force, but also as the arena for their different political participation during Spanish Civil War.

ARCHAEOLOGY IN THE TROPICS SCIENCE AND THE 20th CENTURY PORTUGUESE COLONIAL AGENDA

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Tropical Research Institute (IICT), in Lisbon, holds a remarkable archive related to its former scientific activities, mostly developed between the thirties and the sixties of the 20th century.

These documents are crucial to understand the Portuguese colonial strategy; particularly the one launched by the totalitarian regime known as 'Estado Novo' (New State) ruled by António de Oliveira Salazar (1889-1970), as an answer to the less favourable international entourage, considering its political agenda, forcing to strengthen the national authority in overseas territories.

It was within this context that the Government established a Bureau exclusively dedicated to investigate these same regions, which, together with the continental Portugal, shaped one single identity, as it was claimed by the regime. The relevance of this issue was such that no other institution in the country benefitted, or should benefit, such a support, especially financially speaking, using the most recent scientific technology. The intrinsic message could not be clearer: it was urgent to know better the colonies, in order to rule them better, anticipating eventual similar initiatives started on by other European empires.

Even conceiving a truly holistic scientific plan, the new ideological programme could only be improved through an insightful understanding of the overseas traditions, and ways of living, as taught by the German ethnological school.

Organized as 'Missions', these scientific expeditions were mostly settled by geographers, ethnographers, and biological anthropologists, in what concerned human, and social sciences, within which Archaeology played a significant role. Chiefly designed for countries such as Mozambique, these 'Missions' were accomplish by Portuguese anthropologists and pre-historians, envisaging an opportunity to link material (archaeological) culture(s) to ethnic group(s), and thereby validate the colonial system itself.

We will disclose how Portuguese colonial agenda pursued others, fortified by the archaeological record, essential to highlight the assumed "primitivism" of colonized people. Alongside with this topic, we aim to exemplify how the Portuguese colonial agenda shared others, in what concerned Archaeology, in particular the Spanish one, clearing up the resources, scientific, and technological, employed by the researches during their "Missions".

"POPULAR MEDICAL MANUALS AND GUIDEBOOKS IN LATE-18th EARLY-19th CENTURY BRAZIL"

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The writing of texts aimed at promulgating medical and surgeon knowledge throughout the 18th century and the beginnings of 19th century in the Portuguese colonies is not copious, unlike the published material of the same kind circulating in the United States. It comprises some dozens of books searching for solutions to the delicate moments of disease and accidents, and, in some cases, for indications of how to keep and preserve health.

These are not books made to their author's fellow physicians and surgeons, but, rather, texts written in a language aiming to reach a larger readership which comprised those not initiated in the art of cure. Even so, many of those focused on by these books dealt with groups of families and/or workers (slaves or not) and felt themselves in a certain way responsible for keeping the health of their groups.

There are specific books on topics relating to health, such as the *Erário Mineral* (Luiz Gomes Ferreira, Lisboa 1735), *Medicina Lusitana – Socorro delfhico* (Nuno da Cunha, 1731), Relação Cirurgica e Médica (João Cardoso de Miranda, 1741). Some other books indirectly approach health and health-care as a topic, as it occurs with André João Antonil's *Cultura e opulência do Brasil* (1711). The former set of books is the one of our interest.

Our interest concerns investigating the conceptions of health/diseases circulating in manuals and, for doing so, investigating the circulation of these texts, their authors' education, the impact of these texts on the population. Even with all metropolitan rigour put to halt the promulgation of systematised knowledge by means of the schools, there was circulation of knowledge relating to the medical sciences.

In the texts/books considered as specific to the art of cure, each one of them with its historical specificities, there a common points, like the wish that they were read by an increasing number of readers. Several of them refer to the large number of slaves and/or to specific diseases of the slave population. One can observe that they are texts that value experience, practical life, sometimes to the detriment of contemplative knowledge, and some other times, grounded on valuing experimental knowledge.

The objective of this research is to investigate the building of (a) web(s) of comprehension and promulgation of knowledge in the realm of health-care in that period of time.

IDEOLOGY AND MATHEMATICAL LOGIC: THE HISTORY OF SOVIET-HUNGARIAN TIES BEFORE AND AFTER WORLD WAR II

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1. Russia's scientists before Soviet era were tightly bounded to their Western colleagues: they often travelled to the West (necessary after getting degree for usually an year or two and on many other occasions) and accepted foreigners at their institutions. This tradition to less extent was preserved until the flourish of so called ideologized science in late 1920s – early 1930s when connections with the West seems to be suspicious. Nevertheless, some forms of cooperation between Soviet and Western scientists remained. I mean first of all emigration (often temporary), and seldom invitation of certain Western counterpats. What is the history of Soviet-Hungarian connections in the field of mathematical logic? This history could not be comprehended well independently of certain ideological *pre*history.

2. Some Hungarian social-democrats emigrated to the USSR after the defeat of Hungarian Soviet republic. Among them was Varjas Sándor (1885 – 1939) who has both philosophical (Budapest University) and mathematical (Berlin University) educations. As many Soviet philosophers he did his best to study logic on the basis of dialectics. In his book "Logic and Dialectics" (Moscow-Leningrad, 1928) he did his best to reveal the structure of the proof and judged despite his colleagues claims that dialectics not reject but presupposes formalization.

Relationships between logic and dialectics was acutely disputed until 1960s. In 1951 Fogarasi Béla (1891-1959), the vise-president of HAS in the textbook on logic declared that mathematical logic is metaphysical in its essence, non-Aristotelian logic forms the ground for idealism; in revised edition of 1959 he accused Hungarian logicians of supporting Nagy Imre and rebellion of 1956. Fogarasi was well-acquainted with Varjas but never mentioned him.

3. Very important role in validation of mathematical logic in Hungary played E.K. Vojshvillo (1913 -) from Moscow University sent to Budapest to teach logic, support of newly-minded Soviet philosophers and involvement of some algebraists, Kalmar Laszlo (1905 – 1978) first of all. They all claimed that dialectics do not contradict to the formal logic. Influential philosopher Szalai Sándor (1912 – 1983) published in "Magyar Tudomány"(1957 N 9-10) an article about the development of mathematical logic in the USSR. The hostile milieu toward mathematical logic have been disperse.

4. In the USSR some Hungarian logicians were graduate students (Havas K., Bimbo K., Szosz V., etc). Lakatos Imre in late 1940s attended lectures on mathematical logic by S.A. Yanovskaya. Generations of Soviet logicians and mathematicians used books by their Hungarian colleagues or scientists with Hungarian roots: J. von Neumann, J. Kemeni, P. Halmos, A. Renyi, G. Polya, R. Peter, etc. A. Dragalin (1941 – 1998), the disciple of A.A. Markov and himself interesting logician for more than decade worked in Hungary.

IMPERIAL EARS: OGAWA NAOYOSHI AND THE COLONIAL LINGUISTICS IN EARLY TWENTIETH CENTURY TAIWAN

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Ogawa Naoyoshi (1869-1947) was a prominent Japanese linguist, but nearly neglected by western historiography. Through scrutinizing his published papers and unpublished manuscripts, this article tries to reconstruct his activities in early twentieth century Taiwan. I will respectively analyze his career as a linguist, an anthropologist, a dictionary compiler and a colonial university professor. The documents show how Ogawa Naoyoshi, during his field studies, encountered inhabitants of the colony as well. Despite his achievement, this article would not be a heroic narrative; instead, I put his life and ideas in the context of colonial science and society. I will indicate that his researches got the patronage from Japanese colonial government and also became part of imperial governance. I will then point out that there are certain early linguistic studies made by western missionaries and scholars from mainland China, but the Ogawa Naoyoshi's works had transformed the studies of Taiwanese language into a scientific discipline, institutionally and academically.

PHILOSOPHICAL ROOTS OF BORIS HESSEN: A CRITICISM AGAINST THE MYTH OF HESSEN´S EXTERNALISM

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Our article builds a new interpretation of the Boris Hessen´s celebrated paper, "The Social and Economic Roots of Newton's Principia". It Criticizes the two interpretations that this paper received in the XXs century: the idealistic interpretation created by G. N. Clark and R. K. Merton, A. R. Hall, G. Basalla, and so on, and the materialistic interpretation by H. Grossmann, G. Freudenthal, and so on. The basic attribution that Hessen received as externalist, is criticized, by studying the true philosophical grounds of Hessen´s paper. The article defends that Marxism cannot analyze science externally, because social factors are considered internal to the material content of science. The basic thesis is that Hessen´s paper, against externalist interpretations of L. Graham or W. Schäfer, is originated in the philosophical discussions in the URSS, between mechanics, A. K. Timiriazev, L. Axelrod, I. Stepanov, A. Maximov, and so on, and dialectics, B. Hessen, A. Deborin, I. Sten N. Karev, and so on. The Hessen´s fundamental objective is to defend that the mechanics interpretation has an idealistic root from Newton and its belief in a Creator and Causal God of movement. Under Hessen, only the dialectic materialism can overcome the mechanics idealism. On the other hand, the mechanics consider the new physics theories (quantum mechanics, and Relativity) lead to idealism, while Hessen and the dialectic materialists think that the new physics theories are coherent with the basic thesis of Soviet Marxism-Leninism. The principal questions are the conception of causality, monism, and the "ignorabimus!" problem in science.

AN IVORY TOWER DOWNTOWN: THE RISE AND FALL OF THE "AREA PER LA RICERCA" IN NAPLES (1965-1970)

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In the April 1965, three directors of CNR (the Italian National Research Council) Laboratories in Naples and two Professors at the University of Naples issued to the press the first project for an "Area della Ricerca" (AdR – a multidisciplinary R&D establishment) to be created in Naples. The AdR was conceived as an interdisciplinary research facility with the double aim of fostering communication among researchers in different scientific domains (namely molecular biology, cybernetics and polymer chemistry) and of promoting the development of and the interaction between basic research and industrial production.

Within a larger governmental project of urbanisation and industrialisation in the Southern regions, the AdR embodied a two-fold ambition. On one side, it was meant to facilitate the development of relatively new disciplines whose organisational needs sharply contrasted with the traditional academic establishment. At the same time, it aimed at making the city of Naples the "scientific capital" of the Country, as well as an innovative model of economic and social development, based on capital- and research-intensive, rather than labour-intensive, enterprises.

The project gained momentum in the years 1966-1967, thanks to the interest shown by some of multinational enterprises (most notably Texas Instruments and Mobil Oil) and the University of California at Berkeley (through an agreement for the founding of an international PhD program in Molecular Biology). Also the Italian Government and the City Council of Naples strongly supported the initiative.

Despite the wide public appraisals, however, the realisation of the AdR proved an impossible task, and the project was finally abandoned in 1970. The reasons of its failure are manifold. The AdR firstly clashed with the opposition of most of the Neapolitan Academia, which feared the competition of an international and well-endowed research centre. Secondly, political and bureaucratic forces contrasted the project on ideological grounds. The final blow, however, was cast by the student and worker's movements in 1968-1969, pointing at the AdR as the expression of the capitalistic model of development they were fighting against.

By analysing the brief life of this attempt at creating an innovative techno-industrial vocation for the city of Naples, we will tackle a number of key issues in the relations among science, economics and politics in the shaping of an urban environment (or, better, as it was said at the time, in "defining the vocation of a city"), such as the tensions between local initiatives and grand central interventions, between opposing views of science (a pure endeavour vs. an advanced mode of capitalism) and between contrasting concepts of social and urban development (the utopia of "scientific capital" vs. the industrial city as the locus for social conflict).

THE POLITICS OF ANATOMY IN VIENNA, CA. 1880-1932

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Viennese anatomy was internationally famous for elegant specimens displayed at world exhibitions, widely read textbooks and innovative atlases, as well as for the easy access to dissectible bodies that attracted students from around the world. But it was also a discipline divided into two politically, educationally and scientifically opposed chairs. In this paper, I look at the lives and careers of anatomists at two University of Vienna normal anatomy departments. I start with the generation of anatomists that occupied chairs around 1900 and follow their successors into the turbulent years of 'Red Vienna'. How, when and why, I shall ask, did these divisions take place? How did anatomists' political differences inform their choices of research orientations? And what continuities and changes can we observe when we take a longer perspective?

PLAGUE, CHOLERA AND THE EXPANSION OF HABSBURG MEDICINE TO THE OTTOMAN EMPIRE 1840-1860

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The threat, that contagious diseases like the cholera were posing to Europe in the middle of the 19th century led to a change in sanitary politics towards the Ottoman Empire. After a long period, during which quarantines had been the state of the art in fighting the plague, the occurance of the cholera and a (scientific) change in the perception of the quality of diseases that we call “contagious” today also induced a change in economic and imperial politics towards the Ottoman Empire.

Starting from the 1840s, European medicine was starting to expand its influence to the Ottoman Empire and began to gain control of its unregulated health care market. The causes of diseases like the plague and the cholera remained somewhat unclear to European observers for some more decades, but the involvement with the sanitary situation in the eastern Mediterranean became one of the roots of the internationalization of health care.

The proposed paper will investigate how the scientific discussion of the Cholera and the Plague changed Habsburg (sanitary) politics towards the Ottoman Empire between 1840 and 1860 and how the Habsburg monarchy`s own political and economic interests were affecting sanitary considerations on the other hand. The paper connects the scientific discussion in Viennese Medical Media of the time to the involvement of Physicians from Vienna in the reform of medical structures in the Ottoman Empire. It will show, that the scientific discourse prevailing in the Habsburg monarchy`s medical community has shaped the way that a European style Medicine was gaining ground in the Ottoman Empire.

THE DIARIES OF AN OUTSTANDING PHYSICIST AND HISTORIAN OF SCIENCE

Sergey I. Vavilov

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The Institute of History of Science and Technology (The Russian Academy of Sciences) is completing the preparation for the publication of Sergey I. Vavilov’s personal diaries which were found in his archives. S.I. Vavilov, an outstanding physicist-optician, was one of the inventors of the special sort of luminescence, that was called “ Vavilov-Cherenkov’s radiation”. This invention was awarded Nobel Prize in 1958, unfortunately, after Vavilov’s death. He was also one of the authors of the fundamental works in the sphere of luminescence, nature of the light, and it made him one of the world’s leaders in the spheres of theoretical and applied physics. Sergey Vavilov made a valuable contribution to the development of the history and philosophy of science. He wrote famous works about Newton, Lomonosov, Galilee, Huygens, Faraday, the luminescence of Leonard Aler, the development of the luminescence by V.V.Petrov, physics of Lucretius,Sophia Kovalevskaya, and about his teacher Peter Lebedev, an outstanding Russian physicist.

Sergey Vavilov was at the same time a prominent Russian scientist and the director of two institutes – FIAN in Moscow and The Optical Institute of Saint-Petersburg. Since 1945 and until his death in 1951 he was the President of Russian Academy of Sciences. His work fell on the hardest years of our history – it was the years of political repressions and ideological campaigns. In 1940 his beloved brother Nikolay Ivanovich Vavilov, a well-known geneticist, was arrested and died in prison in 1943. When Sergey Vavilov was the president of the Academy of Sciences, Stalin’s Party’s ideologist announced genetics, physiological sciences and cybernetics as pseudo-science. But S. Vavilov did his best to help science and scientists.

The personal diaries of Sergey Vavilov help us to understand that period of time and the tragedy of the person who had to make a compromise with the system. Here is one of his notes: “ How can we make our life better, how can we be happy without these endless hell, intrigues, ignorance…”(3/07/1949). Circumstances made Sergey Vavilov live in two different lives. As a scientist, he had to develop some plans about new investigations, he did everything he could to help science, he did enormous everyday work. Being a very moral person, he was in the opposition to the circumstances and felt psychological load, especially after the arrest of his brother. These diaries cover the period from 1909 till 1951. In these diaries two World Wars were described as well as the development of Russian science. At the same time this document shows us the forming of the prominent personality of Sergey I.Vavilov.

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10 YEARS IN THE RESEARCH OF THE WATER-POWERED UP-AND-DOWN SAWMILL PROGRAMME IN SZEKLERLAND. (EASTERN TRANSYLVANIA)

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Szeklerland is situated in Romania today, however, it used to belong to former Hungary. Approximately 3 million Hungarians live there. We can find several streams and huge woodlands between the Eastern-Carpathians and the mountains of Hargita, which in fact provides a living for local people.

As a result of the geographical features of this place and its underdeveloped economic situation, even today native farming still plays a great part in people's every day lives.

Until the time of nationalization in 1948, hundreds of water-powered machines made people's lives easier in that area. These mills were mainly made from wood and functioned as corn mills and sawmills where boards were made from logs.

Water-powered up-and down sawmills had been used from the 15th century but from the middle of the 19th century they were gradually converted into factory made cast iron machines. Moreover, as for operation, water power was first replaced by steam and then electricity throughout Europe. However, Szeklerland remained "untouched" and almost all kinds of mills were operated by the hundred year old technology until the time of the 1948's nationalisation. Then, some of the up and down sawmills were placed in museums while others still belong to private people.

In the basin of Gyergyó and Csík, we can find 8-10 traditional sawmills. These mills have been assessed, documented and renovated since 1998 every summer under the organization of a 10 day camp. All participants in the camp are volunteers who work on the mills on their own expenses. The group consists of present and former students and teachers of Lajos Kozma Woodworking Technical School as well as graduates at College of Woodworking who investigate these sawmills as part of their thesis research. Tamás Pauló, who is an engineer of woodworking and also a teacher, is in charge of running the camp and the organisation of all the necessary work concerning renovation. Over the years we have managed to do up a dysfunctional sawmill and reconstructed a 12 m. long traditional sawmill which depicts the technology that was characteristic of a particular period. This sawmill can be found today on the territory of Tarisznyás Márton Museum in Gyergyószentmiklós.

Our objective is to continue the work we have started as renovating these sawmills has an importance not only in the history of technology but also in pedagogy and tourism.

THE ROLE OF OLD GLOBES AS A MULTIDISCIPLINARY SOURCE, IN THE BIRTH AND EMERGENCE OF PORTO UNIVERSITY

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The aim of this paper is to present the globe as a plural source in the university universe. In a first level it's analyse the cartographic heritage of historical globes in the city of Porto, witch timetable concerns mostly the XVIII century, epoch that marques profoundly the city, starting the emergence of Porto as an economic symbol of prosperity.

It's presented a census of the existing globes in the city, witch is briefly analysed the presence oh this patrimony in the local institutions (of different specificities), demonstrates trough the analyses of their functionality (or functionalities) the life story of each of the globes. At this time the interpretative complexity of a cartographic document, specifically globes, comes to light through the many facets it incorporates, such as the history of science and technology, ecclesiastic scholarship, university teaching, imperial propaganda and others.

In the second part is presented the factors that contributed for the birth of a University in the city of Porto, witch reasons are primarily related with the insecurity of Porto's shore that threatened the prominent trade of the Porto Wine. The incoming of a variety of scientific instruments to be used as teaching tools, in the training of pilots and navigators, elevates the cartographical sources as one of the most necessary for this purpose, but this passed role as scientific instruments, has transformed in the most various purposes, since the plain idea of decoration till a more specified utility, the nomination of one of the symbols of the University in this Porto, that is recognised nowadays.

THE MATERIAL CULTURE OF THE FIRST EXPERIMENTAL TESTS OF BELL'S THEOREM: AN ANALYSIS OF THE EXPERIMENTAL APPARATUS (1972-82).

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At this work we analyze the material culture of first experiments with optical photons that tested the Bell's inequalities, considered by Clauser the most profound work in foundation of quantum mechanical of the twentieth century, realized by Freedman and Clauser (1972), Clauser (1976), Fry and Thompson (1976), Aspect, Grangier and Roger (1981), Aspect, Grangier and Roger (1972), Aspect, Grangier and Dalibard (1982). The concept of material culture rises from the archaeology, though it had been introduced in history of science by Peter Galison, in his book "Image and Logic" (1997). Galison defended a three-way development of the physics' history, that is: the instrumentation, the experiments and the theory are physics' sub-cultures which walks, each of them, at its own rhythm. In this analysis we focus on the instrumentation concerned in the first experiments on Bell's theorem. We'll explain what are the instruments, how they operated and their principal functions in the experiments, as well as the excitation's technique, detection and count, seeing that they can be separate in these three techniques. We did yet a historical study of some instruments, checking if these experiments could be realized before, rummaging to understand how the science has been developed in this period and context. Among the crucial instruments needed to make the experiments are the photomultiplier and the coincidence counter, the first invented by Koller and Campbel and the second by Bruno Rossi, both created in 1930. The apparatus's experimental analysis says that an improvement in a technique was connected with the introduction of an apparatus (laser or switch) in this technique, seeing that an improvement in a technique did refinement in the experiments (Fry & Thompson, 1976, and Aspect, Grangier and Dalibard, 1982), showing the instrument's importance in science's development.

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HISTORICAL DEVELOPMENT OF THE DOORS AND WINDOWS IN THE KARPATIAN BASIN

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The aim of this presenatation is to show the historical past of the doors and windows from the fourteenth century to nowadays. This development period is interpretable and exemplificate by the early presentment, linguistic reliefs and the remainded artefacts. The begining of that discussed time is epoch-changing in wood processing. It was a great leap forward, quality jumping from the older timber-work technique to a developed timber-processing method, the attendance of the joinery-work and its permeation. The connecting novelty things which appeared in the joinery-work by well palpablian are the sign of the development and those results are provable. Beside the overall historical impacts the development of accessories and curbings, the glass making, glazing and finally the continously rigourous convenience requirements were affected on joinery-work also.

THE BENDING TECHNIQUES OF WOODS IN A HISTORICAL VIEW

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The bending of wood by warming is known for a long time. The majority of woods becomes soft and flexible after being watered. The changes of techniques reflect the changes of bending metods during its history.

The first process, which is applied during bending is watering above fire. This process was widely used in the manufactoring of the skiis, the ribs of lodge and the barrel's staves throughout centuries, in these cases, bending was made manually for a long period of time.

The manufacturer bending process was revolutioned by Thonet masters in the Austro-Hungarian Monarchy in 19. century. They applied mass production from beech wood that was previously used as firewood. The solution was the layered bending of wood int he 19th century. Moreover, the real break through come from the Thonets: it was the bending of solid lath during the production of seat furniture.

The laminated bending returned int he 20th century with a more modern technique, with the high frequency press.The cold bending of compressed wood become industrially possible int eh 21th century

AESTHETIC PRINCIPLES IN EVOLUTION OF PHYSICS

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The modern stage of development of our civilization is characterized an awareness that Cartesian dividing the world into a man and nature, making basis of objective scientific cognition of the world till now, have led humanity to global ecological, eschatological, and anthropological crises. It becomes clear that all crises of our civilization are associated, and a technique and, more widely, technical attitude toward everything being one of the factors of this global trouble. Thus, the modernity requires conceptually new approaches to teaching and education of higher qualification specialists, based on principles of humanism.

The facilities of exposure the cultural-humanism potential of general scientific and general technical disciplines must to be the analysis of world view and methodological problems of these objects, historic-scientific and historic-technical analysis (especially of biographic material), elucidation their categories and logic.

In this context it is very actually also to develop the principles of construction of educational courses to be settled the tasks of humanizing of technical education through integration of natural, technical and humanitarian disciplines.

It appears us, that integrating idea can come forward certain initial principles, determining the logic of scientific cognition of universe, to be general for natural-scientific and humanitarian disciplines.

In the paradigm of scientific consciousness of the second half of XX c. more and more frequent one refers to aesthetic valued guidelines, trying to understand the degree of efficiency of their participation in the process of acceptance of new ideas, hypotheses, in the period of construction of new knowledge and choice of mathematical formalism, and also at comparison already of the developed theories, united describing the same empiric information.

There are works in which the attempts of logical justification the gnosiological principle of beauty as one of methodological regulatory actions of scientific cognition are undertaken.

Regulating role of beauty in epistemology of scientific knowledge has been revealed by celebrated mathematicians and physicists: N. Kopernik, I. Kepler, E. Galois, D. Maxswell, A. Einstein, T. Khardi, E. Veyl, A. Blokhintsev et al.

TAKING PRACTICES AS AN EXPLANATORY SOURCE: TOWARD A POST-NEEDHAM HISTORIOGRAPHY OF CHINESE SCIENCE

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Roger Hart in “On the Problem of Chinese Science” (*The Science Studies Reader*, Mario Miagioli (ed.), New York: Routledge) says: “Moving beyond ‘science and civilizations’ as a framework for analysis raises the important question of possible directions for future research. How is the study of sciences and cultures to proceed without civilizations as the central actors animating world history, and without a universal, teleological science to gauge the progress of those civilizations toward modernity? If nations and civilizations are imagined communities, if the sciences are disunified practices, how does one analyze their relationship?” In this paper, we defend the idea that a plausible direction for future research resides in taking practices as an explanatory source. Here, a practice is understood as a set of normative actions, whose criteria of correct application are historically and socially constructed. We argue that recent studies on philosophy of scientific practices (such as, Ian Hacking, Nancy Cartwright, Joseph Rouse, etc) give us a plausible theoretical base of this approach. We also take some recent studies on Chinese (Francesca Bray, Nathan Sivin, Geoffrey Lloyd) as examples.

ASTRONOMY AND HISTORY OF ASTRONOMY IN THE JESUIT *MÉMOIRES DE TRÉVOUX* (1701-1762): AN ASSESSMENT OF THEMES AND MODES OF PRESENTATION

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The *Mémoires pour l'histoire des sciences & des beaux arts*, better known as *Mémoires de Trévoux*, or *Journal de Trévoux*, published by the French Jesuits between 1701 and 1762 (year of the banishment of the Society of Jesus from France), are mainly remembered by their involvement in acrimonious disputes with the *philosophes* in general and the *encyclopédistes* in particular, which peaked under the editorship of Guillaume-François Berthier, S.J., from 1745 onwards. Like much Continental periodical literature of the same period, the *Mémoires* were first and foremost devoted to the publication of critical reviews and notices of recent books and dissertations in the broad fields of theology, history and law, letters, and science and arts, as understood in their contemporary 18th century sense (shared, for the most part, by the *encyclopédistes* themselves). In this capacity the journal served, as has been pointed out in earlier studies, as the expression of an "ideal library" of the French Jesuits and their reading public, and as a battlefield for what was worth reading and what was not. A marked increase of reviews in the field of "science and arts" along the course of the century has also been noted before, reflecting, as it should be expected, the surge of interest in these matters. Generally, this category is viewed as being represented by medicine, natural history and the physico-mathematical sciences. In this scheme, astronomy is customarily subsumed into physics (the presentation of which was dominated, by its turn, by the debate between Cartesians and Newtonians).

The case is made in this paper, however, that astronomy retains in the *Mémoires* a degree of autonomy in relation to physics, at least to the extent that it is not necessarily just another chapter in the "Newtonian wars". This is supported by an assessment, both quantitative and qualitative, of astronomical subject-matter reviewed in the journal, in what relates to theme selection and modes of presentation, which reveals the persistent importance of observational astronomy, cosmography, calendrics and discussions of the "system of the world" unrelated to Cartesian or Newtonian physics. The conformation of the Society of Jesus and the place of astronomy in its educational system are keys to understanding this point. At the same time, the study indicates that the history of astronomy is a recurrent concern in the *Mémoires* from approximately 1720 onwards, setting models that would find echoes in later 18th century works on the history of science. Interestingly enough, though, the Jesuits' own contributions to astronomy are much less stressed in the historical narratives of the *Mémoires* than one could expect. A number of representative reviews are analyzed in depth in order to instantiate the arguments, and avenues of further research into this rich material on 18th century representations of astronomy and its history are suggested

HIPPARCHUS VS. PTOLEMY AND THE ANTIKYTHERA MECHANISM: PIN-SLOT DEVICE MODELS LUNAR MOTIONS

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In this paper, I have used geometrical, calculus, trigonometric and complex variable methods to analyze the ancient Greek astronomical calculator known as the Antikythera Mechanism. I have been able to demonstrate that the Mechanism modeled the variations in the Moon's angular velocity as seen from the Earth, to better than 1 part in 200. A major implication of my analysis is that the Antikythera Mechanism of the 2nd century B.C. modeled the anomalistic motion of the Moon more accurately than Ptolemy's account of Hipparchus's theory of the 2nd century A.D. In the present work, Mathematics, Astronomy, History and Methodology of the sciences combine in the study of a unique artifact, preserved for posterity in an ancient ship that sank in the Mediterranean 2100 years ago and recovered by Greek sponge divers at the dawn of the 20th century.

ON METROLOGY OF BUKHARA EMIRATE OF THE END OF XVIII – THE BEGINNING OF XX CENTURIES

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Metrology of Bukhara emirate is a difficult and little studied subject. Little amount of specific articles of researchers cover this subject, which touch upon private issues.

The papers of local authors on metrology are also a rarity. One of the few late medieval works that covers this subject is "Majma' al-arkam" of Mirza Badi'-divan (Manuscript #649 of National library named after Firdavsi) that corresponds an official manual for Bukhara emir chancery on maintaining of financial and land-tax records.

In this work the basic principles of administrative, financial and tax management, the rules of preparing registers of tax proceeds, expenditure sheets, statements of land and other remunerations are stated, and also measures of weight, length, area, irrigation water, etc. are given.

In "Majma' al-arkam" the system of construction of measures of weight of Bukhara are defined as: "...It is ought to know that the weight of one shariah *mann* – forty *istars*. Each *istar* is equal to four and a half *miskal*. Therefore, one *mann* equals to one hundred and eighty *miskals*. One *sa'* equals to eight *ratls*. One *ratl* equals to twenty *istars*. One *miskal* consists of six *danaks*. One *danak* consists of sixteen *javs*. Some of scientists adhere to the mentioned measures, but the others state that one *miskal* equals to hundred *javs*..."

The main measures of length of emirate were *jav* (barley), *agusht* (finger), *vajab* (span), *gaz* (elbow), *kadam* (step) and *farsang* (mile).

The main measures of area were *jufti gav* – word for word "a couple of bulls", "team of oxes", *gav* or *kush* – land area that is worked by the one team of oxes during the season and *tanob* – word for word "a rope", "a string". Shariah *tanob* was equal to *jarib*, which consisted of 60×60 = 3600 square *gazes*. Sometimes measures of weight were also used for these purposes, as it was easier to determine by them the quantity of sowing grain on a certain land area.

In Bukhara emirate the irrigation issue was attached a great importance, as the main revenues of khanate were irrigated lands. In the period under review in Zarafshan valley, a large irrigation basin, all water resources of Zarafshan river were registered. Water from this river was distributed for irrigation amongst the systems in proportion to the size of irrigating areas in each irrigation system. Valuable data on distribution procedure of Zarafshan water amongst the irrigation systems of Bukhara oasis is given in "Majma' al-arkam". The main measurements of irrigation water were: *one ravok of water, one millstone of water, one water, one handful of water, one branch of water and one finger of water*.

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THE PROBLEM OF QUALITY AND QUANTITY IN THE DEVELOPMENT OF SCIENCE FROM ANCIENT TIMES TO PRESENT

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The question of productive and accurate ways of thinking in science has been discussed since antiquity. In his *De generatione et corruptione* and his *Physics,* Aristotle drew up a qualitative view on alteration in our world by means of a qualitative physics based on the four elements (fire, water, air, earth), the four essential qualities (hot, cold, dry, wet) and the four types of motion or change according to four of his most important categories. According to a commonly accepted narrative, in the Scientific Revolution of the seventeenth century qualitative scholastic Aristotelian natural philosophy was replaced by quantitative mechanistic Newtonian mathematical physics (see e.g., E.J. Dijksterhuis 1950/1961). This led to a progressive mathematization, mechanization and quantification of the world picture in natural science, which already in the 17th/18th century had spread to the humanities and medicine, as is shown by William Petty's *Political Arithmetick* (1690), William Harvey's *De motu cordis* (1628) and La Mettrie's *L'homme machine* (1748) (Frängsmyr 1990). The quantitative approach culminated in the logical positivism of the Vienna Circle. Rudolf Carnap holds that the language of physics is the universal language of science and, consequently, any knowledge can be brought back to statements about physical objects.

Despite the ongoing tendency towards quantification there have been in all periods scientists who stressed the importance of qualitative, holistically oriented studies, such as Leibniz and Goethe in his color theory. This constituted an important foundation for the renaissance of qualitative research in the 19th century with Leopold von Ranke, Wilhelm Dilthey and Max Weber. Crucial for the spread of the new qualitative research methods in the 20th century were the Chicago School of Sociology (William I. Thomas, Robert E. Park, Herbert Blumer) and the Frankfurt School (M. Horkheimer, Th. W. Adorno, J. Habermas). The rise of qualitative research in the social sciences was favoured by a deep concern about the affluent society, the population explosion and environmental pollution which led in 1968 to the foundation of the Club of Rome and its influential report *Limits of Growth* (1972). This again introduced the catchwords "qualitative growth", "environmental quality" and "quality of life" to the debate. In recent years qualitative research methods found their way also into the exact sciences (Qualitative Theory of Differential Equations, Dynamical Systems, Qualitative Reasoning). The ongoing struggle between qualitative and quantitative research methods has been sketched and documented in our book *Wissenschaft zwischen Qualitas und Quantitas* (2003) together with a comprehensive bibliography.

PHILOSOPHY OF MATHEMATICS IN THE WARSAW SCHOOL OF MATHEMATICAL LOGIC: TARSKI AND MOSTOWSKI

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The aim of the paper is to indicate the characteristic features of Tarski's and Mostowski's (two main representatives of Warsaw School of mathematical logic) attitude towards the philosophy of mathematics and its rôle in the mathematical logic and foundations of mathematics.

Start by noting that Tarski was interested in philosophical problems and very actively participated in the philosophical life of his time. He was convinced of philosophical significance of his works, in particular of his work on truth. Tarski's philosophical attitude was antimetaphysical, he supported the idea of scientific philosophy. He accepted a programme of "small philosophy'' which aims at detailed and systematic analysis of the concepts used in philosophy. Such a philosophy is minimalistic, anti-speculative and sceptical towards many fundamental problems of traditional philosophy. He maintained also empiricism and abandoned the analytic/synthetic distinction and stressed that logical and empirical truths belong to the same generic category. He was inclined to rather a strongly nominalistic understanding of expressions and to identify mathematics with the deductive method. All those views were his "private'' philosophical views which did not influence his logical and mathematical researches, in other words, his researches were independent of any philosophical presuppositions.

Also Mostowski was aware of philosophical problems connected with mathematics and its foundations and of their importance and meaning. On the other hand he tried to avoid (with few exceptions) any definite philosophical declarations concentrating instead on strongly mathematical and technical side of issues. If it was necessary then some general philosophical declarations have been made (but, in fact, unwillingly). He was aware of the meaning of results obtained in the foundations of mathematics by mathematical methods for the philosophy of mathematics but simultaneously was convinced that those results cannot give definite solutions to problems of the philosophical nature. Therefore he rather presented various possible solutions instead of making any concrete declarations. Philosophical problems and possible solutions to them were discussed by him on the margin of proper metamathematical and foundational studies, in introductory remarks only and – what is very important – did not influenced the latter. Mostowski strongly avoided philosophical comments and remarks in technical papers. Philosophical perspective on the one hand and metamathematical and foundational one on the other were by him strictly separated. Though some of his results were inspired and motivated by philosophical considerations he never wrote about that and never formulated them explicitly concentrating on mathematical and metamathematical studies.

What were the reasons for and sources of this attitude? They can be seen in the attitude and ideology of Lvov-Warsaw Philosophical School and of Warsaw School of Logic – Tarski and Mostowski belong to main representatives of this school. In fact Polish logicians and mathematicians being convinced of the importance of philosophical problems and knowing quite well the current philosophical trends treated logic and mathematics as autonomous disciplines independent of philosophical reflection on them, independent of any philosophical presuppositions. Therefore they sharply separated mathematical and logical research practice and philosophical discussions concerning logic and mathematics. Philosophical views and opinions were treated as "private'' matter that should not influence the mathematical and metamathematical investigations. On the contrary, in the latter all correct methods could and should be used. This "methodological Platonism" enabled Polish logicians and mathematicians to work in various areas without being preoccupied by philosophical dogmas. In controversial cases, as for example in the case of the axiom of choice in set theory, their attitude can be characterized as neutral – without making any philosophical declarations they simply considered and studied various mathematical consequences of both accepting and rejecting the controversial principles and investigated their rôle in mathematics.

TITLE ROLE OF HISTORICAL APPROACH IN THE EMERGENCE OF NEW HUMANIST PHILOSOPHIES OF MATHEMATICS

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Historical philosophy of science used to be treated as focusing on the patterns of scientific change. In this paper I shall argue that historical approach can do much more: it changes our view from theories to the men who made them. I shall show the renaissance of humanist philosophy of mathematics as a result of new philosophical accounts of its history.

History is a main source of constructing identity. History of science gives us a deeper perspective: it shows the roots of present in the past. Anyway, history of mathematics used to be treated as something irrelevant to mathematical thinking. Philosophers of mathematics of the 20th century belonged to the foundationalist school. The most important problems they dealt with belonged to the foundations of mathematics.

Though George Pólya revived heuristic approach to this science, his contribution was not enough to change the philosophers' thinking about mathematics. It was Imre Lakatos, who first showed that the history of a theorem has an explicit effect of the resulting form of mathematical theories. Mathematics may be the language of Creation, but mathematical theories in their actual forms are the result of historical processes. The ideas of proofs, the examples and counterexamples discovered in the course of debates around the certainty of a proof have deep impact to our mathematical knowledge.

Ludwig Wittgenstein in his "Remarks of the Foundations of Mathematics" stressed the role of mathematical practices in achieving certainty of theses and proofs. Today philosophers of mathematics like Reuben Hersh, Thomas Tymocko, Paul Ernest synthesize on different ways the practical line of Wittgensteinian and the historical line of Lakatosian approaches. These philosophies shed a completely new light on mathematical knowledge. History of mathematics became an integral part of its philosophy. The "rational reconstruction" described by Lakatos appears not as an ahistorical rational force of re-construction, but a natural trial of understanding the past. Patterns of scientific change can reveal how the mathematical concepts and the structure of mathematical theories achieved their present form – but they need not exclude other possible patterns of change. The personal knowledge of the mathematician receives its place in the center of this construction. Personal not in the sense that it would be subjective. On the contrary – personal knowledge in the Polanyian sense: as a commitment to discover the truth. A truth in a symbolic world that is strictly constructed by a rigorously thinking and highly creative community.

In this humanist philosophy we gain deeper understanding of what some of the greatest mathematicians – like Alfréd Rényi – wrote about truth, construction and certainty in mathematics.

PHILOSOPHY OF MATHEMATICS AND EFFECTS ON MATHEMATICS EDUCATION

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The philosophy of mathematics as a discipline, has dealt for many centuries with the issue of what is the nature of mathematics and studied the foundations and implications of mathematics. In the last century, the nature of mathematics became a central issue for educationalists as it had been before for the philosophers. These debates develop slowly since each thinker contributes his or her view of looking at the different facets which mathematics presents rather than being conclusive. This philosophical debate is indispensable since teaching and learning mathematics is influenced by the perspective adopted, and because mathematics has had such a central role in the advancement of societies.

There is a range of perspectives in the philosophy of mathematics which can be divided into two groups mainly: 'absolutist' and 'non-absolutist-quasi empirical'.
Absolutist view mathematics as an objective, absolute, certain and incorrigible body of knowledge, which rests on the firm foundations of deductive logic. Among twentieth century perspectives in the philosophy of mathematics, Logicism, Formalism, and to some extent Intuitionism and Platonism, may be said to be absolutist in this way (Ernest 1991). On the contrary to the absolutist philosophies, non-absolutist view mathematics as fallible and changeable social product. Admittedly, this is a disputable issue. At the start of the 20th century, philosophers of mathematics were divided into various schools of thought called as Platonism, Formalism, Logicisim and Intutionism. Each school addressed the issues that came to the fore at that time, either attempting to resolve them or claiming that mathematics is not entitled to its status as our most trusted knowledge. Although in science absolutist views tend to flow away to the non-absolutist way following the works of Hanson, Kuhn, Lakatos, Feyerabend etc.., in mathematics absolutist views are still seemed to be dominat.

Based on the explanations above, this paper aims to explore the origin of mathematics philosophies and explain the philosophical arguments about the basis of mathematics along with giving information about the suppoter scientists of each philosphy. Lastly, paper concluded with the influence of those philsophies on mathematics education.

SCIENCE AND PHILOSOPHY

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Do scientists need philosophy? It is true that men of science philosopher like other men. They do in fact think of problems, such as, does good excite? Have I am immortal soul? What is the goal of this life? The question we wish to ask however whether philosophy is reverent to the activity of the scientist is as such philosophers have always maintained that the two disciplines are related. Hence the subject, philosophy of science many modern scientist regard the philosophers internet in science as an intrusion, Galileo threw away the logic and calagones of Aristotle considering them? Hindrance to bogress to him the distinction the philosopher makes a waste of time his own desire was only to harness wathures powers the philosopher's quantitative concepts like space time and motion were of interest and form should be discarded for the modern scientist, philosophical thinking is too critical. Is our sense knowledge true? Will the future really be like the past? Are the laws of matter based on an assumption like the uniformity of nature? All these questions have a long series of arguments for and against. The scientist is rightly supicious of the philosopher who has turned sophist. Who could convince us of such absurdities as that the world does not exist dreaming? Or that nothing is some thing. To the modern scientists the philosopher is symbolized by Descartes who question every thing and ask a proof even for the obvious. This is important to realize that in reacting against Descartes with such passion, we are too greatly influenced by him. Today's science retaing some thing of the sceptocism it believes it has rejected for instance uncertainly as to whether or not there are laws in nature. Whether the best we can do after multiple of a probability. Whether chance Governs the World and whether we are sure of the future only because thing. Likely for us keep happening the same way Descartes did not share these views he thought he had finally proved that a rigorous necessity ruled everywhere. It was not his beliefs how ever which modified science and philosophy after him, but his doubts. Descartes starts with an universal skepticism and ends with a radical certainly. Yet since his resolution of the former was unsatisfactory. The man legacy he left to later thinkers was his doubt as regards every thing the modern scientists has more in common with Descartes then he is conscious of the latter shared in fact Galileo's contempt's on which modern physics is based give me space and motion he said and I will remakes the world. When in his discourse on method Descartes spoke of employing those ideas which were clear and luminous. He meant ones comprehensible in terns of quantity exactitude being understood only numerically. Descartes recommendations for the study of life were also followed he had asked biologists to do away with the concept of soul and to treat living things as merely more complex matter under the same laws. The Aristotle an concept of form was also to be abolished in all sciences of physical matter. This simplification spread further than Descartes wanted and was applied to the sciences of human persons and society, men and women began to be considered as machines. Very complex once no doubt, but in principle under the same laws as inanimate matter for the father of modern dualism how ever mental activity was not necessity being a reality opposed to matter.

THE RELATIONSHIP BETWEEN SCIENCE AND PHILOSOPHY - HISTORICAL AND THEORETICAL ASPECTS

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Historical periods of development of the relationship between science and philosophy:

First period: from Thales(7th c. BC) to the beginning of Renaissance (middle of 15th c.). An integrative tendency in the process of development of theoretical (scientific as well as semiscientific) knowledge has been dominated. It has been expressed by means of domination of the philosophy as an almost all-embracing theoretically systematized knowledge, involving some scientific hypotheses, or even some elements of scientific knowledge in an embryonic form. So, various elements of future sciences have developed in the framework of philosophy. The mathematics and medicine obtained independent, but weakly differentiated development, being in some connections with philosophy. Generally speaking logic is in process of development in the framework of philosophy, but as a differentiated part of it. These processes have resulted in a process of differentiation of two interlaced trends of thought in the framework of philosophy: (1) scientific, in an initial level of development, involving elements of (1.1) scientific knowledge in an embryonic form, (1.2) methodology of science, and (1.3) logic; and (2) humanitarian – a very philosophy of life.

Second period: from the beginning of Renaissance (middle of 15th c.) to the end of World War II (1945). A differentiating tendency in the process of development of scientific knowledge has been dominated. It has been expressed in a grate degree by means of process of differentiation and further separation from the philosophy of various fields of natural sciences (as well as by means of further differentiation in the framework of last ones, resulting into formation of various branches of them), stimulated by (1) invention and subsequent application of various means of exact observation, measurement and experimentation of various kinds of objects and phenomena, (2) essential application of mathematical concepts and methods into investigation of various fields of the nature, more and more taking the form of their mathematical modelling (3) application of concepts and methods of some developed sciences or scientific theories to investigation of problems of other ones, (4) application of various branches of mathematics and natural sciences to the praxis, in particular to various fields of technique, medicine and agriculture. Isaac Newton's *Philosophia naturalis principia mathematica*, Londoni, 1687, has become a model for shaping various scientific theories as well as various branches of science, so, we shall name them ones of Newtonian type. Logic has obtained a form of a system of formal systems, interpreted in a given abstract way and has become a part of mathematics. As a result of these processes in their integrity the philosophy has split into (1) philosophy of science, offering a methodological fundament of scientific investigations, and (2) philosophy of life, elucidating some social and humanitarian aspects of the science.

Third period: since the end of World War II (1945). It can be characterized on the first place by the essential role of the interdisciplinary investigations, in particular resulted in formation of complex theories, which a not of newtonien type. They involve relevant philosophical problems.

Namely the interdisciplinarity in modern science is the topic of special treatment here.

ENJEUX ENTRE LES APPROCHES HISTORIQUE ET LOGIQUE DE LA RECHERCHE SCIENTIFIQUE

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Mots-clès : logique épistémique, théorie des jeux, contexte de découverte, contexte de justification

Une conception souvent trop stricte de ce qu'on appelle la logique de l'activité scientifique empêche depuis longtemps un dialogue plus fécond entre l'épistémologie et l'histoire des sciences. D'un côté, il y a des philosophes comme Karl Popper, Rudolf Carnap et Hans Reichenbach qui séparent radicalement les questions concernant *la genèse* des concepts, théories et hypothèses scientifiques des questions concernant leur *justification*: chez eux, il n'y a pas une logique de la découverte ou de l'invention scientifique ; la rationalité de toutes les sciences ne se trouve que dans la structure formelle des théories (leur genèse important peu) et dans leur rapport – tantôt deductif, tantôt inductif – avec les expériences qu'elles sont censées expliquer. Ainsi, les informations historiques sur l'origine ou l'échec d'une hypothèse ou d'une théorie ne posséderaient qu'une valeur illustrative pour le philosophe de la science. À l'opposé, d'autres approches tentent de surmonter cette distinction radicale entre le contexte de la découverte des nouvelles conjectures et le contexte de leur justification. Les travaux de Thomas Kuhn et Norwood Hanson, par exemple, mettent en rélief les limites des modèles déductifs et inductifs d'explication scientifique en déployant une analyse à la fois historique et conceptuelle des changements théoriques dans la physique. Cette analyse échoue pourtant à caractériser d'une façon formelle satisfaisante la rationalité manifestée dans les efforts d'invention et de découverte d'une nouvelle hypothèse ou d'une nouvelle théorie. Ainsi, pour tenter dépasser les limitations de ces deux perspectives, on soutiendra dans cet exposé la conception de l'acitivité scientifique comme un jeu de questions et réponses dont la rationalité pourrait être déployée plus rigoureusement avec l'apport de deux outils théoriques: la logique épistémique et le concept de *stratégie*, défini par la théorie des jeux. Ces outils rendraient possible le développement d'une véritable logique de la découverte scientifique et permetraient une interaction plus riche entre la philosophie de la science et l'historie de la science.

EUGENE WIGNER AND PHILOSOPHY: THE STEPS OF HIS PHILOSOPHICAL FORMATION

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This communication presents a historical reconstruction of three intellectual steps in the Hungarian American physicist Eugene P. Wigner (1902 - 1995) formation, since his early years in the *Gimnázium* until the context when he suggested the mental interference to the quantum measurement problem. The first remarkable moment in his formation covers his studies in the Lutheran Fasori Evangélikus Gimnázium in Hungry, where he made his first studies about physics and mathematics subjects. Then, my focus will be in the Wigner's life in Germany in the twenties, mainly Berlin, where his early achievements in mathematical and theoretical physics flourished, such as symmetries in group theory. But, before I intend to suggest how Wigner got his deep knowledge in theoretical physics and his interest about the mind and perception studies; even though the second subject was an intellectual hobby, it became central in his speculations on philosophy and natural sciences. Finally, I will mainly focus the third moment during the 1940 and 1950 decades. I will turn my look to Wigner's readings on Philosophy of Physics and his letters exchanged with physicists interested in philosophy, when he advanced his philosophical ideas and found support to them. Our references about this period came from dialogues recorded and books cited by Wigner's articles, such as: J. von Neumann, *Mathematical Foundations of Quantum Mechanics* (1932); Fritz W. London e Edmond Bauer, *La Théorie de l'Observation en Mécanique Quantique* (1939); Henry Margenau, *The Nature of Physical Reality* (1950); and some historical and philosophical texts of W. Heisenberg and Niels Bohr published in fifties, among others. I discuss why Wigner became interested in such books. I hope with this work to contribute to a future intellectual biography, which should bring wider comprehension about Wigner's personal history in the period that he proposed the consciousness interference to the quantum measurement problem.

In order to do successfully the reconstruction of these three steps of our principal protagonist I use the interview gave by Wigner to Thomas S. Khun in 1963, a biography written by Andrew Szanton in 1992 (*The Recollections of Eugene P. Wigner: as told to Andrew Szanton*) and the early book written by István Hargittai, *The Martians of Science: Five Physicists Who Changed the Twentieth Century*, in 2006. In addition I use the unpublished correspondence exchanged between him and Henry Margenau, in fifties and sixties, and his philosophical texts and speculative writings (1961, 1963 and 1964a) published together in volumes of his Collected Papers.

I am thankful to Olival Freire for commenting on this paper.

CULTURAL AND HISTORICAL COEXISTENCE AND ONTOLOGICAL IRRELEVANCE OF THE PRESENTISM/ETERNALISM DEBATE

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The aim of this paper is to stick out the ontological irrelevance of the presentist/eternalist debate showing meaningful cultural and historical aspects of these currents to embrace a skeptical viewpoint. That is to say, I will defend that this debate is not ontologically genuine and that the debate remains mainly in an epistemological or pragmatic level.

Mauro Dorato defends a skeptical position as well. According to our aims or desires, we sometimes base on the tensed sense of the existence, and we adopt a perspective viewpoint towards the existence. But other times, because of other aims or desires, mainly because of scientific purposes, we base on a tenseless viewpoint and we look at reality from the 'nowhen', considering the past, the present and the future as existence. It must be discerned this pragmatic position in the ordinary aims of ordinary tensed language (Dorato exposes), and not what the presentists claim, that this tensed language is more fundamental and more natural because it is more settled in the linguistic practice.

In fact, as the presentists say, tensed existence is more fundamental in the majority of natural languages. But this majority is not a law. For example, there was not an original no Indo-European word for the abstract concept of time in Basque, there was not a word connected to the flow or passage of time. Although there is not such a word for the abstract *concept*, there are more than sixty *conceptions* of time. Furthermore, it is interesting to point out some features on the history of Semitic languages, which clearly show the trend from spatial to temporal in their linguistic evolution, where measures of space turned into units of time. Otherwise, I will expose more cultural and historical examples that corroborate this hypothesis: (1) the 'motionless present' and 'the permutational calendar' in Bali, (2) the temporal regimen of tribal societies like the Umedas (Central India).

In history of science, from Aristotle to Newton and from classic physics to modern physics, the evolution of the concept of time constructed the new language of numerical variation and covariation which emphasized an eternalist perspective generally, although nowadays this perspective fights against presentist perspectives for interpretations on Quantum Mechanics and General Relativity.

This coexistence of eternalist cultural tendencies within the main presentist 'naïve' society, or what Dorato says about individuals, the possibility of adopting presentist or eternalist viewpoints according to pragmatic motivations, both of them manifest good reasons to be skeptical about the actual status of the presentist/eternalist debate.

MAN'S DETERMINATION OF NATURE'S COGNITION

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The article is devoted to the research of the history of Nature's cognition by means of revealing the evolution of the "external world" of the natural scientist's cognitive existence. In modern epistemological research the classical approach to the reflection of scientific-cognitive activity is changing, which means that sameness of the subject – object relations to the relation of conscience to the existence.

Abstract study of conscience of any natural scientist is relevant to such approach. The classical example of this approach is transcendental subject of I. Kant.

The requirement for coordination of mind's process of the natural scientist of the investigated part of the Nature was first mentioned by the famous British historian and philosopher W. Whewell. He stated that ideas and facts in the process of Nature's knowledge must be identical. (Whewell W. The Philosophy of the Inductive Sciences. Vol. 1 and.2. - N.Y., L., 1967).

Our judgment of achieving the truth in the cognition of Nature is based on the admission of the form of the investigated subject by the natural scientist. He has achieved the status of the theoretical production of knowledge within the framework of abstracting self-organized social-cognitive system "subject – social organized reality". We explain the historical process of Nature's knowledge as the permanent evolution of such system since the 17th century as a result of the development of cultural mankind.

Our philosophical analysis of the evolution history of the natural scientist's individual parameter in the Nature's cognition has stated the sequence of world views from chaos to order. It is equal to the transformation of the natural scientist from the empirical subject to the subject of the theoretical study. This world- view information regulates the activity of the intellect for theoretical investigation.

Under the influence of social information the Nature has changed to the socio-cultural state. The activity of the natural scientist in this environment promotes the formation of the subject's theoretical investigation. His intellect's activity is regulated by the world-view information as an organizing parameter as the whole system of the "subject – socio-cultural reality".

The history of theoretical Nature's study as the real history of Nature's study involves the levels of natural scientist's development of the attitude to Nature. These levels are the result of the chain discontinue of the self-organized system. For example these systems are represented in non-organic Nature as mechanical, electrodynamical and quantum-mechanical realities.

CASUS OR PHILOSOPHY AND REPRESENTATION OF THE SINGULAR?

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A growing interest to the singular, unique, event-trigger has been characterizing all the spheres of humanitarian, culturological and social knowledge long ago. Firstly, this trend appeared due to the disappointment in the metatheory, metanarration, and global explanation schemes. Secondly, it was caused by the inculcation of daily occupation in the exploratory experience and practices of historians, sociologists, and culture experts. Thirdly, refusal from the serial history, typicality in behavior, repeated and reproduced phenomenons in culture were also the factor which stimulated this interest. Fourthly, the change in the perceptive schemes of cultural perception, visualization of culture and its virtualization (i.e. framing of our vision due to the photography spread) was also one of the key issues. The last factor is the change of the consumption of information, even symbolical, and unquealization and "vipization" of information sources.

The interest of researchers lies in microhistory. Theoretician in modern culturephilosophy and culturehistory R.Shart'e in his work "History Today:…" writes: "Microhistiory, departs from the particular situation, typical in its particular exclusiveness, strives to reconstruct the way by which individuals build their social world. They build it consolidating and clashing within the relations connected them and in conflicts separated them". This explains the fact that modern researchers pay attention to the sources where "Otherness" of an immediate, evident, self-determined Somebody, his egological self-identification via the opposition to the others "Ego". The goal of the researcher here is not to reduce "Otherness" to the existence-with, existence-for, but present "Otherness" as the capacity of primacy, activity, and novelty.

One can represent this real "Otherness" in microhistory only after "a completely new form of history oriented, … on the research of differences and discordance existing in different normative systems of the society on the one hand, and inside of each system–on the other hand", is established. Moreover, the attention should be switched "from generally accepted rules to their original interpretation, from the obligatory norms of behavior to the decisions, which were dictated by the specific abilities of each-importance in the society, economic potential, access to the information" (R.Shart'e).

Thereby, the interest to the most ordinary biography is dictated now by the absolutely other circumstances rather than earlier. Structuralistic experience helped to understand that the concept of "clairvoyant" history of the teleological type–cumulative history–is a correlate of such abstractions as abstraction of transcendental subjectivity, which is inapplicable to the concrete research areas.

The history developing under the sign of transcendental and empirical subjectivity is homogeneous in its essence because in fact all its material is the material of consciousness, but the history is not ordered inside itself and not sorted out. Today the need to understand the history as original and dissimilar but at the same time ordered phenomenon has appeared.

NON-COGNITIVE VALUES AND APPLICATIONS OF SCIENTIFIC THEORIES

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The tradition of modern science has defended that scientific research is "value-free". According to this understanding of science, there is a difference between cognitive (such as empirical adequacy, internal consistency etc.) and non-cognitive values (like social and moral ones). Based on this distinction, the usual conclusion of the dichotomy is that science is actually free of non-cognitive values.

I intend to present a refusal to this conception, based on Hugh Lacey's approach to science. As stated by Lacey, it is important to distinguish cognitive from non-cognitive values but the latter must be taken into account in certain moments of scientific research. The moments I am referring to are the ones of the strategy. A strategy is a model to understand scientific practices and it can be divided in three basic moments: (a) the adoption of a strategy or methodology, (b) the acceptance of theories, and (c) the application of scientific knowledge. Therefore, the moments of strategy in which non-cognitive values are present and have a considerable influence in scientist's decisions – according to Lacey – are the former (a) and the latter (c). In the theory choice making (b), only cognitive values are considered. For such reasons, - and, of course, more details of this argumentation can be given – it is possible to affirm that, despite of the presence of non-cognitive values in scientific research, science is undoubtedly a rational and objective activity.

The idea that values are not only present in scientific practices but also that they influence scientific decision making, can be best understood when claims of imparciality, neutrality and autonomy are taken into account. For, Lacey defends that imparciality, neutrality and autonomy *are* constitutive values of scientific practices and institutions.

In short, in this presentation, I aim to explain with some detail the notion of strategy; the interaction between the values of imparciality, neutrality and autonomy within the key moments of the strategy; and, finally, the importance of not denying the relevance of non-cognitive values in scientific research and also in the results or applications of the knowledge obtained in science. The last thesis can be affirmed based on the idea that science cannot always sustain the values of neutrality and autonomy, specially in the moment of application of its theories.

HISTORY OF QUARKS AS THE WITNESS OF INSTRUREALISM IN OBSERVATIONAL-THEORETICAL DISTINCTION: RECONCILIATION OF SCIENTIFIC REALISM AND INSTRUMENTALISM

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Scientific realism and instrumentalism refer to the aim of science and interpretation of scientific theories in regard to the correspondence theory of truth. The scientific realists insist on some epistemic import of theories as approximations of universal truths about the facts of the real world, and regard the scientific theories as more or less true in the sense of relatively correspondence between the theories and the facts, whereas the instrumentalists claim that scientific theories should not be considered as true but only useful as instruments for describing the facts.

The author argues that the final aim of science is true description of the facts via true scientific theories that may be called “ideal theories” identified with “laws of nature”. As long as a theory has its own usefulness, the scientist must accept it as instrumentally or pragmatically useful. Accordingly, a scientist, while searching for theories more and more truly representing the objective facts, might be a scientific realist in regard with some theories and some disciplines while being an instrumentalist in regard with other theories and disciplines. Accepting a relative fallibilism in regard to the claims of knowledge, the scientific realist agrees with instrumentalist approach to theories without stopping at the claims of instrumentalism concerning the instrumentally usefulness of them as the final end of the scientist.

We are confronted with two antagonist extremes of the spectrum of views on epistemologico-methodological status of the scientific concepts and theories: from anti-realism to naïve realism. The author, making use of both the evidence from history of quarks and philosophical analysis of the subject matter, puts the strengths and weaknesses of scientific realism and instrumentalism together to show that they may be complementary to each other on the basis of a moderate critical reading of them in an appropriate atmosphere for dialogue.

Accordingly, the author, having tried to reconcile two theses in a historical context, has coined the term “instrurealism” in comparison with coinage of the term “foundherentism” by Susan Haack in her attempt to combine “foundationalism” and “coherentism”. Instrurealism, with its own theses, would solve main problems with exclusive dominance of one of these rivals. The structure of the term “instrurealism” shows that there is a preference and authenticity for scientific realism.

Keywords. Scientific theory, law of nature, scientific realism, relative fallibilism, instrumentalism, observational-theoretical distinction, instrurealism.

PHYSICS-LIKENESS OF SCIENCE

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Knowledge and research in a field that has the status of a perfect exact science (physics) means that theoretical knowledge presupposes empirical knowledge, the latter, however, presupposes the former as well. Still, this kind of paradoxical situation is not a big problem for modern physics as it is normally determined through theories we have constructed and experimentally substantiated. Since Galileo already, nature has been the subject matter of physics only on the basis of those of its characteristics which can be expressed in the language of mathematics, i.e. which can be measured, exposed and reproduced experimentally. Nature is considered only through idealized and mathematically projected situations. It is physics itself that constructs its object of research. This has correctly been pointed out by social constructivists as well. That is why modern physics represents an experimental exact science in its purest form, making it possible to study the methodological structure and functions of the exact science theoretically.

There are two types of cognition in the field of empirical knowledge:

- scientific cognition, being of a constructive-hypothetico-deductive character;
- nonscientific (natural historical) cognition, being of a classifying-historico-descriptive character (ranging from classical biology to the humanities).

Chemistry studies particular kinds of substances (stuffs) and their transformations. One of the primary tasks of chemistry is identification and classification of substances and of their modes of transformation. From the point of view of these tasks chemistry belongs to the classifying-historico-descriptive type of knowledge. However, chemistry can be approached from another angle as well. A pure exact science can be defined by means of the laws of nature. Chemistry has to be defined through substance (stuff) and only thereafter as a research field that studies how and to what extent substances can be treated scientifically from the viewpoint of the laws of nature. Therefore, it should be possible to model and construct substances. Substances with certain properties can be created by transforming one stuff into another or by creating conditions for such transformations. The constructive-hypothetico-deductive character of chemistry depends on the extent to which the transformation of substances can be controlled, i.e. what in the substances can be grasped from the viewpoint of the laws of nature. The whole chemistry depends on our being able to isolate pure substances with reproducible properties. There are laws stating that kinds of material with reproducible properties exist. An example of a chemical law of nature is the periodicity of elements discovered by Dmitri Mendeleev.

On the basis of chemistry we can understand the difference between physics itself and a physics-like science. Biology cannot really challenge chemistry here. It is a life science and as such cannot be physics-like enough. Obviously, biology does not construct the research object for itself. It is foremost a historical discipline. However, from time to time biology makes use of hypothetico-deductive theories, which are based on observation that can be considered a quasi-experiment.

HISTORICAL REASONS AND POSSIBLE WAYS OF THE NEW SCIENTIFIC SYNTHESIS

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The modern science is very badly fragmented: there are contradictory general approaches in physics – loop quantum gravity and strings theory, in psychology – neural networks and gestalt theory, in philosophy – materialism and idealism. From science history we know that contradictory scientific theories are rather complementary than opposite. Obviously, a new great scientific synthesis is required in order to expand our vision of reality and make it intuitively simpler. It may be the aether physics and a new multidimensional geometry, based on smooth infinitesimal analysis. The reality may be considered as the process of time evolution of holistic material macro objects – elastic membranes (for example, our Universe), which are supposed finally to be embedded into the absolute infinite dimensional space-time. An embedded membrane is a holistic unification of infinitesimal segments which are the result of splitting of the corresponding segments of the parent membrane and it may be considered as the material source of a holistic excitation (squeezing) of the infinitesimal segments of the parent membrane around the embedded membrane. On the contrary, elementary particles (strings) are simply internal excitations of the membrane. According to the new approach instead of been composed of points a membrane is holistically composed of "connections" (spherical connections connect infinitesimal segments and form holistic membranes, they are the analogs of compact dimensions in strings theory). An embedded membrane in this multidimensional aether world will look differently for the external and internal observers: from the outside it will be a set of excitations with smooth infinitesimal geometry and as a set of points equipped by a metric from the inside. When interacting with elementary particles and other membranes, a membrane will transform their energy into its elastic energy (a new form of energy) – energy of stretching of the infinitesimal segments. If we suppose that the speed of light along a transformed segment will be also changed in proportion to the stretching when these elastic deformations will not be observed from the point of view of the internal observer. Heisenberg's uncertainty principle will work in this physics only from the point of view of the internal observer. For the external observer each embedded elastic membrane may be stretched and even a very small region will become observable.

Introduced above elastic membranes may be very useful in order to explain our perception and its 2-dimensional nature: elastic oscillations of 2d extended compact membranes embedded into our bodies may be responsible for our sensations. To the selected organism will correspond only one elastic membrane responsible for its "self", but there may be other membranes, even at the cell level. For example, living organisms play the role of the internal observers of the Universe, and at the same time they serve as the external observers for 2-dimensional membranes embedded into our Universe. We can indirectly observe our self-membranes through our sensations. According to the new approach the contradictory theories mentioned above are complementary: they simply reflect points of view of internal and external observers.

WAS EINSTEIN RIGHT ABOUT QUANTUM MECHANICS?

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It's a classic the controversy held between Einstein and Bohr about Quantum Mechanics. On one hand, Einstein rejected it because of its unpredictable essence, while Bohr had no trouble accepting the limits imposed by Nature to the human knowledge, being happy with just a statistical description of it. Time has passed, and Quantum Mechanics works beyond any reasonable doubt. That possibly means that Bohr's world vision was right and we should abandon Einstein's idea of Nature working as a deterministic clock's machinery. However, despite the success of the Quantum theory, some of its implications still seem absurd, while the world more and more shows a mathematical essence, just as Einstein thought. In this paper, Einstein's point is defended, in the light of the resemblance between Mathematics and the natural world.

Keywords: Einstein, Bohr, Mathematics, Quantum Mechanics

LE DÉVELOPPEMENT DE LA THÉORIE DE LA RELATIVITÉ DANS LE MILIEU PHILOSOPHIQUE FRANÇAIS DANS LES ANNÉES 1920: UNE ÉTUDE À PARTIR DE L'ÉPISTÉMOLOGIE BACHELARDIENNE

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La publication de la théorie de la relativité restreinte, en 1905, et de la générale, en 1916, par Albert Einstein eut un large impact au sein de la communauté scientifique à l'époque, en raison des changements profonds que ses propositions énonçaient sur les phénomènes physiques. A cause de leur caractère innovateur, il eut beaucoup de résistance de la part de la communauté scientifique à les accepter. En France, par exemple, la théorie de la relativité s'est heurtée au début à une opposition de la part du milieu scientifique, et elle fut reçue avec indifférence et hostilité par un bon nombre des physiciens. Sa diffusion, jusqu'au commencement des années 1920, fut pour une large part le résultat des travaux développés par le physicien Paul Langevin. Pourtant, cette diffusion atteignit non seulement la communauté scientifique mais aussi la communauté philosophique, exerçant son influence sur plusieurs philosophes français remarquables de l'époque, comme Henri Bergson, Emile Mayerson, Eduard Le Roy et Léon Brunschvicg. C'est à partir du contact avec la nouvelle théorie que Brunschvicg fait paraître *L'expérience humaine et la causalité physique* ; Bergson, *Durée et simultanéité*, l'un et l'autre en 1922, et Meyerson, *La déduction relativiste*, en 1925. Ces ouvrages eurent des répercussions dans la communauté philosophique de l'époque, sur d'autres philosophes , comme Gaston Bachelard, qui fut amené à écrire le livre *La valeur inductive de la relativité*, en 1929, en réponse au livre de Meyerson, et les livres *L'intuition de l'instant*, de 1932, et *La dialectique de la durée*, en 1936, en réponse à l'œuvre de Bergson. L'interprétation que Bachelard donne de la théorie de la relativité est est reliée à la critique du continuisme de Meyerson dans l'élaboration de la connaissance scientifique et à la rupture d'avec l'idée bergsonienne d'un temps unique. Dans cette perspective, Bachelard démontre dans son épistémologie que la relativité n'est pas un prolongement de la théorie de Newton, mais qu'elle naît de la rupture avec des concepts considérés comme évidents, en l'occurrence, celui de ~~la~~ simultanéité. La relativité se caractérise alors, dans sa formulation, par un ensemble de principes qui moyennant le processus déductif engendre sa propre phénoménologie. Cette création du phénomène relativiste a lieu par l'induction, qui chez Bachelard a un sens différent du sens usuel, signifiant création de réalités Mathématiques. Ces phénomènes ne peuvent être vus ni compris que dans le champ de la théorie. La relativité devient, par là, une méthode de découverte, qui mène à une compréhension tout à fait différente de son rôle dans la science, en la caractérisant comme un processus rattaché à la théorie qui l'embrasse: il n'y a donc pas d'objectivité garantie par une méthode universelle, mais par une objectivation atteinte à partir des moyens propres employés dans la construction de la connaissance scientifique. Cette nouvelle manière d'interpréter la science contemporaine a été considérée par Bachelard comme étant un nouvel esprit scientifique.

STRING THEORY – THE FALL OF SCIENCE?

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The success of the contemporary scientific method consist in the rigorious application of the mathematical structures in the analysis of the laws that govern the physical universe. These laws are revealed by means of a repeated experiment where the empirical data are put into mathematical formulas. The role of mathematics in science, however, is not confined only to a mere device to organize and store data. Mathematics is considered to penetrate into the inner structure of the physical reality whereby its mathematical model is obtained. Besides their descriptive power, such models are able to predict new phenomena. The general theory of relativity offers such an instance where the correct mathematical structure – the spacetime geometry – has quickly yielded empirically verifiable data. Similarly, the standard model of elementary particles enjoys experimental confirmation to a great degree of accuracy. The reliance on experimental evidence in conjunction with the use of mathematical modeling of the physical reality has undoubtedly become the canonized method of the natural sciences. Following the year of 1973, when the full formulation of the standard model was at hand, new ideas were sought by the physicists in order to deepen the scope and understanding of the model. An idea that gained considerable amount of attention was to replace the point-like elementary particles with one-dimensional objects called « strings ». Despite of its considerable mathematical complexity, the proposed superstring theory resulted in much initial excitement for it gave perspective for the quantization of gravity. However, the theory suggested the existence of many additional unobserved dimensions as well as an abundance of hypothetical particles generating practically no experimental evidence thereof. Such state of affairs led to the conviction that the superstring theory might be equivalent to the entire *landscape* of physical possibilities leaving out any chance to be empirically tested. In order to revamp the string idea, the *anthropic principle* was applied suggesting the existence of a multiverse allowing for the parallel realization of all possibilities implied by the theory. Since this contradicts the standard criterion of the theory's empirical falsifiability, several prominent physicists such as Roger Penrose and Lee Smolin have recently voiced their objections in view of the evident abandonment of what is traditionally understood as a scientific method. Is this situation indicative of the true fall of science as Lee Smolin argues in his book entitled *The Trouble with Physics*? It will be argued that although alternative routes of unifying general relativity with quantum theory may give new hope, they may demand a radical departure from the concepts that are currently in use by most of the contemporary physical theories (e.g., Connes' non-commutative geometries or Penrose's twistors).

EINESTEIN AND NEWTON: TWO GIANT PHILOSOPHERS – SCHOLARS RELATIVITY ABSORBS QUANTUM GRATIVITY AND NEGATES ABSOLUTE!

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> Newton, forgive me; you found the only way which, in your
> Age, was just about possible for a man of highest thought and
> Creative Power. The concepts, which you created, are even
> Today Still guiding our thinking in physics, although we now
> Know that they will have to be replaced by others farther re-
> Moved from the sphere of immediate experience.
>
> (Einstein: *Authobiography*)
>
> *Hypotheses non fingo[I frame no hypotheses]*
>
> (Newton: *Famous Dictum*)

Philosophy of physics is always double faced: On one hand, physics serves as a subject of philosophical inquiry: we tend to use the tools of philosophical analysis to explain and even criticize the theories and methods of the physics. But from ancient times to this day it does not happen as expected and we turn to physics for answers to philosophical issues, specially the questions of fundamental ontology. We are interested to grasp what physics explains us about the nature of the world - matter, space and time - since one of the primary philosophical problems is to understand What There Is. As the most fundamental natural science, physics attracts the two sided attention from naturalistically minded metaphysicians.

All of the great twentieth century achievements in fundamental physics - Relativity and quantum theory - have undergone extensive philosophical investigation in their own reality. But as problematic as these inquiries have been, they must ultimately be regarded by the metaphysician as merely provisional. Ontology based on physics cannot yet be complete since physics itself is not yet complete. The problem is these theories do not appear to be compatible. The urgent project in physics will be the unification of quantum theory and the General Theory of Relativity in a theory of Quantum Gravity.

Welcoming Newton's thoughts and Newtonianism in the opening decade of German Enlightenment is often interpreted vaguely. It can be suggested that two reasons help to explain this phenomenon. One is that the philosophers who have adopted Newtonian arguments were critics of Wolffianism. Anyhow, these critics influenced the indigenous currents of thought made early reception of Newton in Germany. The other reason is that the challenges between Wolffians and their critics based on metaphysics. This issue is usually discussed that the Berlin Academy after 1743 included a Newtonian group, but even there the acceptance of Newtonianism was questionable. Some philosophers were not satisfied to be labeled 'Newtonians', because this implied a dogmatic belief in Newton's ideas. At last, after mid-eighteenth century 'Newtonianism' was increasingly regarded as a philosophical system.

Traversing some great thinkers of the world as James Clerk Maxwell, Ludwig Boltzmann, Charles Darwin, Louis Pasteur, Antoine Lavoisier, we reach far away on the line of Equator to Newton on one extreme and to Einstein on the other. As philosophers, both Einstein and Newton had intellect that led them to different known continent of their contemplations and beyond. It is true that Newton invented the calculus, formulated the laws of mechanics and motion, proposed a universal theory of gravitation; and Einstein founded the basis of two skyscrapers of modern physics, special relativity and quantum mechanics, and created a new theory of gravity. But these inventions are greater and more important than mere scientific theories. In fact, they are philosophies, they are symphonic themes, and they are colorful manner of existing in the cosmos. To say, as philosophers, both Newton and Einstein were principally theoretical physicists and at the same time, tried their hand at experiments. Newton, the far greater experimentalist, discovered among other things that white light is composed of a mixture of colors and besides, invented mathematics that he worked with. Instead of mathematics, Einstein was led to meditate and adopt the obscure non-Euclidean geometry of Riemann and Gauss for geometric theory of gravity, by the aid of his brilliant intuition. Therefore, as the result of their huge mounting, both developed worldviews. In this century we recall "Newtonian" universe and the "Einsteinian" universe-the first being a world of absolutes, the second a world of relativities. In Newtonian cosmos of thought, time flows as unchangeable, as absolute! Causality is as definite as a commandment of God; every effect, without exception, has a cause and the future is undoubtedly predictable from the past. In Einsteinian cosmos of thought, time is not absolute and the rate of temporal flow depends on the observer. Moreover, due to new quantum physics, which was founded by Einstein despite reservations, the intrinsic uncertainties of nature at the subatomic level prevent predicting the future from the past and Certainties must be replaced by Probabilities.

As we acknowledge the fact that, the laws of the nature are hidden in the core of the cosmos and the nature has its own rules and exists by harmony of contradictory forces! So, we can claim that both giants were artists and musicians as the same time. Because these two genius philosophers and scientists, were dealing with the pattern of the cosmos and discipline of the things and harmonic structure of the world, but in different method and point of departure. In other words, both of them devoted themselves to simplicity, elegance and mathematical beauty on one hand, and most complex, synthetically and philosophical interpretation in relation to the way of harmonious being in the world. This is not even surprising that, it was Einstein with his physics and philosophy, who gave a new and creative way of interpreting to the Nietzsche's Third Copernican Revolution; since he, with his extraordinary and seemingly absurd postulates of special relativity, demonstrated that the great truths of nature cannot be arrived at merely by close observation of the external world. Rather scientists must sometimes begin within their own minds, inventing hypotheses and logical systems that only later can be tested against experiment. In this way, the issue of the philosophy is not either to know the world by experiment or reason, but existential being of the Man in the world and discovering the laws of nature and his individuality-society by conscious being in the relative space-time and traversing beyond the time!

Modern physics has recently advanced to an understanding of nature beyond human sense perception and experience, teaching us that our commonsense grasp of the world can be mistaken. And as Einstein has written in his introduction to a 1931 edition of Newton's *Opticks*, "Nature to him was an open book… In one person he combined the experimenter, the theorist, the mechanic, and, not least, the artist in exposition. He stands before us strong, certain, and alone." We can undoubtedly recognize these two as Golden Stones of the Monumental Building of the Physics – Philosophy. One, the receiver of the Apple of the Knowingness from the Nature, of which Man was forbidden to eat! The one who devoted his life to grasp and postulate firm rules not to be moved, under the influence of Gravity. The other, more than being simple receiver of the rain of laws of the Nature, was discoverer of the mystery of the falling of the Apple, not merely by the Absolute Law of Gravity, but also by the Harmonious Melody of Cosmos which gave birth to Dancing Apple through the Golden Equation of Relativity.

Regular Session T24
Science and Military Affairs

TURNING ORGANIC CHEMISTRY INTO ‘A SCIENCE RATHER THAN AN ART’: THE ROLE OF THE US MILITARY DURING AND AFTER WORLD WAR II

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This talk will explore the complex relationships between science and the military in the area of organic chemistry. Those relationships have received much attention with regard to physics, geology and other physical sciences; by contrast, they have been relatively neglected with respect to chemistry.

Through WW I, organic chemistry was the most empirical and most applied of the physical sciences. By the end of WW II, however, an influential group of organic chemists had made strides in refashioning the discipline as ‘a science rather than an art’, increasingly quantitative and focused on ‘fundamental’ questions unconnected with any immediate application. The British were leaders in this reorientation, but there was a strong cadre in the US as well. Their combined efforts led to the creation of a new subdiscipline, eventually called physical organic chemistry (POC).

The phrase quoted above is from (Sir) Christopher K Ingold of University College London (UCL), who stood *primus inter pares* among the founders of POC. One of the holy grails of POC was the elucidation of reaction mechanisms, which can be thought of as motion pictures of chemical change at the molecular level. At UCL, mechanistic investigations were pursued without regard for potential applications. The same had also been generally true in the US during the interwar years. However, by 1940 several US groups began investigating reaction mechanisms of direct military relevance: aromatic nitration (explosives); paraffin alkylation (aviation fuel); vinyl polymerization (gun turrets, windscreens); action of mustard gas (chemical warfare).

The last three topics were actively investigated in the laboratories of Harvard University’s Paul Bartlett, the dean of American physical organic chemists. The work of of Bartlett and like-minded investigators inspired confidence that the empirically grounded organic reactions which had produced a host of new materials, explosives and medicinals during the war could be brought under rational control. After the war ended, the Office of Naval Research (ONR) addressed the task of sustaining the highly effective American research network. Bartlett was an early ONR grant awardee and was rapidly recruited to serve on the Panel on Organic Chemistry of the ONR, which made recommendations on grant proposals submitted to ONR. The Panel was explicitly instructed not to take relevance into account in its recommendations. Thus, the US military found itself supporting the ‘pure’ research of this burgeoning new field.

The growing visibility of, and funding for, physical organic chemistry led to a major shift within the US organic chemistry community. The best and the brightest’ began to migrate into POC and away from traditional areas such as synthetic organic chemistry. In addition to describing these developments, the talk will offer observations on the wider issue of military support and ‘pure’ research.

THE QUEST FOR NATIONAL FUELS, AN INTERNATIONAL MATTER OF THE INTERWAR

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In this paper we have chosen to outline a specific historical moment of the long history of the alternative fuels industry. The first step will be an attempt to give a definition of what we can call historically an “alternative fuel" and to discuss the complexity of this transdisciplinary object that has been continuously redefined, jointly with networks of actors structured around it.

We’ve decided to limit our present study to the 1918-1939 period. Indeed, by showing the role that motorized armies would be leaded to play in futures conflicts, World War One has tragically emphasized the strategic aspect that oil had just acquired. However, for countries like Germany, Italy or France, which had no significant resources on their European territory, a breakdown of imports now could quickly paralyzed a army. Consequently, the production of substitutes for oil directly from national products as alcohol or wood, even it could only give extremely low quantities, appeared to be an indispensable condition in order to keep a minimal military activity. It’s no surprise political and military authorities became highly involved in those researches just after the war.

The central part of this paper, once defined the context of alternative fuels issue, will concern its circulatory aspect. Indeed, between the two world conflicts, exchanges of knowledge and techniques grew up in a dimension unknown before 1914. The whole history of substitute fuels has to be seen as a transnational field; actually the development of this new activity took place as well in the colonies of Western empires, as in a newly redefined Eastern Europe or in South America. Moreover researches were not done in parallel in those various locations, they were a combined effort, each country kept an eye on the activities of others and when one of them changed its legislation, or released on its market a new product, it was discussed by others and often imitated. Places where this co-construction was effective were specialized international summits; technical journals or simply small meetings held outside World Fairs, we will emphasize those networks of communication in this work. However, we cannot fail to be surprised by this paradox that those multilateral developments of alternative fuels were at the service of clearly autarchic policies desired by nationalist movements. But did our actors aware that their present partners would be possible future opponents? We'll try to give a first answer.

The conclusion of the paper will deal with the posterity of those researches by analyzing the impact that World War Two had on alternative fuels. Some elements will also be given, especially for the case of France, about the very contemporary problematic and the renewed interest for alternative fuels that we can notice today. We'll particularly point out distinctiveness of present and past situations.

WORKING OUT OF THE LASER WEAPON UNDER THE PROGRAM «STAR WARS» IN THE USA IN 1980-ES (POLITICAL AND ECONOMIC COMPONENTS) (ON MATERIALS OF OPEN FOREIGN SOURCES)

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The program beginning «The Strategic defensive initiative» (SOYA) dates to March, 1983 and to the well-known speech of the US president of R.Reagan, though actually the first statements for necessity of creation of spase weapon, including the use of high-energy lasers, have sounded in 1978-1979. Initiators were senators from Republican party, M.Wollop, and the former cosmonaut - H.Shmitt. First "informal" statements, appeared in Press, confirmed that protection of USA orbital space flight devices from fighting companions of the USSR becomes "a paramount problem" of the USA Air Forces.. For 10 years, dates from October 1968, Soviet Union has ostensibly spent 16 tests on interception and destruction of companions of the prospective opponent.

In 1980 official representatives of the USA government and Pentagon began to assert that the Soviet laser fighting stations will be on orbital injection by 1985. USA have called Japan, Germany, and other countries for cooperation in the field of working out of the weapon with the directed energy. It was considered that the one who will be first to put laser fighting station into orbit, can supervise a conclusion of spaceships of the potential opponent. Therefore in the USA were full of determination to make all possible, to outstrip the USSR. There was affirmed that at existing rates of developments of laser techniques Soviet Union will be able to put high-power lasers into orbit approximately to 1984-1985. USA Intelligence service considered that scientific level works of Soviet program creations of laser weapons in 3-5 times exceeds level of works in the USA, and the Soviet program is calculated on working out of concrete system of laser weapon. Besides, they considered that the USSR ostensibly spends for working out of the laser weapon of space basing in 3-5 times more financial resources, than USA.

By the end of 1982 all kinds of armed forces of the USA have conducted demonstrational tests of own laser weapons experimental systems. In 1983 association of development and research works under the SOYA program had started. The basic efforts on a national scale in second half 1980th years have been directed on creation laser weapon for antimissile and anticosmic defences. Minor significance was in the mid-eighties attached to tactical laser weapons. So, in 1987/1988, on the development of strategic laser weapon were assigned 1685,5 mln. dollars, and on the tactical weapon - only 66,8 million $

In this report political, technical and economic aspects of development of a laser part of the program of the SOYA in the USA in 1980th years are tracked. It is shown that only new course of the USSR directed to put an end to the "cold war», has dumped "flywheel" turns of "Star wars», and, owing to financing reduction, has not allowed to transfer «laser race» from land experiments to the large-scale space.

Regular Session T25
Modernization and Development

FORGOTTEN “INDUSTRIAL WARRIORS”: THE BOOM OF VOCATIONAL TRAINING IN SOUTH KOREA, 1967-1986

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This research will investigate the South Korean government’s vocational training policy and the response of the younger generation, from 1967 to 1986. Vocational training was strongly encouraged by the Park Chung Hee administration (1961-1979), as a premise of its export-oriented economic development program. The government motivated youths by organizing and supporting teams for “the International Vocational Training Competition” (IVTC) and rewarding the winners. From the late 1980s, however, vocational training gradually lost its impetus. Also the technicians, once praised as the “industrial warriors” in the 1970s, became eclipsed by the white-collar scientists and engineers. I will show that it corresponded to the growth of heavy industries and the spread of higher learning in science and technology in the 1980s.

The IVTC was originated in Spain in 1947 to encourage young people’s vocational skill training. South Korean government noticed the IVTC as a useful opportunity, not only for enhancing vocational training, but also for legitimizing its export-oriented economic policy. As the tryout and training procedures were so similar to the ones for the Olympic Games, the competition was soon called as “Technicians’ Olympics” in South Korea. Especially the deprived youths were motivated by the government’s promotion, taking it as a chance for self-promotion. Many of the winners in the IVTC could elevate themselves to the middle class.

In 1977, ten years after their first appearance in the competition, South Korea won the most gold medals among the participating countries. It could also maintain its championship for nine consecutive matches, from 1977 through 1985. This brilliant performance in the IVTC was received also as an icon of South Korean’s mastery of technology. The government and the mass media revived discourses on “Korean’s scientific and technological ingenuity,” which had been first claimed during the colonial period. These discourses were received by the public as historical justification for the remarkable growth of South Korean industry.

In the 1980s, however, South Korea became less dependent on the skilled manual labor as heavy industries occupied increasingly bigger portion in South Korean economy. As white-collar scientists and engineers trained in the US came back and led industrial R&D programs in South Korean companies and universities, the incentive provided by the vocational training was gradually reduced. The vocational schools established in the 1970s lost their prestige, as higher learning became widely available. As a result, although select South Korean technicians still remain among the top candidates in the IVTC, the vocational training since the 1980s could not recruit competitive youths as easily as in the 1970s.

This case study may contribute not only to the history of science and technology, but also to such fields as Korean history or the economic history, by reviving the forgotten actors that used to be an integral part of the industrialization of South Korea.

A REVIEW OF THE OBSERVATIONS OF THE HISTORIAN KUME KUNITAKE ON CHEMISTRY EDUCATION, MINING AND CHEMICAL MANUFACTURING IN THE WEST AND IN JAPAN IN *THE TRUE ACCOUNTS OF THE IWAKURA EMBASSY TO THE UNITED STATES OF AMERICA AND EUROPE 1871-1873*

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In November 1871, only four years after the declaration of the restoration of imperial rule in Japan (the Meiji Restoration, December 1867), a diplomatic delegation was sent to America and Europe. The delegation included around fifty prominent government ministers and officials and about sixty students and experts. The main aim of the Iwakura Embassy, headed by Iwakura Tomomi, was to revise the treaties signed between Japan and few of the leading states after the opening of Japan to foreign trade, which followed the visit of Commodore Perry and the American fleet of “black ships” in 1854. The other aims were to learn about the West, which was unfamiliar to the Japanese who had been secluded for the previous two hundred and fifty years; to study the law and governing systems, education at all levels, industry and economy, in order to learn from those and to establish a strong and prosperous Japan. A further aim was to present the unfamiliar Japanese people to the world.

The Account of the journey of one year and nine months was compiled by Kume Kunitake (1839-1931), who joined the Embassy as an assistant secretary and later became a prominent historian and who published it at the end of 1878. By 1883 the Account had been reissued three times and at least 3,500 copies were printed and sold. Kume's Sino-Japanese style writing was translated into English[1] in 2002 and even into modern Japanese in 2005. Kume's description of the West, his perception of the differences between the countries that the delegation visited and his observation of the status of women's education in various countries, give us an understanding of how elite Japanese looked at the West and Japan in the second half of the 19th Century.

This paper will take a look at the observations of Kume Kunitake on chemistry. Kume Kunitake observes chemistry education in America and in England. He realizes the importance of chemistry for the development of an advanced chemical industry and compares its status with the status of chemistry in Japan. He states several times that the Japanese are not aware of what chemistry is; they relate chemistry to its role in medicine and in the production of drugs, but nothing further. Kume describes his impressions of the mining of coal in England, in Russia and other countries: He describes Western mining to his potential Japanese readers and explains the role of coal as a heat source for the promotion of industry; he explains the meanings of 'chemical manufacturing' and of 'commerce'.

Kume himself was not a chemist and his knowledge of chemistry was very limited. However by analysis of his writing in the Account, one can understand how an intellectual in early Meiji period Japan, with an enlightened spirit, conceived chemistry and the role of the chemical industry in society.

1 Kume Kunitake, *The Iwakura Embassy 1871-1873, A True Account of the Ambassador and Plenipotentiary's Journey of Observation Through the United states of America and Europe*, The Japan Documents, 2002. Tokyo.

DEVELOPMENT OF TRANSPORT SYSTEMS FOR OIL AND GAS DELIVERY FROM OFFSHORE FIELDS

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Onshore oil and gas fields are steadily exhausted, while huge reserves are hidden under the water layer. Leading scientists and geologists suppose that the most part of the world's oil and gas reserves will be produced from the offshore arctic regions and continental shelf.

Nowadays there are four ways of oil and natural gas delivery from the offshore fields:

1) by means of pipeline;

2) by means of LNG (liquid natural gas) carriers;

3) by means of CNG (compressed natural gas) carriers;

4) by means of tankers for oil and oil products.

Delivery from oil and gas fields by means of pipeline transport is developed enough in the Gulf of Mexico and Northern Sea, where new technologies and technical means are applied during stages of design, construction and exploitation. As an example, development of technologies and technical means for construction and exploitation of the sea pipelines was fully considered within the presented work.

Another variant of the reserves delivery is by means of LNG carriers. Generally for LNG transportation two types of tankers are used: 'Moss' type (spherical) and membrane. Tanker of the 'Moss' type has typical separate spherical tanks without inner structural elements. Membrane tankers are equipped with flexible steel partitions for cargo storage. Besides transport option, possibilities of the LNG production at the onshore and offshore plants were considered within the research.

Third alternative delivery way is by means of CNG (compressed natural gas) carriers. This technology was developed by Norwegian Statoil and Leif Hoegh together with Canadian Teekay Shipping. They have proposed gas compressing instead of it's liquefaction with further transporting under the high pressure in the large diameter pipes by means of special carriers. Such carriers will be necessary for gas projects, which now seems to be unprofitable due to distant geographical position or onshore infrastructure absence.

Variant of delivery by means of bulk oil tankers is the most common for the beginning of the XXI century. Within the research main tankers constructions and it's features were considered as well as development of new tendencies in the design, construction and exploitation of tankers for oil and oil products.

BULGARIAN DAIRY INDUSTRY MEETS THE (WEST) EUROPEAN, 1910-1940

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The papers focus on the construction food quality standards and how they reflect on the making of Europe. Food standards might be seen as an impotent arena for constructing Europe on the material, institutional, and discursive levels. The paper can be seen as part of the efforts to trace standardization of common products in Europe by paying attention to the importance of building of typical types. The case study of Bulgarian yoghurt, and in general the modernization and industrialization of dairy industry of the country, is an interesting avenue to look at the characteristics of Eurointegration.

Modernization of dairy industry in Bulgaria tried to adapt to the European standards for dairy production that were represented in the trade press as similar or even the same as Bulgaria's exported milk products. Interestingly, at the early 30s, Bulgaria started to adapt its internal market according to quality standards first introduced in the European countries with developed internal and external dairy market as Denmark and Germany. Furthermore, this analysis of transfer knowledge, standards, and practices simultaneously traces the transformation of a typical home production to industrially processed product. The work shows that even traditional foods that are related with great conservatism on behalf of the consumer could not escape from the European standards of regulation and quality control. All this resulted in profound changes of their farmers' traditional technology.

THE GAS HYDROCARBON STOCK FOR ELECTROENERGETIC

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While processing crude oil, associated, coal and biological gases the hydrocarbon compositions of different component formula and structure are obtained.

We have studied the processing and conversion of associated gas and hydrocarbon fractions into different products and intermediate products for oil- and gas- chemistry.

There are three main hydrocarbon fractions separated while processing of associated gas (C2-C2, C3-C4, C5-C6). These fractions are used both as a basic raw material and as intermediate products in petrochemical processes for hydrocarbons, polymers, elastomers, fertilizers and general mechanical rubber goods production.

The processing of hydrocarbon raw material could be conditionally divided into 4 stages: First reduction of associated gas: stripped gas. Along distillate of light hydrocarbons, gas condensate or stable gasoline.

Second reduction of long distillate: gas fractionating, in obtaining of close-cut fraction of hydrocarbons (C2 – C6).

The first gas utilization started in the 80s of 19th century, when entrepreneur Shibayev used gas, considered a blue fuel of the future, on his plant of oil distilling.

By the beginning of 20th century, when oil refining sector was developing, plants for production of aromatic and unlimited hydro-carbons were created that constitute the first processes of petrochemistry. Later, in the 40s and 50s the development of gas refining was started, which increased petrochemical raw materials additionally.

In 1954 the first units of Tuymazin gas refining factory (GPF) were built, in 1961 Shkapovskiy GPF was put into operation. By 1964 liquefied gas were produced in GFU-1 and AGFU-2 of New-Ufa oil refining factory, the unit 1 of the plant 43-102 of UNPZ, on oil refining factory after XXII party congress (at present OA "Ufaneftekhim"). The building of these objects allows increasing steeply the volume of gas refining in the country, and gave impetus to the development of petrochemical productions, but the first fraction using like composition for electroenergetic.

DEVELOPMENT OF MATHEMATICAL METHODS AND INFORMATION TECHNOLOGY IN OIL AND GAS INDUSTRY

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Computing facilities for the calculations came into world in the end of XV century.

In 1878 B.Abdank-Abakanovich (1852-1900, Polish mathematician) invented analogue integrator, which was grounded in the first computer for the solving of differential equations.

The beginning of oil and gas complex (OGC) dates from VI – IV centuries B.C.

The research of both oil and gas businesses irrespective of their theoretical and practical developments is interlinked with mathematical calculations and commensurate applications of mathematical methods.

Mainly, papers on computing facilities belong to thirties and forties of XX century.

In forties I.S.Bruk developed electro – mechanical differential analyzer. At the same time there were born up different directions of the application of mathematical methods in oil and gas chemical industry, such as :

- Research by Kantorovich, who developed the technology of large blocked programming;
- Research by Glushkov who carried out works on algebraic theory of automats
- Research by Pushkin as a basis of the development of the methods of situational management of big systems, which is applied for both oil and gas production industry.

In this paper we present separate areas of mathematics and several areas of information technology in above – mentioned industries. Produced set of instruments is started from the application of simple mathematical questions to complicated problems of the calculation in oil and gas processing. Questions and areas are offered in the chronological order, mainly covering XVIII – XX centuries.

DEVELOPMENT OF HELIUM INDUSTRIAL PRODUCTION FROM NATURAL AND CASING-HEAD OIL GASES IN RUSSIA

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The main source of helium production is helium-containing natural gas. Among the natural gas deposits in Russia known at the day some 250 ones can be considered as helium sources.

In the USSR the development of helium problem was begun in 1920-1930: the e searches for deposits of helium-containing gases were being conducted, in 1931 a pilot-scale plant with import equipment for helium production was started in Melnikov village in Saratov region. This plant had been working on the pilot scheme till 1935. The helium industry in the USSR had to be developed on the base of processing of natural and casing-head oil gases containing from 0,05% till 0,1% of helium, while in the USA industrial plants helium was produced from natural gases containing 1,5-3,0 % of helium.

Industrial production of helium was started in 1949 in Uhta. In the 1950-60-ies industrial plants were built in Sosnogorsk and Moscow gas-processing plants. Up to 1978 there were 4 small plants operated in the USSR (Uhta, Moscow, Minniba-evo and Otrdnoje plants). They all produced not more than 1,7 mln. m^3 in a year. Now helium production on the above plants is reduced or stopped because of helium deposits exhaustion and some economic reasons. To make the process of helium production from poor helium-containing natural and casing-head oil gases more profitable the methods of combined gas processing were developed: combination of helium, ethane and more heavy hydrocarbons extraction. Such a process was started in 1978 in Orenbourg helium plant. Now 6 plants can be operated in OHR, and each plant can process 3 billions m3 of “poor” natural gas containing 0,055% of helium. The marketable products are: gas and liquid helium, ethane fraction, wide fraction of light hydrocarbons and liquefied gases. The six plants can produce 9-9,5 mln. m^3 of helium in a year.

The further development of the equipment of helium plants and methods for helium production, and also the composition of helium containing gas in Russia deposits are reported.

EVOLUTION OF THE TECHNOLOGIES AND TECHNICAL MEANS FOR OFFSHORE OIL AND GAS FIELDS DEVELOPMENT

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Oil industry workers were the last, who came to the sea. Before there were fishermen, travelers and military men. Oil industry men are people from the shore, and limited oil reserves was the reason of their offshore movement. This movement was very rush. They developed costal waters as well as deep distant areas less than for a century. Such a success was ensured by the development of scientific and technical ideas, creating safe technical means for offshore areas development and putting out to the open ocean.

First attempts, made in the 19th century, for costal area development were not so successful. Such a failures made newcomers to struggle with the sea by means of capturing it's territories. This way seemed to be more successful and first oil, produced from the offshore areas of California and Caspian Sea, was worthy tribute for perseverance.

In 1987 G. Williams after piers constructing put out to the Pacific Ocean and developed the depth of 10m at the distance of 150 m. P. Pototzky had chosen another way and captured the offshore area in 1925 by filling up part of Bibi-Eibat bay with imported soil. Williams and Pototzky have proved the possibility of oil producing from the offshore. In the late twenties of the twentieth century oil industry workers have begun more serious capture of the vast offshore territories.

In 1947 according to the design project of Raginsky B., Timofeev N., Asan-Nuri A., Krilov E., Ozerov N. construction of the first sea pipe rack with adjacent sites for equipment was started. In 1947 Kerr-MacG company accomplished the first drilling in the open sea by means of tender platform. Since that development of the offshore areas was growing rapidly. First floating units for the offshore drilling at the significant depths appeared and the development of the new offshore regions with prospective oil fields, such as Alaska in 1959 and Northern Sea in 1964 has begun.

Within the research, carried out by the authors, technologies and technical means, applied during oil and gas field development, were considered in detail.

Regular Session T26
Technology and Society

STRATEGIES FOR SIMULATION OF VIEW IN THE PRODUCTION AGROINDUSTRY

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Key words: Academic, Laboratory, machines, reconversion, byword.

Abstract:

The agriculture, process that depends on climatic factors, when these are strong affects the production. This one can simulate pair to create the best stage across the optimization, with it it will be a question of minimizing the costs and risks interfered in it.

The production of a product will be simulated across vensim, there will take the best stage and ideal analysis of seeds, also the average environmental system will talk each other.

1. Introduction

The simulation is one of the tools for analyzing the design and implementation of a complex production system. The computer model of forage production hydroponics is used to understand the production system designed to evaluate various strategies with which it could operate. With the simulation is to understand the evolution over time (Aracil & Gordillo, 1997). According Aracil & Gordillo entire system has an entity that characterizes it, which is why the system of hydroponic fodder production has particular characteristics that differentiate it from other production systems which were maintained over time to an environment that presents changes.

The simulation of the dynamic systems VENSIM using the computer program is developed for the production of hydroponic fodder with the mood to find a description of the behavior of the system designed taking into account the variables and parameters that are related to each other.

The methodology used initially raised the functions of the design process of hydroponic forage production, which defines the input parameters of the system simulate the flow variables and state and performs the mathematical model for VENSIM.

2. Simulation Tool Used

VENSIM is an environment of the dynamics of the system, ie using a programming language specific. The programming is done in graphical form or writing differential equations. Aracil & Gordillo (1997) recommended the use of specific programs as VENSIM released because the programmer's job to implement algorithms for integration.

The use of these tools is based on understanding and simulation of the systemic relations of the process that achieved with VENSIM. The simulation program handles this kind of continuous variables such as those presented for the production of hydroponic fodder.

The results with VENSIM relate with respect to the dynamic behavior of the production system, but do not determine the physical constitution of the system (Ramirez Herrera, 2008).

(Oversized abstract. Please contact the author for the full text)

L'USAGE DU MARBRE DANS LA CONSTRUCTION DES ÉGLISES : LA TECHNIQUE AU SERVICE DE LA SYMBOLIQUE DANS LA SPIRITUALITÉ CHRÉTIENNE

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Le marbre est utilisé dans la construction depuis l'Antiquité. La Bible fait déjà référence au marbre blanc de Paros comme matériau de construction du Temple de Salomon.

Dans l'architecture, l'usage du marbre persiste à travers le temps ; dès l'Antiquité, il est intensif en opus sectile au sol. Des vestiges archéologiques en témoignent en Grèce et à Rome. A l'époque des croisades, certaines églises possèdent des dallages en « labyrinthe », considérés comme l'emblème du Temple de Jérusalem. L'époque romane voit le début de l'utilisation du marbre dans le mobilier liturgique.

Mais c'est dès l'Antiquité que les marbres, comme les gemmes, sont auréolés de symbolique et parfois confondus entre eux ; le jaspe, par exemple, est considéré comme marbre ou comme gemme. Les plus beaux marbres sont dits « jaspés », dès le XVIe siècle.

Ils sont souvent associés à l'albâtre et à l'onyx et considérés d'un même regard pour leur poli parfait (poli brillant), l'éclat et la variété de leurs couleurs. L'ajout d'or et de bronze les rehaussent encore.

Une grande valeur est donc accordée aux marbres, comme aux gemmes, tant cette « pierre » est précieuse.

S'il n'est pas courant dans la construction des églises, le marbre est néanmoins utilisé en grand, moyen et petit appareil, nouveau ou de réemploi. Il est aussi présent dans l'équipement et la décoration où son poli et sa couleur magnifient les rites, suivant une symbolique établie de longue date.

Il s'agira donc d'exposer la manière dont le marbre a été utilisé dans quelques constructions d'églises, la technique étant ici au service de la symbolique chrétienne, tant en appareil de construction, qu'en équipement et en décoration. Le poli du marbre et sa couleur magnifient en effet les rites, suivant une symbolique qui sera exposée à l'appui des techniques employées et des marbres choisis.

Des photos illustreront les propos, tant en appareil de construction, qu'en équipement et en décoration.

DE LA PARADE AU CHANGEMENT CLIMATIQUE : HOMME, HABITAT ET ISOLATION THERMIQUE

Dominique Theile

DominiqueTheile RFC, France

S'intéresser à des trajectoires temporelles n'est pas spécifique des évolutionnistes : les divergences portent sur les tentatives d'explication des déterminants de ces trajectoires. Pourtant l'idée que seuls les meilleurs s'imposent est courante, en ce qui concerne la structuration des trajectoires technologiques. Cependant, sur la longue durée, il apparaît délicat de mettre en évidence des règles intemporelles de sélection des innovations, autres que le constat que l'émergence des technologies est fortement dépendant du contexte social, et plus généralement des contextes culturels voire civilisationnels.

C'est sous cet angle que nous nous proposons de retracer le lent cheminement qui part des techniques de parade aux aléas climatiques des premiers humains, pour arriver aux politiques de prévention du changement climatique, à savoir l'histoire de certaines pratiques humaines d'isolation thermique en climat tempéré (France).

L'isolation thermique telle qu'elle est connue en France aujourd'hui résulte de la rencontre de diverses trajectoires technologiques et culturelles :

- stratégies de protection climatique : habits, literie, habitat
- mouvements technologiques majeurs : maîtrise du feu, révolution agricole (sédentarisation), révolution industrielle
- disponibilités en combustibles : bois, charbon, pétrole…
- paradigmes culturels : substitution généralisée de l'énergie musculaire par l'énergie mécanique et essor d'une nouvelle idée du confort et du progrès

Dans ce cadre d'analyse, nous replacerons historiquement les stratégies de protection à l'origine des pratiques d'isolation contemporaines de type de celles pratiquées en France. On s'intéressera notamment à l'évolution du rapport entre habit (enveloppe primaire), aménagement de l'habitat (enveloppe secondaire), construction de l'habitat (enveloppe tertiaire). Puis nous nous intéresserons aux trajectoires technologiques suivantes : laine de verre, polystyrène, isolation à changement de phase, isolation dynamique.

THE PLOT OF CONCRETE IN BRAZIL: A HISTORY OF THE TECHNOLOGY DIFFUSION OF REINFORCED CONCRETE

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Reinforced concrete was introduced in Brazil at the beginning of the 20th century as a patented product, applied mainly in the construction of bridges, tunnels and viaducts. It was originated from the building systems called Monier and Hennebique, both European with commercial representatives in the city of Rio de Janeiro. After 1930 its use also grew in housing enterprises, due to radical changes in the socio-political and economic scenario, including industrialization and urbanization of the country. Around 1950 reinforced concrete had already achieved hegemony in building production as well as in academic research and education of architecture and engeneering. The technology gave rise to the so called "Brazilian Modern Movement in architecture" an the "Brazilian school of reinforced concrete", having its formal and technical development expressed above all by the work of Oscar Niemeyer. Nowadays, such hegemony became naturalized in the whole production chain of built space. Concrete is indiscriminately used in the construction of Brazilian cities. It is present in both, formal and informal settlements, with or without technical assistance.

Drawing from a socio-historical view, this paper analysis the spreading of the building system of reinforced concrete and the development of its hegemony, in order to disclose the related network of influences (technical, economical and political). It describes the main agents of such hegemony from the middle of the 20s until the end of the 30s: campaigns for professional affirmation and organisation of architects and engineers; academic reform; proliferation of consultancy and projects of architecture and engineering; creation of the Brazilian Standard Association (ABNT) and its first technical standards (which in fact concerned concrete); reforms of urban regulation allowing high-rise buildings; industrialisation of civil construction; and, finally, an intense advertising campaign of the cement companies. Thus, this paper questions the belief that the intense use of concrete happens due to its structural performance, plastic qualities, and logistic and economic advantages.

RISK ASSESSMENT AND RISK SOCIETY: WINNERS AND LOSERS IN GENETIC DISCOURSE

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Biological and medical knowledge been particularly important to establish normality in an "organic" dimension. Genetic information, expressed in statistical data, provides an explanation of the human being in terms of normality: there are genes that are normal and others that are malfunctioning, defective, mutated, and abnormal (the 'deviant' genes). The genetic discourse, while employing notions of normality and deviance, also articulates the notion of *risk*. The detailed knowledge of different genotypes leads to choices concerting reproduction that are selective along the basis of risk – the calculation of the possible harms in a given scenario, in opposition to the possible gains. While normality is based in statistical calculations to establish an average, the notion of risk goes further, since it uses probabilities to predict a future event. This implies that the calculation of risk is used as device to predict and control future events, avoiding the 'abnormal' outcomes.

In 1983, the National Academy of Sciences published a document that standardized the process for health risk assessment. The authors of this report advocated a clear conceptual distinction between risk assessment and risk management, noting that maintaining this distinction would help to prevent risk assessments from being constructed with inappropriate policy influences. Risk assessment would entail the evaluation of information on the hazardous properties of substances, on the extent of human exposure to them, and on the characterization of the resulting risk. Risk assessment would only be an area of analytical consideration, through which scientific knowledge and activity would be organized and integrated. In this way, risk assessment would lead to a systemic consideration of the viability of alternative risk reduction or risk management procedures. Ulrich Beck, in Risk Society, argues that late modernity, as a reflexive social order, 'manufactures' new risks and uncertainties: risks become global, rather than territorially specific; risks are contrasted to dangers and natural hazards as they are made by society; and risks cannot be limited and therefore cannot be insured against or compensated for. Genetic calculations transform biological events once perceived as natural and arbitrary, into calculated occurrences, in which there is an analysis of the costs-benefits for the individual. The idea that individuals should take responsibility for their health is implicitly assumed in this model. While risk assessment is done in conjunction with a health care professional, and through the devices made available through the healthcare professionals, the management of risk is individualized.

This paper will analyse the discursive and concrete practices of genetic technologies and their relationship with risk conceptions and structures. We will contend that at the light of the new genetic paradigm which informs medical practices, as Beck argues, a new conception of Governance revolves around the concept of risk. The losers, those who do not fit inside the category of normalcy (as determined by risk assessment and management) are usually a target of diverse policies and institutions. Therefore, we propose to clarify how concepts of risk, normality and normalization are expressed in the new genetic discourse, leading to global structures of risk assessment, but making risk management an individual enterprise leading to continuous self re-examination and re-assessment.

SHATTERED HOPES – THE SWEDISH WOOD GAS EXPERIENCE

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The paper will discuss a part of my thesis regarding alternative fuels in Sweden 1919-1950. My project is part of *Fuel of the Future?*, a research programme on biofuels in Sweden from the early 20th century up until today. The two fuels at the centre of my study are ethanol and wood gas.

During World War II wood gas became the most important substitution to petrol in Sweden. As importation restriction followed the international crisis, wood gas became regarded as a reliable fuel. In 1932 political efforts to make wood gas one of the main Swedish fuels were under way. Its dependability in crisis situations made it an appropriate substitute fuel, but initially visions aimed to establish wood gas as a central national fuel. Early efforts failed, but the outbreak of World War II dramatically changed the conditions, enabling wood gas to enter the market.

Although motorists in private as well as public sectors appreciated being enabled to use their vehicles, the attitudes towards wood gas were divided. For many it was nothing but a substitute for petrol. The tasks connected with wood gas usage were dirty and time-consuming. It could also be directly life threatening. Wood gas usage had several unwanted consequences, my conference contribution will centre around possibly the most debated.

Wood gas poisoning became one of the most widely discussed occupational disease, subject of a medical controversy. The dispute came to centre on the diagnosis chronic wood gas poisoning, which in more general terms were called chronic carbon monoxide poisoning. While representatives for the wood gas clinic at Sabbatsberg's hospital in Stockholm strongly defended their patients' rights to insurance and a diagnosis, two prominent neuropsychiatrists claimed that wood gas poisoning was nothing but a mass psychosis located only to Stockholm.

At the end of World War II the return of petrol was greeted with cheerful headlines. Not being restricted to wood gas, motorists breathed a sigh of relief. Wood gas was superfluous and one of the most debated technological and medical issues came to and end.

A CHAIN OF TECHNOLOGICAL DEVELOPMENT IN JAPAN AFTER THE WW II AND SOCIAL CONSTRUCTIONISM OF TECHNOLOGY

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As well known Japan introduced a lot of technology after the WW II, and also from America. How it can be explained that Japan had so lot of technology transfer, is an issue still now. A cause can be found in the fact that the weak point of Japanese technology, which had been formed from the age of Meiji period by the special production way lacking on own tool machine industry, not only remained during the War time, but also was increased under the special war production system, widening the gap in technological level in the whole between western countries and Japan because of cession of interactions. Toyota automobile company, for example, could after the Korean War with the enormous war profit renew many machines which had been installed at its very founding time at Koromo, used for about 20 years and aged and lost their accuracy. This rapid introducing foreign technology strengthened the links with American.

To'rationalize'the iron and coal industry following the first industry reconstruction policy after the WW II it needed a lot of funds, and that was covered by 'tied loan' from America, that forced Japanese industry to introduce American technology.This introducing American technology didn't completed itself within technology, that is, American blast furnace for example requested not Japanese coke but one producted from American, or foreign coal. Thus Japan became to depend on America not only in technology but in material resources. It was for Japan disadvantageous to transport material and heavy products for long distance, that caused Japan to built special ships. Japan was famous for shipbuilding industry in 60's and 70's.

But it should be notable strongly that Japan was not good at building every type of ships but special at 'short fat' typed ships suited for material transport.

The second cause can be found out already in the avobe story. It was the 'tied-loan' from American banks for reconstruction of factories under the occupation of the GHQ, which forced to introduce American technology to Japan. The GHQ's occupation policy itself made up new social structure which formed conditions for new technology. The GHQ forced to divide the electrical power monopoly into 9 companies. Each new company was forced to supply the power demand within one own of 9 areas by itself. This condition originated the constructions of big steam power plants and water power plants, because the area suitable for power plant was limited, and finally complete change in character of power production pre War Japan. For construction big plants it needed a plenty of funds, and because of spending on'tied loan'the electric power had to buy American technology.

The story above on the historical development of technology after the war Japan could be thought that it is able to be explained from the standpoint of 'social construtionism of technology'. But the constructionists ignore the fact that the movement of artificials differs from social and economical movement. Really In Japanese history can not be explained not only from social factors, it needs natural ones. The paper discusses also methodology of history of technology.

TELESCOLA: AN EDUCATIONAL TELEVISION PROJECT DEVELOPED IN PORTUGAL, IN THE 1960'S

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Our paper will explain the purposes and characteristics of a successful project in educational television, developed in Portugal during the late 1960's. This experiment was driven by the expectation that technology would produce greater efficiency in education. Further we'll focus our attencion on films developed for television concerning Geometry.

During the late 1950's and the early 1960's, Portugal was seeking, both, economic and tecnological development. In this aim, the access to basic education had to be widen. But, the government was unable to build schools fast enough to absorb the increasing numbers students, in part, due to the nature, small and scattered, of portuguese villages in rural areas. By that time, in our country, middle schools and high schools could only be found in larger towns; students from rural areas often must migrate to larger towns in order to continue their education. Other problem was the a shortage of trained teachers.

The Portuguese Ministry of Education decided that educational television was a solution to the two pressing problems: teacher shortages and school building. The interest in the *educational media* inspired the creation of The Institute for Audio-Visual Means in Education, within the Ministry. The Institute main purposes were "to promote the utilization, expansion and improvement of audio-visual techniques as auxiliary aids, to expand instruction and o upgrade the culture of the people". The model for use was based on "talented teachers" delivering lectures which would then be broadcast widely; classroom teachers would deliver individual instruction to supplement these lectures.

The portuguese compulsory basic education consisted of primary school, which comprised four grades, from 6 to 10 years of age, and a two-year middle school. The educational television project ***Telescola*** was focused on this last grades. The curriculum of the *Unified Course of Telescola* was the same of technical secondary school preps, except for Mathematics one.

The 1960's were years of great ferment in the world of mathematics education. The debate on modern mathematics was alive. A portuguese Math teacher, inspired mainly by authors like Dienes and Papy, designed, for *Telescola*, a curricular project to supplement and enrich the traditionally taught curriculum. This teacher, was the first one who delivered lectures in television. He developed the contents of his television lectures and some materials to support it, including films.

A PHENOMENOLOGICAL ANALYSIS OF FACEBOOK

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Social networking web sites like Facebook are increasingly becoming popular means by which we interact with each other. This means of interaction is spilling over into the work environment, including co-workers and employers. As a framework, it provides an arena within which we encounter our "selves" and the other by means of various mechanisms. These mechanisms include the "publication" of different items such as images or photographs, written statements, the status update, and commentary. This allows the user to exert control over the representation of him or herself in explicit ways. However, this presents the user with the possibility that the representation of the other that is encountered may not represent the other accurately. This technology changes social interaction, creating not only a new social space but changing the nature of the encounter with the 'Other' as well.

Levinas conceptualizes the 'face to face' as an account of intersubjectivity which maintains the absolute difference of the Other; that is, through the interpersonal relation, the transcendence of the other person is transformed into immanence. This is the moment of the ethical encounter, a moment of recognition and difference. The self faces a continuous awakening through the presence of the other; the self as a being, always troubled by the other.

The creation of a hyperrealist public sphere where the mediation of the social encounter allows for the possibility of 'being social' without true 'social' interaction sets up Facebook as a device that encourages the reification of 'the face' of the other, mediating the referential relationship between the 'real' other and the 'copy' that the other chooses to show. Therefore, due to the nature of the technological device itself (in accordance with the different 'applications' or modes of communication that convey a limited subset of information about the subject) and the decision of the 'other' to make visible only certain aspects of itself, the constructed representation is unable to faithfully represent the other. As Baudrillard argues, representation has been replaced by the process of simulation, which places the copy – the simulacrum – as the actual truth. However, since the simulacrum often precedes the real as a mode of presentation it cannot be an actual copy, and it becomes instead the real itself, i.e. the hyperreal.

Facebook serves as a vehicle for the transformation of real and traditional social interactions in which the real 'face to face' is abolished at the expense of the hyperreal commentaries, messages, and other modes of communication that Facebook enables. We explore how Facebook mediates a new form of intersubjective relation, one that implies that the modified subjective experience no longer conforms to the traditional forms of the 'face to face' with the other. The face is no longer the canvas of constitution and reconstitution of subjectivity, and the types of content imposed by Facebook along with the ability of the other to employ certain filters to construct a self, is leading to a new subjective experience.

DEVELOPMENT OF HIGH-TECH AND SOCIAL FAIRNESS

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Since 1970's, science and technology has been great changes: the emergence of high-tech and the appearance of "post-academic science". Consequently, there have been great changes not only in the relations between science and technology, also in the relations between science and technology and economy, politics, culture in society. It is a remarkable sign that "knowledge economy" and "knowledge society" have appeared. Today, science and technology indirectly has been regarded as resource, even capital. It has been commercialized, capitalized and marketized because it can be possessed, invested in, exchanged and make profit. The process of R&D and production of high technology has become an economic activity and it has indirectly participated in the production of wealth and distribution of powers, which has change the interest structure of knowledge production and that of social interest distribution, has influenced the mode of production of social wealth, the structure of powers and the relations of social class, so the development of high technology not only has furthered prevenient inequality, also created new problems of social inequality. The problem of "digital gap" obviously indicates inequality of distribution of social wealth and rights. The commercialization, capitalization of life science and technology has produced the problems about faire distribution of social advantages, risk and price. Furthermore, technology transfer also has extended and intensified the gap of poorness and richness, inequality of rights between developed country and developing country. It is a root of the problems that science and technology and capital has combined together, which is a basic power shaping our time. There is a trend of the combination in the development of high-tech and post-academic science.

It is necessary that we should explore the problems on social justice according to the characters of time and the background of practice. Justice is historical category and an ethic that makes social interest rightly distributed. Basing on Marx's theory of justice and reviewing western and especially John Rawls's thoughts of justice, according to new conditions of society and history, we try to put forward a new opinion of justice. Above all, in the conditions of market, we should rightly deal with the production and distribution of science and technology, or knowledge.

Key words: high technology; social justice; "digital gap"; technology transfer

THE NECESSITY OF CONTROL OF THE INCREASING GLOBAL RADIATION RISK BY WAY OF THE CREATION OF THE COMPLEX SYSTEM OF THE TWO-UNITED RADIONUCLIDE–ECOLOGICAL AND THE MEDICAL-GENOME MONITORING (REMGM).

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The modern situation in World is characterized by the increasing radiation and chemical risk for the environment, human health and heredity The most large-scale and the actual example of the similar situation – Chernobyl Disaster, happened of 26 April 1986. The unprecedented consequences of this Disaster have exposed many countries and people to its influence, the consequences of which arise with each year.

As it's pointed in the works of the specialists from RSC "Kurchatovski Institute", the development of the emergency processes in the active zone of the reactor RBMK-1000 has produced to the effluent of the almost all nuclear fuel. **The active zone is absent in the pit of the reactor. The pit of the reactor is empty.** Not only the depressurization, but also the melting and the partial evaporation have the place in the process of the explosion of the reactor. .It's necessary to underline that the **surface explosion** of Chernobyl reactor with the weakly-enriched fuel differs principally from the high-level explosion of the nuclear bomb with the high-enriched uranium-235 in Hiroshima in August, 1945.

The radioactive clouds of Chernobyl have passed over Europe, over Northern hemisphere of Earth and were fixed on the territory of USA at twice, in Canada, Japan, China, in other countries also. The unique situation has revealed in the history of mankind, when the very large contingents of the population have found themselves before the real danger of the influence of the long-lived radionuclides on the unlimited period of the time in future. The neglect by the ecological problems produces inevitably to the catastrophic consequences for the society.

The especially importance have the works of Israeli, Russian, Belarus and Ukrainian genetics published in the last years. They showed that radiation can cause the changes of heredity in the embryonic cells and to produce to the increasing weight of the new mutations ("de novo") in the off-springs (posterities) of the liquidators and other persons which have exposed to this influence in the not very large doses (so named "transheredital effect of the unstability of genome").

The worked out by the part of the authors of the present report the new conception of the "radionuclide-toxicogenic-genome risk" is proposed to the realization in the system REMGM as the part of the structure of the service of the monitoring in the countries of European Community (EC) on the base of the acting information network Internet (on the analogy with the daily represented prognosis of the weather in the program "Euronews".

THE MOST COMMON TECHNICAL SYSTEMS IN THE SERVICE OF THE MANKIND - HISTORY OF TOILETS

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The toilet and the well and are the most common technical systems in the service of the mankind. They are simple by structure, but if they are built wrongly or become non-functional, they can endanger the health of both humans and environment. In this paper focus is in the toilets.

Old saying is that money does not stink. The history of toilets is not always very pleasant but it is very long. There were private and public toilets already in ancient cities.

In historical perspective emptying toilets was considered as unpleasant tasks. These tasks were usually put to the lowest social group available - children, women and slaves.

Free public toilets are unfortunately becoming rare nowadays. There should be a chance to develop better public toilets with urine separation. The need of revealing oneself has not vanished anyway.

Major conclusions

Water and sanitation are highly gender-related issues: fetching water was, and in many places still is, hard work, mainly done by women and children. Now, in 2009 in Africa, women and children spend annually 1.4 million person-work-years just fetching water. The UN Children's Fund estimates that one in 10 school-age African girls either skips school during menstruation or drops out entirely because of lack of sanitation.

One of the key issues nowadays at least in developed economies is how far piped water and sewerage systems could and should be extended and who owns these systems.

Key references:

Juuti P. & Katko T. (Eds.) 2005. Water, Time and European cities.

Juuti P.S., Katko T.S. & Vuorinen H.S. (2007). Environmental History of Water IWA Publishing.

Juuti P. (text) & Wallenius K.. 2005, Brief History of Wells and Toilets.

LONG-TERM THINKING IN WATER SERVICES IN FINLAND

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Proper water services, including water supply and waste water services, are something Finnish people often take for granted. We are used to excellent water services, but in most parts of the world it is still only a distant dream. Development of proper water services has taken a long time and has involved a great deal of strategic decisions.

In Finland water services are basically local solutions, but cooperation can be done between neighbouring municipalities. The best possible solution can be different in different places and in different times. In many municipalities it is wise to examine water services as a regional issue and combine resources to offer proper solutions for water services. For example, a regional joint-stock company may be the best entity to organize water services, but this cannot be generalized. Sometimes when new ideas come from too far away from local level, like from a political body asserting ultimate authority over a large geographical area, it is possible that long term development of water services are threatened to go in a wrong direction. In Finland municipal water services have a long history and water utilities have become strong independent units. It might be strategically unwise to change that process.

Gradually in Finland's water sector it has been understood that history and path dependencies do matter when the future is considered. Long term development of water services has been researched especially during last decade. Results of completed research have also been utilized in this paper, which focuses on the development of water services in three case cities. Water services have also been discussed through aspects of water use priorities, water consumption, and customer view. What were water use priorities before and have they changed over the years? What were the decisions that were critical for development? What were common matters? How were these matters solved in other cities in Finland?

Water utilities have to act by resources given by owners. In practice, there usually is no time to deeply analyze strategic decisions in daily work. It has been argued that the true owners of water utilities – citizens – are too passive. But why be active if good quality tap water is running smoothly and waste water is taken care of? For the citizens, the environment is seen to be cleaner than in the 1960s, for example and it is argued that citizens are now more educated than earlier. They know their rights and if something goes wrong with water services, citizens immediately start to ask questions.

There is a need for long term strategic thinking in everyday management of waterworks but especially before changes. These conversations should also be made familiar to the public, both citizens and decision makers.

INFORMATION SOCIETY AS SURVEILLANCE SOCIETY

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The concept "information society" is less theoretical than political term. Most of its definitions express the intention "to overcome the current social stagnation" (Schienstock), whereas this paper makes use of another model. According to it

"surveillance society is a society which is organised and structured using surveillance-based techniques. To be under surveillance means having information about one's movements and activities recorded by technologies, on behalf of the organisations and governments that structure our society". (D.Wood -K. Ball, A Report on the Surveillance Society. Public Discussion Document, London 2006, p. 5).

The presentation is focused on problems connected to this kind of society that is on its risks and dangers. The paper points out that the greatest error of its risk management is an inadequate approach to social problems: Decision makers think that social problems can be solved by technological means that is by information and communication technologies, only.

An important feature of the "surveillance society" is lack of trust: "Surveillance processes and practices also help create a world where we know we are not really

trusted. Surveillance fosters suspicion. Employers who install keystroke monitors at workstations or tracking devices in service vehicles are saying that they do not trust their employees. The welfare benefits administrator who seeks evidence of double-dipping or solicits tip-offs about a possible 'spouse-in-the-house' is saying they do not trust their clients. And when parents start to use webcams and GPS systems to check on their teenagers' activities, they are saying they do not trust them either."(l. c. p. 4).

In considering this situation it seems to be evident that under these circumstances people's privacy is under threat of intrusion, invasion.

But why is it important, to protect our privacy? The paper agrees with Moor, when he says that on the one hand privacy is expression of the "basic (core) value security." (intrinsic value) On the other hand it is "a support of the following basic (core) values: "life, happiness, freedom, knowledge, ability, resources and security." (instrumental value)

By restricting access to our private zones privacy protects us against physical and non-physical intrusion causing harm for us. (Moor) The paper accepts this part of Moor's "restricted access theory", but goes beyond his view. In the author's view privacy is more than business of individuals. It is about social phenomenon, too.

Then the author argues for a proper privacy policy based on privacy impact assessment (PIA) and surveillance impact assessment. (SIA) considering the social character of privacy.

SHOWMANSHIP AND TECHNOLOGICAL FUTURISM: THE MIDDLETON FAMILY AT THE 1939 NEW YORK WORLD'S FAIR

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This paper discusses the public image of technology in the 1939-1940 New York World's Fair by looking into and placing in context the promotional film commissioned by the Westinghouse Electric and Manufacturing Company "The Middleton Family at the New York World's Fair". It serves as a case study to address the more general questions of how past narratives on technological futures shaped in a politically significant way the collective fantasies about technology, and how the rhetorical strategies of production of wonder through showmanship and display that shaped the public image of technology in international exhibitions were appropriated by the visitors.

The world's fairs of the second half of the nineteenth century and the first half of the twentieth were a major space for technological popularization, and a battleground for different visions of technology and its future. David E. Nye has portrayed the New York World's Fair, whose theme was "Building the World of Tomorrow", as a utopian ritual orchestrated by the designers of the corporations' pavilions, who relied on a new kind of dynamic showmanship to reach their goal. In this paper I focus on another dynamic popularization medium: the film. "The Middleton Family", which shows the visit of a middle-class family to the Westinghouse pavilion, is especially interesting because of its twofold nature: firstly, the film is part of a wider corporate promotional strategy and it presents a markedly biased narrative on technology. And, secondly, it is also a document (although a fictionalized one) that helps us in trying to reconstruct the phenomenology of a visit at the Fair. Hence the level of analysis is twofold.

On one hand, the paper puts the film's narrative in the context of contemporary discourses on technological futures in the United States, and it relates the film with other images of technology and technological futures, present in some of the films among the more than 500 that were screened at the Fair –like other sponsored films such as General Motors' "To New Horizons", or the documentary "The City", written by such a prominent public thinker on mechanization as Lewis Mumford.

On the other hand, this paper uses the footage from the film actually shot inside the exhibition (alongside with amateur footage of the Westinghouse pavilion) as a source in order to get closer to an understanding of the public response to the technological wonders displayed. How did the organizers want the visitors to react to their encounter with the machines? And how did they actually react? Is it possible –or useful– to answer such a question? Can contemporary fictionalized sources help us in this regard?

The conclusion will discuss these questions and, by relating both levels of analysis, will raise more questions on the political significance of the public reception of technological futurism in international exhibitions.

GM RICE TRIAL IN JAPAN: ITS HISTORICAL BACKGROUND AND MEANING

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GM (Genetically modified) rice is now pending in civil court in Japan, attracting many of national and international interests. This trial is one of fascinating cases to consider about Japanese history of 'technology and society' in the field of food and agriculture. This presentation aims to analyze its historical background and meaning with special interests on risk governance of new technology.

The GM rice in question was generated by Niigata Research Center of the MAFF(Ministry of Agriculture, Fisheries and Forestry) as a part of the national project, and its field experiment was authorized by the MAFF and the Ministry of Environment on 2005. However, 15 people including rice farmers near by the experimental field took the Research Center to the court right after the plan of field experiment had been made public.

It should be noted that Niigata is a place know for its rice, and the plaintiff traditionally had a high respect for the defendant and their relationship had no problem conventionally. In such context, why a legal wrangle had started between them? Among other things, the presence of consumer movement that has grown spectacularly in the last two decades took the decisive role.

In the history of food related trials in Japan, the GM rice is the second 'anxiety trial' following the Pesticide Residue trial during 90's, and it is apparently on the continuous line of the grass-rout consumer movements that emerged after the major chemical poisonings such as the Morinaga (arsenic poisoning by powdery milk discovered on 1955) and the Kanemi (PCB and dioxin poisoning by cooking oil disclosed on 1968). In short, the GM rice trial is burdened with the history of consumer movements that were trained themselves corresponding to the drastic change of food environment in Japan after the W.W.II.

Then, what is a battle line in the GM rice trial? Although the case initially started from a simple question by the plaintiff, the dispute has been developed to a highly complex and professional scientific question. Especially the possibility of appearances of resistant bacteria by the field experiment is the heart of the issue, because antibacterial protein *defensin* gene is introduced to the GM rice in order to be resistant to two of major disease in Japanese rice.

By analyzing the process of dispute, at least two things would be point out. One is that the GM rice trail revealed a defect of approving procedure of the field experiment concretely. Another is that the trail itself substitutes the risk communication and risk assessment regarding the safety of the GM rice. Concerning its historical background from the point of consumer movement, the trial suggests an accumulated problem that is no bridge between the court and policy with respect to risk governance.

PUBLIC OPINION TOWARDS BIOTECHNOLOGICAL APPLICATIONS: EXAMPLE OF TURKEY

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This study deals with a specific section of a project called "Consumers' Level of Knowledge about and Their Tendencies towards Genetically Modified Organisms". This project is supported by TUBITAK (The Scientific and Technological Research Council of Turkey) and still in progress. The data in the project conducted in line with multi-staged stratified sampling model were collected through face-to-face questionnaire administrations with 2626 participants in Turkey.

The data were collected through a scale called "attitudes towards bio-technological applications". This scale was developed by the researcher. The related sub-scale consists of 17 5-point Likert-type items; "general attitudes towards applications (n:4)", "attitudes towards the areas of genetic applications (n:5)", and "ethical attitudes towards genetic applications (n:8)". The content validity of the scale was realised by removing the items whose factor weight values were found to be lower than 0.300 in light of the data obtained from the piloting, and the reliability of the scale was calculated through Cronbach Alpha test (&: 0,799).

Participants' responses to the scale items aiming to solicit their general attitudes towards genetic applications and technology, their ethical attitudes towards genetic applications and their attitudes towards the use of genetic applications in specific fields were coded in compliance with 5-point Likert rating and they were analysed with appropriate statistical tests (Chi-square, Kruskall Wallis and Mann Whitney).

As a result of the analyses of the data, it was found that (I) the participants have some concerns about gene technology and its applications, (II) while they approve of the genetic applications concerning medicine and hygiene, they largely disapprove of the applications related to food production and reproduction technologies, (III) while they find medical genetic applications ethically appropriate, they think that applications concerning the genetic modification of the living organisms is not ethically acceptable.

Keywords: Gene-technology, bio-technology, genetically modified organisms (GMO), public opinien

ONE OF THE WAYS TO SOLVE POWER AND ENVIRONMENTAL PROBLEMS: APPLICATION OF THE SUPERCONDUCTIVITY

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The paper will be devoted to the historical-scientific analysis of genesis and development of ideas of technical application of the superconductivity.

Today energy is becoming increasingly expensive, and constraints with regard to environmental protection are becoming more stringent. The correlation between the electricity consumption and the prosperity of society on the one side, and the necessity for a most efficient use of resources on the other, will continuously increase the demand for best practice solutions in electrical and electronic engineering. In this connection the performance of superconductor technology can provide enabling solutions to many current and future needs of society. It is known, that from the discovery of superconductivity in 1911 and its commercial use as superconducting cables passed almost 50 years. During this period the theory of the phenomenon was developed (G. and F.London, J.Bardeen, L.Cooper, J.Schrieffer, N. Bogolyubov) and new spheres of its application, for example in medicine were found out. The important results in experimental studying of superconductivity were received in Ukraine at the 1930s. So, L.Shubnikov discovered the phenomenon of absolute diamagnetism irrespective of W.Meissner and practically simultaneously with him. At the end of 1950s N.Bogolyubov created the microscopic theory of superconductivity. Today superconductor technologies combine electrical, mechanical and thermal management of nano-engineered materials, allow to provide the key features such as high efficiency, high current,high power densities, small weight and size, quantum-precision sensitivities, ultra-high speed. There are a number of components and systems in the different fields of electric power, industrial processing, transportation, medical applications as well as information and communication, in which superconductors offer unique functions.

SOCIAL AGENDAS AND TRANSDISCIPLINARY EDUCATION AS ENGINES FOR RADICAL SCIENTIFIC INVENTION: STANFORD OVSHINSKY'S ENERGY AND INFORMATION INVENTIONS

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On January 1, 1960, Stanford Ovshinsky and his soon-to-be wife Iris Miroy Dibner founded a small industrial laboratory in a Detroit storefront, Energy Conversion Laboratory (the name would later be changed to Energy Conversioun Devices, Inc.). Their stated goal was to use science and technology to solve some of the world's important societal problems, including pollution and wars over oil. Born in 1922 in Akron, Ohio of working-class immigrants from Eastern Europe, Ovshinsky was a self-educated machinist and tool-maker without formal education beyond high school. Based on his father's example, and on teachings offered by the Akron Workmen's Circle, an organization comprised mainly of Jewish immigrants who believed in social justice, Stan Ovshinsky developed a deep commitment to social values, including labor rights and civil liberties.

This paper argues that transdisciplinary self-education and social agendas can drive scientific invention. In Ovshinsky's case, his intensive studies, especially in machine and human intelligence, cybernetics, neural disease, and neurophysiology, together with his deeply-rooted social concerns, worked in concert in his long inventive career that yielded approximately 400 patents. Because he was not constrained by traditional disciplinary training, Ovshinsky was free to draw analogies between domains that academics usually hold separate (e.g., machines and cells). The resulting scientific discoveries led to innovations that implemented his progressive social values. Ovshinsky built a mechanical model of a nerve cell. Realizing that the plasticity of a cell's irregularly structured membrane is the basis for its ability to learn, Ovshinsky opened up the new scientific field of amorphous and disordered materials, an area that is well-populated today. These materials became the basis for many of his socially useful inventions, such as the environmentally friendly nickel metal hydride battery, rewritable CDs and DVDs, flat screen liquid crystal displays, and flexible solar energy panels.

THE PUBLIC SIDE OF TECHNOLOGY: THE PUBLICATION OF PATENTS IN FRANCE XVI-XVII CENTURIES

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Since the second half of the XVI century, in France, it was compulsory to publish, once expired, the patents obtained on the French soil. At the end of the granted period of monopoly the State tried to spread the patents. The technical process, after having been exploited, has to became integrated in the community and became part of the process of innovation. Even if the publications became systematic only in the XVIII century, the presence of these documents is quite important and has not yet been studied. How many privileges (patents) have been published? Why not all of them have been the object of a publication? Where the information was distributed? How can the people know where the publication was? How was formulated? Was it easy to understand? Which worlds have been used to communicate? Has it changed the industrial reality? A study on these publications can enlarge our scant knowledge of technical publication before the XVIII century.

HISTORY OF ELECTRIC ENERGY IN BRAZIL: THE "ELECTROMEMORY" PROJECT - 1890 TO 2005

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The "Electromemory Project" aims the identification, study and diagnostics of the documentary sources related to the generation, transmission and distribution of electric energy in São Paulo State, which pioneered industrialization in Brazil, ranging from 1890 to 2005.

For that purpose, field surveys have been conducted in private and public hydroelectric power dams and substations to map out the corresponding archival, bibliographical, museum and architectural heritages, recording their state of organization and conservation. Data gathering is integrated with research, crossing over historical analysis with the memory preservation efforts. The field results will be tabulated on the basis of a controlled vocabulary to allow for multiple connections among the different structures that have been found.

The research has as starting point the archives of a public foundation (FES), as well as the major electricity corporations in the state (AES Eletropaulo, AES Tietê, CESP, CTEEP and Duke Energy). The project has recruited senior researchers in the areas of history, archives, material culture, and documentation science, besides undergraduate students as well as graduate ones, and will include symposia and publications.

An interesting point is that the present electrical companies in São Paulo are the result of a series of successive regulatory and privatization waves in over a century of existence, amid several business mergers and splits, which have strongly impacted their conservation policies, with distinct results. Some of these companies remain in Brazilian hands, while the majority has been bought up by foreign investors.

"Electromemory" foresees the creation and structuring of a data basis containing the historical sources for academic research, to be managed by a foundation and made available for public consultation; it is financed by the state's research agency, FAPESP.

A BRAZILIAN IN THE GENESIS OF ELECTRONICS TECHNOLOGY

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In an interesting article of the *La Recherche* magazine (May 1995), the French historian of science Jean Cazenobe retook the polemics around the radio's "father-inventor". He had like a starting point a journalist's article (L. C. D. Joos, "La Génie a trop de patries; il y a des Popov partout", *Sélection du Reader's Digest*, Nov. 1971, p. 14) that by reason of claims of Russian academics in favor of priority for his compatriot Alexander Popov, decided to consult in respect of this point the main European encyclopedias, verifying that Popov was the only elected for the Great Soviet Encyclopedia, Marconi was on the Italian, the Great Larousse elected E. Branly, the Britannica Encyclopedia preferred Oliver Lodge, while in Germany the first place belonged to H. Hertz and F. Brawn. The cited article concluded that "the author of a great invention must have, necessarily, the nationality of the editor of a great dictionary" (CAZENOBE, Jean, "Marconi a-t-il inventé la radio?", *La Recherche*, 276, May 1995, vol. 26, p. 509). However, other names from different countries are generally mentioned in these and other works.

It's not the case of a Brazilian father, from Porto Alegre, Roberto Landell de Moura (1861-1928) who, for several reasons, still needs to be recognized even in his own country (lack of government interest, economy based mainly on agriculture, high illiteracy rate). Descending of a traditional family of the Rio Grande do Sul state, Roberto Landell de Moura was born in on January 21, 1861, in Porto Alegre, where he achieved his initial studies. Influenced by one of his brothers, Guilherme, both followed to Rome to follow the ecclesiastical career. He entered the Pio Americano School attending, alongside, classes of Physics and Chemistry at the Gregorian University. He was ordered priest on November 28, 1886.

In addition to the study of theology and its pastoral work developed in several Brazilian cities - Rio de Janeiro, Porto Alegre, Sao Paulo, Espirito Santo do Pinhal, Campinas, among others -, he dedicated himself to the studies of other fields of science, but he outstood himself, however, for his experience and pioneering work in wireless electronic communication, realized at first, in his modest home laboratory.

The first experiences of public broadcasting and receiving wireless electronics were achieved with success by father Landell between Avenida Paulista and the Alto de Santana, Sao Paulo, at a distance of approximately 8 km, in 1893 and 1894, establishing contacts in both wireless radiotelegraphy and radiotelephony. But only later Landell de Moura patented his inventions: a Brazilian patent from 1900 and three patents obtained in the United States between 1901 and 1904: the wave transmitter, wireless telegraph and wireless telephone. Already in 1901, he recommended the use of short wave to increase the transmissions distance. Also, in his inventions and patents, using the voltaic arc for transmission of signals of varied light intensity, he established the principle that would be reborn after decades in the development of laser and fiber optics. In the context which he lived, it was asking too much for anyone who glimpsed that his inventions, in the future, would even be suitable for interplanetary communications. He passed away on June 30, 1928.

NEW RURALITY: APPROACHES AND SYNERGIES. EMERGENCE OF AN ALTERNATIVE DEVELOPMENT MODEL

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In this essay, although it will be highlighted some of the major obstacles and weaknesses of the approach of the new rural areas, is not intended to provide a complete picture of consistency, errors or limitations, rather, to identify their dominant and their viability with an inclusive vision, from the perspective of different players and the link with the institutions. In that sense, it seeks to make a contribution to the debate on these issues, without attempting to cover only partially, which is a complex range of issues and problems that require constant movement necessarily complex and higher levels of research. Rather than conclusions, provides elements for analysis and discussion. Hence, at first discusses some conceptual approaches which support the theoretical construction of the new rurality; in a second outlines a new model alternative agricultural and rural, from the changes under the new rurality neoliberal, noting some rules of compatibility, to resize the vision of rural life.

Keywords: new rurality, compatibility, rural-agricultural model

TECHNOLOGY'S FINGERPRINTS ON SOCIAL CROSSROADS

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Regular Session T27
Politics of Technology

NEGOTIATING NEIGHBOURS – NATIONAL AND TRANSNATIONAL POLITICS OF A NATURAL GAS PIPELINE

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It has been said about natural gas contracts that they can be compared to feudal marriage agreements during the Middle Ages. Since a gas project means big initial investments in a large technological system, which is tightly coupled and cannot be used for any other purpose, a contract concerning a pipeline construction focuses on mutual interest, long-term alliances, trust and dependability. These contracts are bilateral and their often secret clauses are adapted to the parties involved, one supplier and one buyer. Usually they are concluded for a period of 20-25 years. All these factors create a relationship between two countries built upon a situation of mutual dependency, but also mutual trust.

This international aspect of a gas contract is of great importance and it touches on questions regarding the possibility of forming a long-term relationship built on trust in and dependency on actors with whom a past history of animosity is shared, worries about the future environment and safety, inclusion and exclusion, alliances and vulnerability. The bilateral natural gas agreements have grown over the last 40 years into a Pan-European infrastructure network reaching from the North Sea to North Africa and the Middle East, resulting in an interconnectedness proving to generate both vulnerability and resilience. As an example, during negotiations between Russia and the Ukraine in January this year, certain countries were left without gas, but others were able to quickly transport gas from other supplying countries through the integrated network.

However, whether or not a country engages in an international agreement is of course also dependent on the national political situation at the time. The relation between national and foreign policy is very complex, and political winds may shift quickly. Thus while the transnational perspective is important, the national aspect can not be neglected. Rather, these two interact, influence each other and may dominate the agenda at different times.

In my paper I want to look at these political interactions surrounding the conclusion of a natural gas contract. I will analyze a contract concluded between Sweden and Denmark in 1980 called the Southgas-project. It was negotiated during a very intense period in energy political terms, namely from June 1979 to February 1980. This was a year when the Swedes prepared to vote in a referendum on nuclear power, and Denmark had just decided to invest in one of their biggest energy related projects ever: The introduction of natural gas on a large scale. Heavily influenced by two oil crises and the ongoing discussion on nuclear power that escalated after the Harrisburg accident, these negotiations may help to shed light on the complex national and international aspects of energy politics at work when a new energy source and the technology that comes with it is being introduced on a national market.

THE POLITICS OF DUST SUPPRESSION IN SPANISH COAL MINING, 1944-1975

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Coal mining has traditionally been described worldwide as an extremely hazardous industry. In addition to the risks posed by the working environment of the pits, dust related diseases have been a major killer and responsible for high levels of disability in coal industry. Historiography has revealed a complex combination of scientific, technical, socio-political, economic, and cultural factors affecting the identification of occupational risks and the adoption of corrective measures and compensation schemes. In the case of coal dust, the late recognition of pneumoconiosis as an occupational disease of coal workers in the 1940s was largely because the hazard of silica overshadowed that of coal dust. It has also been pointed out that medical and engineering preventive approaches to coal dust problem were mediated by profit-oriented managerial cultures and by the changing importance of coal for national and international economies (Derickson; McIvor, Johnston).

In the case of Spain, the coal mining industry had a period of expansion in the 1940s and 1950s, when its traditional lack of competitiveness with British coal was overcome by autarchic protectionism under Franco regime. This gave rise to an intensification of workloads and the worsening of working conditions, converting coal workers' pneumoconiosis into the main industrial disease in Franco's Spain. While compensation strategies have been studied (Menéndez-Navarro), the preventive approach to coal dust problem has received scant attention from historians. Thus, the aim of this paper is to explore the politics of preventive approaches against coal dust diseases during the Franco regime. Particular attention will be paid to the changing strategies developed after nationalisation of the sector in 1967.

It will be argued that, apart from medical monitoring, very little action was taken on dust suppression until the early 1960s. The Silicosis Scheme, which covered coal mining (1944), did not include the regulation of safety standards. Furthermore, despite the costs of compensation in this period, employers failed to take voluntary action to address the dust problem. The growing labour unrest and political concerns about rising pneumoconiosis rates in the late 1950s led to the updating of the Code of Mining Safety Regulations (1960), which for the first time included regular dust control measurements. After nationalisation, the new public corporation (HUNOSA) focused more on prevention than compensation, developing a more technical approach to dust suppression.

References

Derickson A. 1998, *Black Lung: Anatomy of a Public Health Disease*, Ithaca: Cornell University Press.

McIvor A. and Johnston R. 2007, *Miners' Lung: A History of Dust Disease in British Coal Mining*, Aldershot: Ashgate.

Menéndez-Navarro A. 2008, 'The politics of silicosis in interwar Spain: Republican and Francoist approaches to occupational health', *Dynamis*, 28, 77-102.

LEVIATHAN AND THE AIRPLANE: THE RISE AND FALL OF THE TECHNOLOGICAL STATE IN INDONESIA, 1966-1998

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In 1976, Indonesia made a debut in high technology when the New Order regime led by President Suharto poured ample financial resources drawn from the oil bonanza to establish the Indonesian Aircraft Industry (IPTN) located in the city of Bandung. Within ten years, IPTN turned into one of the most ambitious technological projects ever seen in the developing world. Its primary mission was to become a major aircraft developer in the world challenging the dominance of Euro-American aircraft producers. Focusing on the development of IPTN, this paper discusses the history of high technology development in Indonesia's New Order regime, which arose in 1996 and collapsed in 1998. To explicate the political dimensions of this mega project that was once the symbol of Indonesia's technological nationalism, this paper offers the concept of the technological state. The concept is not aimed merely at explaining how the state funds technological development but more on how technology serves to fulfill the ideological interest of the state. In this light, technology is seen as the embodiment of the whole state ideology whose political economy is structured around the desire to accelerate socio-cultural transformations of a post-colonial society. In the Indonesian context, the technological state is born, and intimately linked, to authoritarian characters of the New Order regime, which extensively utilized violent practices from the moment it took power throughout its 32-year rule. Embarking from the violent nature of Suharto's authoritarianism, this paper argues that the aircraft technology developed by the New Order state was technically and symbolically constructed to transform the state's violent ideology into a socio-technical configuration of an advanced industry that establishes a modern image of the technological state. Here the state's ultimate goal goes beyond economic interests as it eagerly pursues technological supremacy. To solidify the concept of the technological state demonstrated in the Indonesian experience, the empirical materials in this paper are structured around the historical sociology approach examining three levels of analysis, namely ideology, institutional/personal relations, and technical practices. At the first level, it analyzes the ideological foundation of the New Order regime rooted in developmental nationalism and how high technology was seen to support such an ideology. The second level examines the patrimonial structure of the New Order state which the network of the regime's technical elites was tightly clinched to and fed by. The third level takes a deep look into the minute process of how the whole ideological foundation of the technological state was translated into magnificent technological artifacts whose construction absorbed massive financial, human, and political capital. Armed with this array of analysis, this paper seeks to contribute to the understanding of a complex interplay between politics and technology through an assemblage of technological artifacts, institutionalized power, and political/technical elites. By the same token, this paper explains why Indonesia's technological state has failed to cope with globalization forces that painfully displaced the New Order regime from its long established power.

Regular Session T28
Approaches to History of Science

DIFFERENT APPROACHES TO THE HISTORY OF SCIENCE AND AN IDEA OF THE OPTIMAL DOCTORAL PROGRAMS IN THE HISTORY OF SCIENCE

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The history of science as a research branch of knowledge and as a university discipline flourishes in many countries throughout the world (though, unfortunately, not in all of them). There are many trends in the development of this branch in the current times. In this context, the following question arises: How to organize the doctoral programs in the history of science, in order for their graduates to be well prepared for research? The author of this paper will try to find an answer for this question by analyzing this issue through its different aspects.

Firstly, he will discuss the issue of the different approaches in the history of science, such as science and scientific theories, science and scientific experiments and instruments, science and scientific methodology, science and general philosophy, science in society, science and art, science and religion, science and technology, science and politics, science and the and religion, science and technology, science and politics, science and the city, science and the military affairs, science and women, science and gender, ….

Secondly, he will analyze the issue of the structure and status of the institutions that deal with the history of science, such as the institutions (institutes, departments or units) in universities or scientific societies that research: the history of science; the history of science and philosophy of science; the history of science, technology and medicine; the history of science and sociology of scientific knowledge; science studies; science and technology studies.

Then, thirdly, he will consider the issues of:

- the structure of doctoral programs (education, research and trainings) in the history of science,
- the international standards for doctoral programs in the history of science,
- the networks of cooperation between different doctoral programs in the history of science,
- the education, skills and achievements of doctoral students.

The crucial aim of these considerations is the quest for the optimal doctoral programs in the history of science and in science studies and the quest for international standards for such programs.

Furthermore, according to the author of the paper, there exists a real need to determine international standards for doctoral programs in the history of science and science studies and to create a standardized international system of networks of cooperation between such doctoral programs.

ON THE RESISTANCE OF THE WORLD

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Virtually every historian of science working today acknowledges that the world plays a part in determining scientists' conclusions. There is less clarity and consensus about the ways in which the resistance of the world to scientists' proposals can and should be conceptualized in historiography of science. The idea that nature simply shouts "No" to some hypotheses has been superseded. Today, instead, Andrew Pickering proposes that resistance denotes the failure to achieve an intended capture of agency in practice, and accommodation an active human strategy of response to resistance. He claims that the practical, goal oriented and goal revising dialectic of resistance and accommodation is a general feature of scientific practice. By contrast, according to Steven Shapin and Simon Schaffer, any institutionalized method for producing knowledge has its own foundations in social conventions. These can be conventions about what is normally expected and what counts as an anomaly (or resistance), etc. They claim that a fact (and resistance) is a constitutively social category. In my analysis, I present a comparative investigation of diverse conceptualizations of the resistance of the world. I base my survey on articles published in the journal ISIS since 1985. The issue is interesting because on the one hand, conceptualizing the resistance of the world is not an easy task for anyone and on the other hand, any substantial contribution to historiography of science must necessarily be based on a conception – explicit or implicit – of the recalcitrance of the world to scientists' proposals.

ERNST MACH AND GEORGE SARTON: THE GENESIS OF IDEAS IN THE HISTORY OF SCIENCE

Siemsen, Hayo & Siemsen Karl Hayo

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“But in my opinion […] there are still deeper reasons why the scientist should give his attention to the history of science. I am thinking of those, which have been so splendidly illustrated by Ernst Mach in his *Mechanics*.”

George Sarton

George Sarton had a strong influence on modern history of science. The method he pursued throughout his life was the method he had discovered in Mach’s Mechanics when he was a student in Gent. This influenced him so much that he wrote his dissertation on the same topic (Mechanics). In 1911, he even wrote a letter to Mach, asking him to join the editorial Board of ISIS, which Mach had to refuse at the time because of his health. Nevertheless, with Wilhelm Ostwald and Jaques Loeb, other Machians had an important influence on ISIS in the beginning.

As Marc de Mey has indicated in his introductory speech at the George Sarton Centennial in Ghent 1984, Sarton was in fact throughout his life implementing a research program inspired by the epistemology of Mach. Sarton in turn inspired many others (James Conant, Thomas Kuhn, Gerald Holton, etc.). What were the origins of these ideas in Mach and what can this origin tell us about the history of science and technology nowadays?

The following article will elaborate the epistemological questions, which Darwin’s “Origin” raised for human knowledge and scientific knowledge and which Mach was first to answer (1863). Sarton had an unusual concept of “genesis and development”, which he proposed as the major goal of ISIS in his first editorial. Mach had elaborated this epistemology in his *Knowledge and Error*, which Sarton read in 1911 (de Mey 1984).

According to this epistemology, history becomes not only a subject of science, but a method of research and epistemology. Culture and science as part of culture are a result of a genetic process. In a double dependency, history of science shapes science, but in its epistemology needs to be adapted to scientific facts and the philosophy of science. Sarton was well aware of the need to develop the history of science and the philosophy of science along the lines of this double dependency. Even today, there is again a strong need of this method in history as Koselleck has claimed in his last book (2003). Looking again at the origins of the central questions in Ernst Mach, which gave rise to this research program, will help in the current epistemic and methodological development of the history of science and technology, especially because these origins are seemingly mostly forgotten today.

ROSALIND FRANKLIN AND THE DNA DOUBLE – HELIX: HISTORIOGRAPHICAL ACCOUNTS

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The history of the model for DNA (DNA double-helix), proposed in 1953 by James Dewey Watson and Francis Crick, has deserved by the historians an attention in what concerns to the experimental work of Rosalind Franklin with x- ray diffraction of DNA. Since that this work has provided the fundamental empirical evidences to the building of the model, is questioned why Watson and Crick weren’t very excited with Rosalind’s participation. To Watson, in spite of producing experimental data which provide a first empirical evidence to the model, she wouldn’t have any theoretical keen to the DNA helical representation; while to Crick, Rosalind was not a very imaginative scientist, and her methodological choices blocked her from trying to discover something about the DNA’s structure without using much experimentation.

However, some biology historians, as well as to some Rosalind’s biography writers, didn’t accept this treatment and questioned Crick and Watson’s considerations from three distinctive argumentative lines. In first place, as Anne Sayre articulates, Rosalind should receive a more generous historical consideration since the discovery of the fundamental empirical data to the double-helix demanded from her the production of a sophisticated experimental work; besides that, to Brenda Maddox, her methodological scruples of not purposing a model before being sure about the information accuracy stopped her from presenting a molecule as a double-helix. In the second place, it wouldn’t be right accredit her theoretical restrictions to the idea of helix, because there are registers attesting that, to Rosalind, the most probable form of the DNA would be the helical; so it's surprisingly, according to Robert Olby, that this myth of her being anti-helix had been created. In third place, it's reported, for example by Anne Piper, that Watson and Crick had access to the experimental information without Rosalind's knowledge; and as without this information Watson and Crick hardly would have reached the conclusion that the DNA could be represented as a double-helix, and besides this, according to Aaron Klug, as Rosalind was really close to get to this conclusion, then a good part of Watson and Crick's merit in this scientific realization may be questioned.

It seems very clear that the three arguments are emphatic about Rosalind's contributions to the problem of the DNA's structure. However, this was not the only problem concerning to the DNA, given that the DNA deserved more than just a treatment about its structure, but also about its genetic function. Thus, this paper has as a purpose to argue that on the opposite of what happened to the problem to the DNA's chemical structure, there was not a such dispute regarding to the problem about the DNA's function, because, as Michel Morange arguments, Rosalind didn't share with, to Watson or Crick, any interest on the implication of DNA to genetics.

FROM THE LOCAL TO THE GLOBAL. THE 'CIRCULATION OF KNOWLEDGE', A PROMISING PERSPECTIVE?

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The circulation of knowledge is gaining ground among historians of science.[1] This is not surprising since it appears to offer a third way to study the history of science.[2] The concern with finding such a mediating road is a reaction to problems experienced with the social (constructivist) and anthropologist approaches.[3] These have resulted in detailed small scale studies focusing on practice and material culture. Doing so has yielded a host of new insights into the process of science but the drawback is that the historian cannot go beyond the local settings he studies. Increasingly the need is felt to delocalize research findings and create bigger pictures. Falling back to old school or 'first way' teleological and presentist historiography should however be avoided.

Thus emerged the idea of a circulation of knowledge. Knowledge from this perspective is seen as a form of communication which gives central importance to studying translation and transformation of knowledge and the interaction of local settings. Presumably this indicates the right way to keep knowledge tied to the sites in which it is produced while at the same time we may grasp how it transcends these local contexts via the study of communication.

This attempt at delocalisation is interesting but it is unclear how promising it really is. The main threat is that in the end it will proof to be no more than an extension of the 'second' way. So far the focus on material culture and power relations has remained predominant. A workshop held last year in Ghent, Belgium, made clear that the key terms 'circulation' and 'knowledge' in connection with ideas of Bruno Latour, the most extreme thinker of the 'second' way, can become very confusing. Questions like: 'Are we speaking about circulation or accumulation?', 'Is there a difference between scientific and non-scientific knowledge or do we have to treat these on a par?' could not be answered satisfactorily.

More contradictions and ambiguities emerge from the key note lecture James Secord delivered at Halifax.[4] I give two of them. Secord does not think delocalization needs a new research method but at the same time observes a loss of direction in our discipline and signals the need for a new theoretical perspective. He presents circulation as a dynamic notion erasing hindering boundaries between making and communication of knowledge, the medium and the message and the local and the global (...) while at the same time stressing the need for stable patterns of practice, generic regularities of circulation and relative stability of networks.

All this confusion indicates a need for reflection on the reference and scope of the terms used. What do we mean by circulation? What happens to the content of knowledge when it is transferred? What happens when a network grows? Which network theory is the most suitable to study the history of science?

1. The fifth British-North American joint meeting of BSHS, CSHPS and HSS held in Halifax 2004 had for instance as its central theme 'circulating knowledge.' In the Low Countries most PhD's in the history of science devote their attention to it inspired by a large scale project called 'the circulation of knowledge'. More examples can easily be found.
2. Interestingly the theme of the Budapest conference reflects the search for a third way since it wants to focus on both *ideas* (a primary concern of the first way) and on *instruments* (a primary concern of the second).
3. Called the 'second' way here. Jan Golinski *Making natural knowledge* (1998) provides an excellent survey.
4. Published in Isis the same year: James A. Secord, 'Knowledge in Transit' *Isis* 95 (2004) 654-672.

YANGZHOU SCHOLARS' EYES ON JESUIT SCIENCE: REFLECTIONS ON THE *CHOUREN ZHUAN*

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In his *Science and Civilisation in China*, Joseph Needham pointed that the *Chouren zhuan* might be most likely a history of Chinese science in China. L. Van Hee and Mikami Yoshio before Needham, and a number of researchers after him were even more certain that the treatise was a book on the history of science. Nowadays, interpretations of the *Chouren zhuan* have gradually changed. Benjamin A. Elman in his recent broad exposition of Chinese science in 1550-1900 paid more attention to the time and to the background in which the book was written, as well as to the personality and life experience of its author Ruan Yuan. This shift reflects the transition of the historiography of Chinese science from naive account of "scientific achievements" to the pursuit of a more comprehensive cultural understanding.

The *Chouren zhuan* was perhaps the first and also the last historical work written in belief that traditional Chinese science would finally succeed in the world. What traits of Chinese historiography did it contain? What were the motives of the author, what were the *genre* and the influence of this work? How did it reflect the spirit of the epoch when it was compiled? In answering these questions through my analysis of Ruan Yuan's writing process and critically assessing the results of past studies of Ruan Yuan's life and his academic experience, I will explore Ruan Yuan's intention of using history of science to express his political position and his beliefs. My exploration of the book structure and of Ruan Yuan's choice of materials will lead me to conjectures concerning his historical views and, in particular, to Yangzhou scholars' opinions on Jesuit science. The paper will focus on the descriptions of 26 Jesuit scholars narrated and commented by Ruan Yuan, and compare them with the biographies of the traditional Chinese scientists found in the book. Moreover, I will discuss the origin and significance of the belief that the "Western learning originated from China" arguably shared by Ruan Yuan, as well as the connections between the positions of Ruan Yuan and Mei Wen-ding on the relationship between science and Confucianism, and Ruan Yuan's contribution to the "discovery" of traditional Chinese science during the Qing Dynasty.

LE « DEGRÉ ZÉRO » DE LA NANOTECHNOLOGIE : À PROPOS DE FEYNMAN COMME PRÉCURSEUR

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Dans les discours des nanotechnologues, en particulier ceux qui ont pour but de présenter et d'interpréter la nanotechnologie, et aussi dans les manuels et les *handbooks*, il est très fréquemment fait référence au physicien nord-américain Richard Feynman, et plus particulièrement à sa conférence au Caltech du 29 décembre 1959 – « Il y a beaucoup d'espace en bas » [« *There is plenty of room at the bottom* »] – comme le moment fondateur de ce nouveau champ d'investigation technoscientifique (Shukla & Bahar, 2004 ; Lahmi, Dupas, Houdy, 2004 ; Drexler, 1986, 1990, 1996, 2001, 2004 ; Melo & Pimenta, 2004 ; Alves, 2004 ; Laurent & Petit, 2004 , 2005; Bhushan, 2004 ; Poole Jr. & Owens, 2003).

Comment peut-on comprendre le sens de cette qualification de la conférence de Feynman ? L'argument principal et toujours repris par les discours des nanotechnologues consiste à faire de Feynman, et de sa conférence en particulier, le premier événement historique de la nanotechnologie. La date de naissance de cette discipline serait ainsi fixée, au 29 décembre 1959. De cette manière, les discours des nanotechnologues « *déplacent* » le personnage Feynman d'une trame de relations et d'interfaces théoriques et discursives, dans laquelle il est notoirement situé – à savoir, le réseau de la physique théorique des particules et en particulier de l'électrodynamique quantique – pour le *replacer* dans un nouveau réseau d'interactions, spécifique et plus approprié aux efforts de recherche, de divulgation et d'enseignement de la nanotechnologie. Cette stratégie de déplacement, aboutit à modifier la figure de Feynman, qui n'est pas présenté simplement comme physicien, mais transformé comme par miracle en nanotechnologue, le premier d'une nouvelle lignée de chercheurs. C'est ainsi que les nanotechnologues prennent sa conférence de 1959 comme le moment historique de l'origine de la nanotechnologie.

Nous nous proposons, donc, d'analyser l'histoire « officielle » de la nanotechnologie, à partir de l'affirmation commune aux nanotechnologues quant à l'origine de cette discipline, faisant référence au physicien nord-américain Richard Feynman, et en particulier à sa conférence au Caltech, le 29 décembre 1959 comme le moment fondateur de ce nouveau champ de recherche. Nous nous proposons de démontrer que ce discours n'a pas seulement pour but l'affirmation et l'auto-légitimation d'un statut scientifique, mais aussi, bien que partiellement, de rendre effective son émergence historique comme techno-science.

INTERESTS AND INSTRUMENT: A MICRO-HISTORY OF OBJECT WH. 3469 (X-RAY DIFFRACTION POWDER CAMERA C. 1940)

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The historical opacity of Wh. 3469 verges on darkness. The Whipple Museum of the History of Science catalogue describes object accession Wh.3469 as an “X-ray Powder Camera” dating to the 1930s. There is no mention of manufacturer or maker. The catalog entry also notes that Wh. 3469 was acquired from the University of Cambridge Department of Earth Sciences in 1987. Even these bare facts are problematic. First, what identity did Wh. 3469 have for its creators and users? Would they have recognized it as an “x-ray powder camera,” or had this label been retroactively applied? Furthermore, the Department of Earth Sciences was established in 1980. If Wh. 3469 could not have been produced or used by the Earth Sciences Department, what organization in Cambridge (if any) originally required the instrument? Why was 3469 constructed? How was its design arrived at? What purpose was it expected to serve?

My investigation into the history of Wh. 3469 demonstrates how the micro-history of instruments may be deployed as a vital means of revealing and examining forms of scientific activity which have left few obvious traces in the present. My study departed from the suggestion of other scholars that scientific instruments manifest the marks of their local environment. I set out to reconstruct Wh. 3469’s community of users, designers and makers as well as their personal, scientific and professional concerns. Synthesizing evidence gained from analysis of the instrument itself, technical journals, institutional archives, departmental accounts, and personal histories; my study manages to recover two very distinct cultures of interwar British crystallography from Wh. 3469’s design, construction, and movement. One of the cultures revealed by Wh.3469 represents a neglected episode in the history of crystallography at Cambridge which could only have been rediscovered through close attention to Wh. 3469 itself.

Regular Session T29
Darwin 1809-1859-2009

THE DIALECTICAL STRUCTURE OF DARWIN'S ARGUMENTATION

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This paper will focus on the dialectical argumentative structure of Darwin's *Origin of Species*, the complementary character of his logically rhetorical (or rhetorically logical) argumentative tools, and the central role of controversy in his argumentation.

The argumentative structure of the *Origin of Species* is dialectical in the (Aristotelian) sense of being constructed by means of the logic of dialectical and rhetorical arguments using strategies such as: the structuring of the entire argument as a whole-part movement where the parts (chapters and partial arguments) and the whole (the long narrative and the "one long argument") mutually clarify and support one another; the comparison of Darwin's views with those of his opponents; the appeal to the explanatory power of Darwin's theory as a whole; the balance of reasons for and against particular issues; the interplay of the real (what is actually given) and the possible (what is not logically or physically impossible in the light of what is actually given); and the careful treatment of difficulties. This is in addition to the use of more traditional procedures (such as systematic observation, experimentation, subsuming of facts into rules, the study of exemplary cases, classification, and the use of diagrams, illustrations, discussions, comparative tables and analogies) or more innovative ones (such as the use Darwin makes of imagination, metaphors, the extent of our ignorance in spite of all our efforts, the authority of the scientific community and its values and ideals, and the psychological conditions of scientific investigation). These procedures can be included under the broad meaning of "explanation", which can be construed from its association with the linguistic expression of "explanation" and its cognates in Darwin's work.

Throughout his explanatory task, Darwin is plainly aware of the fact that explaining always *depends on a given theoretical view or assumption* and, in particular, on the *comparison of different views*. To make comparisons between the accuracy and scope of his own views and those which are in opposition to them is one of Darwin's principal strategies in constructing and defending his theory. One important result of these strategies is that "explaining" can be defined as *presenting the best possible explanatory alternative* (in line with Darwinian theory), and later this theory becomes the *only possible (rational) explanation*. Thus Darwin's argumentation is also dialectical in the particular sense of being developed through polemical and (quasi)dialogical interactions between opposing views. By way of example, a number of Darwinian controversies are briefly analysed.

HISTORY AND PHILOSOPHY OF SCIENCE ON TRIAL

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This paper will reflect the social and political implications of the legal reception and reconstruction of History and Philosophy of Science (HPS) in Creation Science litigation. Whilst Creation Science litigation has often acted as a surrogate for broader political anxieties it has also frequently provided an important site for the construction of 'public science' and spawned various public/legal reconstructions of HPS. Creation Science litigation has also presented opportunities for HPS experts to be cited or called upon as expert witnesses. Creation Science litigation provides then, a valuable area to explore the way HPS experts may influence law and public images of science (and HPS), and to examine the processes involved in the reception and reconstruction of HPS in legal and public settings. A detailed analysis of the recent (2005) United States 'Intelligent Design' case of *Kitzmiller vs. Dover Area School District,* United States District Court, Pennsylvania, will be used as the main case study to explore these themes.

THE INTRODUCTION OF DARWIN IN PORTUGUESE SCIENCE AND CULTURE (1865-1914)

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In the field of Natural History, it was Júlio Augusto Henriques (1838-1928) who, in 1865 and 1866, argued in favor of the Darwin's biological theory in two academic works entitled *As espécies são mudáveis?* – english trans. *Are the species changeable?* – (Coimbra, Imprensa da Universidade, 1865) and *A Antiguidade do Homem* – english trans. *The Antiquity of Man* – (Coimbra, Imprensa da Universidade, 1866). In these two exceptional works, the future director of the Botanic Garden analyses all the proofs of the Darwinian theory.

Another pioneer was the young azorean naturalist Arruda Furtado (1854-1887) that maintained correspondence with Darwin. The english wise man, 72 years old ate that time, advised Arruda Furtado on the study of the fauna and flora of the archipelago of the Azores. Between 1881 and 1887, Arruda Furtado published numerous works on Darwin in several magazines and newspapers, all properly referenced in the work *Darwin em Portugal* (1865-1914) – english tans. *Darwin in Portugal* (1865-1914) - (Coimbra, Almedina, 2001, 629 pp.). In the Faculty of Philosophy of the University of Coimbra, from 1865 onward, several *Thesis* were defended, in which the signs of the presence of the theory of evolution, as well as of the discussions that the same theory aroused, are outstanding.

Darwin was introduced in Portugal by the most notorious figures of Portugal's unavoidable "Geração de 70" (the generation of the 1870's). The intellectuals of the "Geração de 70" are the most original interpreters of the revolution that Darwin carried out in the Sciences of Life and in the Sciences of Man with the famous works On the Origin of Species (1859) and The Descent Man (1871). Some of the figures of the "Geração de 70" were coursing Law school in Coimbra by the midst 1860's. It was the case of Teófilo Braga (1843-1924), of Antero de Quental (1842-1891) and of Eça de Queirós (1845-1900), the latter entered Law school at the age of 16, completing the course in 1866. The "Geração de 70" produced outstanding and deeply innovatory texts concerning the new logic of life inaugurated by Darwin. Antero de Quental renewed the philosophical thought questioning and incorporating the scientific theory of evolution. Teófilo Braga authored the first treaty of sociology with a naturalist basis and created a theory of history based on several principles, among them, the principles of the theory of descent with modification. Ramalho Ortigão (1836-1915) renewed the pedagogic thought and the social and political critic with a very original interpretation of the Darwinian Theory. Oliveira Martins (1845-1894) authored the first treaty of anthropology in Portuguese language, where there are visible signs of a dialogue with Darwin.

MENDELISM ENFORCING DARWINISM: THE INTRODUCTION OF THE MENDELIAN LAWS OF HEREDITY IN THE PORTUGUESE SCIENTIFIC THOUGHT OF THE EARLY 20th CENTURY

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Central theme in the discussions between neo-Darwinists (supporters of the germ plasm theory of Weismann) and neo-Lamarckists (faithful to the principle of the inheritance of acquired characteristics) in the late 19th century, the laws governing heredity would finally be unveiled by the recovery of Mendel's works in the year 1900. This recovery favoured the appearance of a new scientific field, Genetics, which would soon discredit all other mechanisms of evolution, except natural selection. This process was more efficient in the Anglo-Saxon world, facing a particularly strong resistance in France, as well as other countries where the French scientific thought was highly influential, like Portugal.

The introduction of Mendel's laws in the Portuguese scientific thought took place in the opening years of the 20th century, with the particular feature of having been processed in straight articulation with the affirmation of Darwin's theory among the natural sciences. The introduction of Darwinism among the natural sciences in Portugal faced two major obstacles: the predominance of Linnaeus and Cuvier's statistic models, that favoured the inventory, identification, and classification of species; and the strong influence of the French scientific thought, mainly neo-Lamarckian concepts.

The discussion about the laws governing heredity, prior to the recovery of Mendel's works, was addressed by the Portuguese scientific community of the time. Bernardo Aires dedicated it an entire part of his PhD thesis in 1892: *Zoologia II – Negamos a hereditariedade das mutilações (Weismann)* – english trans. *Zoology II – We deny the hereditary of mutilations (Weismann).* The rediscovery of Mendel's laws inspired some works worthy of notice. In 1904 an article entitled *As leis da hibridação segundo Mendel e De Vries* (Revista Agronómica) – english tans. *The laws of hibridação according to Mendel and De Vries* – was published. A work that deserves especial reference, due to its thorough analyses of the late 19th century discussions on heredity and articulation of Mendelism with Darwinism, is the degree thesis of Luís Wittnich Carrisso, entitled *Hereditariedade* (1910)– english trans. *Heredity*. Other major works are Artur da Cunha Araújo's *O mendelismo no homem* (1909) – english trans. *Mendelism on man* – that, as the title suggests, explores the application of Mendelism to humans, and Armando Cortesão's *A teoria da mutação e o melhoramento das plantas (Estudo trematológico)* – english tans. *The theory of mutation and the improvement of plants (trematologic study)* - ("Renascença Portuguesa", 1913), concerned with plant breeding. The teaching of Genetics as an independent discipline occurred in 1929-30 (Faculty of Sciences of Coimbra), and the first original Portuguese authored works on Genetics appeared precisely in the 1930's.

THE DEVELOPMENT OF DARWINISM BY UKRAINIAN ZOOLOGISTS (END OF XIXth - BEGINNING OF XXTH CENTURY)

Oleg Pilipchuk

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The first professor of zoology in Kyiv University A. Andrzheovsky was holding the interesting opinions about convertibility of organisms. As well as naturalist and broad specialist he worked in the field of zoology, paleozoology, and botany. During the investigation of collected paleontological materials he was guide by doctrine of evolution. According to his opinion plants and animals have common origin and change under influence of environmental conditions. That's why it is necessary to take into account closely-related species during the construction of the animal kingdom's system.

Investigator of fauna of Ukraine, Russia, and the Black Sea A. Nordman studied modern and fossilized species of animals and plants. He was holding advanced views about successive beginnings of animal kingdom's representatives. It was reflected in his monograph "Paleontology of South Russia" (Vol.1-4, 1858-1860) and in other works.

At the beginning of his scientific effort K. Kessler was supporter of Zh. Kuivue's opinions but later became follower of the doctrine of evolution. In 1847 he made a speech "About Origin of Domestic Animals" on the grand meeting of Kyiv University. In this speech he expressed views about wide convertibility of the animals under influence of environmental conditions. At the first congress of naturalists (1861) K. Kessler made a report about aims of the investigations of fauna in Russia. In this report he considered these goals in direct connection with Ch. Darwin's doctrine of evolution. His disciples K. Yel'sky and A. Karpinsky were active followers of Ch. Darwin.

The great Ukrainian writer, thinker, and scientist I. Franko was an active propagandist of Darwin's theory and a fighter for materialistic ideas. Thast's why I. Franko devoted several articles to the problems connected with doctrine of evolution. The primary work is "Thinks About Doctrine of Evolution in the History of Humanity" (1882). I. Franko characterized basic questions of Darwin's theory, described struggle for existence, defined origin of human based on the latest scientific data. In his article "Crisis in Biology" I. Franko noted that the second part of XIX century in the biological sciences is a period of Darwinism. In 1904 the book of E. Ferrier "Darwinism" was published in the Ukrainian language edited by Franko and with his preface.

In the report there will be given the evaluation of evolutional views of M. Antonovych, V. Zalensky, I. Mechnikov, A. Kovalevsky, N. Bobretsky, P. Sushkin, A. Severtsov, and I. Shmalgauzen.

WHAT HAD HAPPENED IF DARWIN HAD KNOWN MENDEL (OR MENDEL'S WORK)?

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The question asked by the title is usually answered by saying that "the history of the development of evolutionary philosophy would have been very different from that which we have witnessed" (Bateson, 1901) or, according with the later developments of biology, even by saying that the "synthesis" between the theory of evolution by natural selection and classical genetics, which took place in 1930's-1940's, had taken place much earlier. Moreover, it was close to had happened: if Darwin just had cut the pages of Mendel's paper that was in his library! or if Mendel had met Darwin in London or in his house outside London on occasion of Mendel's journey to that city!

The aim of the present communication is to give elements for a quite different answer to the standard one, on the basis of further historical evidence, as well as of Mendel's and Darwin's works.

DARWINISM AND THE STUDY OF BEHAVIOR: THE CASE OF "CLEVER HORSES FROM ELBERFELD"

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This paper analyses debates around the so-called "Clever Horses from Elberfeld" with respect to other cases of anthropomorphically behaving animals reported in the first two decades of the 20^{th} century. The main focus will be given on the somewhat surprising role of Darwinism and some prominent European (Darwinian as well as non-darwinian) biologists in these affairs.

Having a thorough look inside scientific journals and popular newspapers, one considers how much attention was paid to apparently intelligent behavior of various animals meaningfully communicating and counting (even square root function etc.) with the help of different techniques such as hoof(paw)-tapping for example.

These affairs were mostly ignored by the mainstream history of science as an oddity or non-science, partially because of an obvious affinity to the belle époque spiritisms.

Tough, the crucial role of Darwinism within the academic debate as well as in the presentation of these occurrences for the public can be shown.

A relatively clear line can be drawn between the supporters and the opponents of "clever animals". It roughly divides the Darwinian and non-darwinian camps within biology and other scientific disciplines. Here we focus on the Darwinian camp impersonated by Heinrich Ernst Ziegler, Ernst Haeckel, Ludwig Plate and other well known Darwinists. Less public attention was paid to their opponents, such as Hermann Dexler, a veterinarian from the German University in Prague, or the rather undecided Emanuel Rádl (biologist and philosopher from the Charles University in Prague), well known for his pivotal studies in the history of biology. Both sides of the conflict supported their positions with their scientific theories as well as with specific social, political and cultural values. Therefore, it is rather hard to blame one or the other side for being "unscientific". Such accusations were nevertheless a common part of the examined period as well as contemporary discussions on anthropomorphism.

The "struggles about the animal soul" (Rádl) became a "hatchery" of ideas within scientific disciplines studying animal behavior and instinct (widely exceeding the limits of biology) and later on in the thirties led to the formation of ethology. This can be shown both on the theoretical as well as personal level. The fact, that this discussion on anthropomorphism led i.a. to the constitution of one of the prominent trends in the study on animal behavior, is rather unmentioned in current historiography of behavioral sciences.

The paper is based on the analysis of articles in several scientific journals and popular newspapers, where the debate over the proposed skills of the animals took place. (Paper supported by the Grant Agency of the Charles University, GAUK 113607/2007)

Regular Session T30
Galileo 1609-2009

ON MECHANICAL SCIENCE: LEONARDO, TARTAGLIA, GALILEI AND LORINI

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The literature produced a reconstruction of the theory upon statics applied to structures coinciding with *Le Mecaniche* (1634) and *Discorsi e dimostrazioni matematiche sopra a due nuove scienze* (1638) by Galileo Galilei (1564-1642). It is evident that it looks like to consider these two manuscripts as unique important modern contributions for a *practice* existed since late Middle Ages. Based on our previous researches we tried to understand (if and) how and in which way Galilei's works feed upon ideas of others his contemporaneous scholars or others who preceded him. Our talk presents a historical and epistemological investigations of *Libri VII* and *VIII* of statics in *Quesiti et Invenzione diverse* (1546; 1554) by Niccolò Tartaglia (1500?-1557). We also analyse wood-beams deformability (1478-1519: *Codice Atlantico*) by Leonardo da Vinci (1452-1519). The presentation also refers to the role played by fortifications in mechanical science in Galilean Age. In order to catch in the Renaissance fortification plans crucial aspects (e.g. *Bastion defence systems, enfilade and flank guns, drawbridge*) of a primeval mechanical science different from the medieval machines, we will shortly present an historical analyse of *Libro sesto* and its *Gionta* upon fortifications in *Quesiti et Invenzioni diverse* (1554) by Tartaglia, *Trattato di Fortificationi* (1592-93) by Galilei and *Delle Fortificazioni* (1609) by Buonaiuto Lorini (1550-1611).

Primary bibliography

Da Vinci L. 1940. *Mechanical books* (in Italian), by Uccelli A., Hoepli, Milano.
Galilei G. 1890-1909. *The Works of Galileo Galilei,* Nat. Ed., by Favaro A., Vol. II: *Breve instruzione all'architettura militare*, 15-75; *Trattato di fortificazioni*, 77-146.
Galluzzi P., Torrini M. 1975-1984 (eds.) *The works of Galileo Galilei's disciples. Correspondence* (in Italian), Giunti-Barbera, Firenze, 2 Vols.
Lorini B. 1609. *Le fortificazioni nuovamente ristampate, corrette & ampliate con l'aggiunta del sesto libro*, In Venetia, presso Francesco Rampazetto**.**
Tartaglia N. 1554. *Quesiti et inventioni diverse de Nicolo Tartaglia brisciano*, (1^ ed. 1546), by Masotti A., Brescia, new edition 1959.

Secondary bibliography

Capecchi D., Pisano R. 2007. "Torricelli and the centre of gravity theory as basic of statics" (in Ital.), *Physis*, Vol. XLIV, (1), 1-29.
Clagett M., Moody E.A. 1952. *Medieval science of weights*, Univ. of Wisconsin press
Pisano R. 2008. *The role played by mechanical science in the architects and engineers of Renaissance* (in Italian)*,* 2 Voll., Ph.D Thesis, Univ. of Roma "La Sapienza".

GALILEO'S MILITARY COMPASS AND THE CONTEXT FOR MATHEMATICAL PHYSICS

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Galileo's Geometric and Military compass was an important tool in what has been called the military revolution. This paper explores the relationship between this instrument and the new science of mathematical physics that Galileo developed thereafter. While the device, following simpler proportional compasses by Commandino and Del Monte, could allow a set of standard calculations to be done effortlessly, it was primarily a combination of two devices initially introduced by Tartaglia. One (the *squadra*) measured the angle of elevation of a gun barrel. The second measured the distance of an artillery target from the gunner by triangulation. Developing the instrument between 1595 and 1599, Galileo taught its use to his private students, who were future military commanders. The battlefield computations that this military compass could perform ranged from questions of possible rectangular arrays in which a specific number of infantrymen might be arranged, to how much gunpowder a cannonball would need to reach its target.

The micro-history of Galileo's instrument must be understood as embedded in the broader macro-history of the military revolution. But it must also be placed in the context of the macro-history of the university. For at this time, Galileo (who had dropped out of the University of Pisa to study military engineering privately with Ricci and Del Monte) was teaching mathematics (basic geometry and Ptolemaic astrology) to medical students at the University of Padova, while simultaneously working as a consultant to both the Venetian army and navy.

Every artilleryman's problem as he measured the distance of his target was to determine the elevation of the cannon-barrel that was required to hit that target. Galileo's device could measure both magnitudes, but there was no way to relate them. For that one would have to know the geometry of the cannonball trajectory, which was not yet understood. Tartaglia had earlier guessed that it was a combination of a straight line and a circular arc. Del Monte had hypothesized a parabola. Experience from the real world of artillery firing indicated that the trajectory violated Aristotle's theory of motion taught in all universities.

With his background in military engineering, Galileo faced enormous opposition from the Aristotelian faculty for suggesting that university physics, which did not admit artillery experience as an acceptable counterexample to the established Aristotelian framework, was wrong. In the university, geometry and physics were incompatible disciplines that could not be mixed. In the face of opposition (and unknown to the university), Galileo privately went on to create a new non-Aristotelian physics by 1607 – that he would not publish for thirty more years. This radical new analysis of *moto forzato* demonstrated that the cannonball trajectory was indeed a parabola.

«LA RAGIONE DEL VACUO»
WHY AND HOW GALILEO MEASURED THE RESISTANCE OF VACUUM

Cesare S. Maffioli

(Independent Scholar, Italy)

In the First Day of *Two New Sciences* (1638) Galileo maintained that there are two kinds of forces of cohesion. The sort of glue sticking together their small component parts characterizes solid bodies. Resistance to the formation of a continuous vacuum is, on the contrary, common to all bodies. To measure it Galileo had to select a particular liquid substance devoid of any cohesion except that offered by the resistance of vacuum. Water was best suited to this purpose because it had no resistance to division, as Galileo had shown a quarter of century earlier. Therefore, he equated the resistance of vacuum to the force of cohesion of a cylinder of water and devised an experiment to measure it.

In a letter to Galileo the French architect Antoine de Ville criticized the feasibility of this experiment. The Tuscan mathematician had, however, other arrows to his bow. Thanks to them he emphasized that the resistance of vacuum is limited and he was able to quantify it as the weight of a column of water of 18 *braccia* (about 10.5 m) of height.

In this paper I argue, firstly, that Galileo neither became aware of the existence of this limit nor obtained the elements for measuring this fundamental constant of nature through a laboratory experiment. It was rather a broader and larger kind of experimentation, performed in the field that put Galileo on the right track. Secondly I question part of the story told by Sagredo in *Two New Sciences*. The idea of the limited height of suction certainly came to Galileo from the coeval practice of suction lift pumps. But through this practice it would have been very difficult to get a better value than the one of about 20 *braccia* that Galileo had put forward in a letter to Baliani of August 6, 1630. I suggest, finally, an alternative, more plausible path that Galileo might have followed in becoming convinced that 18 *braccia* was the real measure of the resistance of vacuum.

OBSERVER POINT OF VIEW AS AN ARGUMENT FOR PHYSICAL KNOWLEDGE (FROM GALILEO TO HAWKING)

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In Padua University Galileo studied inertia and phenomenon of free falling. He has formulated the principle of relativity. Galileo has invented mental experiments in which representations about "internal" and "external" observers play important role. Galileo used beliefs about "internal" and "external" observers for substantiation of objective character of physical knowledge. According to Galileo a criterion of objectivity of scientific knowledge is experience. The point of view of physical experience has replaced the point of view of subject, observer. Thus, Galileo has changed character of argumentation in science. He distinguished "transcendental" and "empirical" observers. The carrier of true and objective knowledge is the transcendent "external" observer. That feature of classical science is justified cultural and historically.

Beliefs about "external" and "internal" observers were used by Einstein in his well-known mental experiments connected with interpretations of special and general theories of relativity. The ideas of nihilism and relativism of the end of the XIX - the beginning of the XX centuries has been realized by Einstein by means of denying the notion of transcendent observer. In the contemporary physics both "internal" and "external" observers are considered as immanent to the real world. And so, scientific knowledge is a result of interpretation of experience.

In the report I consider how Galileo's idea about different observers "works" in the contemporary theories of multiverse (H. Everett, D. Deutsch, A. Linde, S. Hawking).

Regular Session T31
History of Science in Education

"LES MAGICIENS DE LA LUMIÈRE" OR "WIZARDS OF LIGHT" A FILM TRACING THE HISTORY OF THE SPEED OF LIGHT

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The film "Les Magiciens de la Lumière" *(Wizards of Light),* a collaboration between the SCAVO[†] and the GHDSO*, is an historical reconstruction – with actors in realistic historical environment – tracing the main historical measurements of the speed of light, from XVII[th] to XIX[th] century. It focuses on Foucault's famous spinning-mirror experiment in 1862, which was an essential element of our experimental approach of History of Science. However, other protagonists of this enlightening story also appear or are evoked: Galileo with his lanterns, Römer and Cassini debating about Jupiter's moons, Bradley and the stellar aberration, Fizeau and the toothed-wheel experiment, Le Verrier, Froment and others. The main issue is to give an insight on the way in which science is built up in its historical and social context.

With Foucault's 1862-measurements, the scientific status of the velocity of light undergoes a dramatic change: while, for long ago, only an item of intellectual curiosity, it becomes, with Foucault's former air-water comparison in 1850, a criterion to decide about the structure of light – an only qualitative experiment. But, from the first *accurate* terrestrial measurement in 1862, it becomes the new standard for the survey of the solar system and, beyond, the Universe. Thus, the motivations and the signification of a measuring process in Physics should emerge from the film.

The length of the full film is approximately one hour. Therefore, the presentation at the Conference will mainly consist of the projection of selected scenes of the film (with sound!), in French original version with English subtitles; short comments will be given between the scenes (in English, plus eventually in French).

The final format will be a DVD. Besides the film itself, it will include several supplements or "bonus", in particular: an interview of William Tobin, the author of *The Life and Science of Léon Foucault*; a *café des sciences* during which "good questions" will be answered; and a scene with modern students repeating the rotating mirror experiment. The DVD is intended to be widely distributed, in France and abroad. The audience is expected among students and scholars of secondary schools, universities and engineering schools, science museums and institutions of popularization of science, and any people interested in the place of Science in our societies.

HISTORICAL ARTEFACTS - DIRECT AND INDIRECT EVIDENCES FOR EVOLUTION IN BIOLOGY CURRICULA

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The aim of my presentation is threefold. First, I reveal the historical origins and through this I problematize the distinction between direct and indirect evidences for the theory of evolution wildly used in science textbooks from Hungary to different Anglo-Saxon countries. Second, I show that the examination and historical contextualization of the distinction is a handy way to shed light on Nature of Science topics for students and that it might also lead to a more effective way to teach scientific content. And lastly I suggest an up to date and philosophically justifiable criterion for classifying evidences.

The direct-indirect distinction is left unexplained in the textbooks investigated and it appeals to an intuitively plausible distinction between directly observable evidences, without the use of complex scientific tools and/or theories, and evidences that can only be observed through the use of the mentioned tools. This distinction is based on an outdated concept of empiricism and its examination may provide a good opportunity for teachers to make sense of the concept of theory-ladenness for students.

The typical example of direct evidence in biology is a fossil, but it is obvious from the point of view of history of science, that the interpretation of fossils as phenomena has changed over time. Many different narratives have been invented to explain their existence starting from mythologies, creationist theories and different scientific theories form Cuvier's catastrophe theory to Lamarck's or Darwin's theory of evolution. Therefore there is no difference between fossils and homological organs as evidences for evolution with respect to theory-ladenness.

Although the evidences which are usually referred to as "direct" in textbooks are also theory-laden, the fact that something is a fossil of an ancient life form is not dependent on the acceptance of evolutionary theory, but it depends on other theories like particle physics in the case of radiocarbon dating. In contrast, the fact that two organs are homologous depends on the acceptance of the Darwinian theory. Based on this distinction a new and justifiable criterion can be introduced. There are phenomena to be explained by the theory of evolution and there are facts which can only be interpreted as such from the point of view of evolution.

SCIENCE AND WORLDVIEWS IN THE CLASSROOM: JOSEPH PRIESTLEY AND PHOTOSYNTHESIS

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There are three important social and educational considerations that justify dealing with Joseph Priestley in school science programmes: first, at all levels schools are asked to address the pressing environmental problem of the 'goodness of air' (to use Priestley's phrase) and consequently the process of photosynthesis on which Priestley shed so much early light; second, 'nature of science'(NOS) goals are included in numerous international curricula and Priestley's writing well illustrate many of the essential features of NOS; third, there is a widespread concern in education and in culture with reappraising and re-examining of the tenets of the European Enlightenment tradition, a tradition to which Priestley made significant contributions, and whose essential features are manifest in Priestley's life and writings.

Priestley is an under-utilised figure in science education. Although his contribution to the discovery of oxygen is recognised, this is usually glossed by comment about him being an obscurantist concerning Lavoisier's new chemistry and a dogmatist concerning his own adherence to the phlogiston account of combustion and respiration. Unfortunately Priestley's contribution to the modern understanding of photosynthesis is seldom mentioned in school curricula. This is a pity as his role was pivotal, and students can very easily be led through many of the same steps that he took. There is the opportunity for students to 'walk in the footsteps' of a great scientist and thereby not only learn scientific content, method and methodology, but also to get a sense of participation in a tradition of thought and analysis that is at the core of the modern world.

Such Priestley-guided participation allows students to appreciate and understand key elements of the scientific tradition: hard work, experimentation, independence of mind, a respect for evidence, a preparedness to bring scientific modes of thought to the analysis and understanding of more general social and cultural problems, a deep suspicion of authoritarianism and dogmatism, and the concern for promotion of an open society as the condition for the advance of knowledge.

Bringing Priestley into education allows light to be shed upon the mutual interaction of worldviews and science; it allows the scientific sources of the European Enlightenment to be investigated; and it allows the evaluation of the special Enlightenment *niche* occupied by Priestley, namely the theistic, albeit dissenting, strand of the Enlightenment. Understanding and appreciating this connection between science and the Enlightenment, and having the opportunity to examine what is dead and what is living in that tradition can be a major contribution of science classes to the general education of students in the modern world. classes to the general education of students in the modern world.

GEORGE SARTON'S VIEWPOINTS ON THE TEACHING OF THE HISTORY OF SCIENCE

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As a key founder of the discipline of the history of science and with nearly forty years of teaching experience on the history of science, George Alfred léon Sarton(1884-1956) was qualified to express his views on the teaching of the history of science. He believed, the teaching of the history of science has not been attached adequate importance to, and the teaching of the history of science should bridge the gap between science and humanity. Therefore, the teachers should devote themselves to the research and the teaching of the history of science, command languages as many as possible, enrich their knowledge constantly, collect new historical material continuously, know the general history of science as well as be good at one aspect, make their teaching systematic and interesting, and their guidance should benefit the students' future development. George Sarton's viewpoints are still resources for the teachers nowadays to draw inspiration from.

"THE FIRST DAYS OF ELECTRICITY" TEACHING PROPOSAL FOR THE EXPLORATION OF THE HISTORY OF ELECTRICITY USING AN HISTORICAL SCIENTIFIC INSTRUMENT COLLECTION

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Key words: history of electricity, historical experiments, museum exploration, teaching & entertaining, nature of science, distance learning

This paper will describe a teaching proposal created for the exploration of the history of electricity through the use of an historical scientific instrument collection. It consists of a "lesson-show" combining narration, audiovisual presentation, and historical experiment performance or simulation. From 2005 to 2008, the proposal was applied at the Science Museum of Chios, a school museum hosting a 19th and 20th century scientific instrument collection for educational use, and was attended by 750 visitors - students, science teachers and general public[2].

The presentation of the scientific content incorporates comments on the nature of science and stimulates thinking and discussion about the way science develops and interacts with society, as well as about the relations between experiment and theory, science and technology.

The scenario focuses on the days of 1750, when experimentation on electricity accelerates significantly and becomes popular. Benjamin Franklin tries to "rule the lightning", Peter Musschenbroek manages to enclose the "electric fluid" in a bottle of water, Abbé Nollet investigates using his 200 monks, how fast electricity is. Such scientific events, together with famous experiments, like Bose's electric kiss, or Franklin's electric bells, create the 1750's scenery: used for scientific investigation, as well as entertainment, electricity is perceived to be a fine fluid. It can be produced by friction with the newly invented, yet popular, electrostatic generator, transferred, and stored. It can produce attractions, repulsions, sparks… It is very quick. Its nature seems to be the same as that of the lightning. It begins to be imagined as a current…In a "flash back", we discuss the ancient origins of electricity, and the landmark-transition "from amber to electrics" introduced by Gilbert in the early 17th century. The scenario closes with the invention of the first direct current battery in 1800, which opens a new chapter in the history of electricity.

The educational software prepared for the presentation of the "lesson-show" has a form which allows its future use as a distance learning tool. It incorporates videos of the experiments conducted during the presentation, extensive historical scientific texts, bibliographical references, and links to electronic ones.

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[2] Flora Paparou was in charge of introducing the Science Education Programme at the Science Museum of Chios during the academic years 2003-4, 2004-5, 2005-6, 2006-7, 2007-8

ANALYSES OF THE HISTORICAL THERMODYNAMICS CONTENTS IN THE PHYSICAL CHEMISTRY TEXTBOOKS USED IN BRAZIL

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In recent years, the importance of History and Philosophy of Science to undergraduate courses, especially in scientific areas, has been recognized. In Brazil, this trend appears clearly in documents as the National Curriculum Guidelines for the Chemistry's courses, which proposed that the students have "basic knowledges of History, Philosophy, Sociology, Economics, Science History and Education", to be able to "recognize the Chemistry as a human construction including the historical aspects of its production and its relationship with the cultural, socioeconomic and political contexts".

The objective of the present study is to analyze the contents of the textbooks more frequently used for undergraduate physical chemistry courses in Brazil in order to investigate how the history of thermodynamics is presented. The analysed books were *Fundamentals of Physical Chemistry* (Castellan, 1983), *Physical Chemistry* (Moore, 1972), *Physical Chemistry* (Atkins, 2006), *Chemical Thermodynamics* (Chagas, 1999) and *Guide of Physical Chemistry* (Wedler, 1997). The criteria for the analyses were based on the history and philosophy of science perspectives. The first four criteria are related to the historical information included in the textbook and the fifth one concentrates on the bibliography related to the history of science. Only the chapters on gases and thermodynamic laws were consulted in the present study.

Three of the textbooks report only dates and scientists names, including details about their personal lifes. Some of the textbooks, for example, describe the works of Torricelli, Boyle, Charles, Gay-Lussac, Dalton, Clausius, Maxwell and Boltzmann but they never show photographs of scientists or anecdotes about their lifes. However, some one show illustrations of historical thermodynamic experiments. The presentation of the historical thermodynamics contents is basically the same in most of the textbooks, but sometimes, such as in Wedler's book, it appears at the beginning or at the end of the text and even as appendix. The Moore's book shows the thermodynamics as a body of knowledge, emphasizing it as a way of investigating giving however little importance to the thermodynamics as a way of thinking or a way of interaction among science, technology, and society. Besides this, it also include detailed biographies of scientists. It is important to note that only this textbook devotes a specific topic to the History of the First Law of Thermodynamics. On the other hand, the Atkins's book narrates histories that focuse mainly the works of individual scientists avoiding specific discussions about the historical development of scientific ideas as an evolutionary and continuous process.

The present study shows that most of the physical chemistry textbooks lack to approach to the framework of the history of thermodynamics and that their authors do not appreciate the importance of how chemists discover ideas and historical development of chemical thermodynamic concepts.

NEW ATTITUDES TO THE TECHNICAL HISTORY RESEARCH BY WAY OF AN EXAMPLE: MODELLING OF THE ELECTROTECHNICAL ORIGINS IN CZECH COUNTRIES

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In the recent exact sciences, the experts have been using more frequently the attitudes based on the elementary principles. These ways serve to understand the complicated processes (technical, scientific) which are the part of these disciplines. The elementary models become the ground of conjugate assignments. By this way, the behaviour prediction of the particular object under non-specific states can be done. Further, their influence under the more outer factors may be assessed. Nonetheless, it is possible to research the system under the critical conditions. Exact sciences are able to study the elementary phenomenon integrated in the complex system (mathematics, physics, electotechnical theory, chemistry, etc.) and they describe their behaviour statistically. In the social sciences, especially in the historical topics, this system has not been regimented up to now. There is the question: What are the limits of the historical research which could subordinate them into the system of the basic parts. They are coupled only through the marginal conditions. If we want to describe the system, which consists of the inductive attitudes, we heap the well understood knowledge. This methods support the technical and scientific methods, if we have not authentic conception about their behaviour. On the other hand, the historical discipline works with the real results incorporated in the databases of archives and museums. These bases were managed on their quantitative and factographical analysis. However, some of them often lack. The absenting facts make impossible to find the continuous projection. The system seems to be discrete. History of technical has become the multidiscipline branch of knowledge. It consists of both the exact part and humanitarian part of research. The space for the model application in the frame of their discrete parts is preserved. **Key words:** Historical model in electrotechnical engineering. Museum of mathematics in the St. Clements's Colleague. **Main model criteria**: The fulfilment of so called model method should be presented on the real example – the historical collection of technical devices arose in the 1722 as the part of Jesuit's Mathematical Museum. The aim of this work is not to map and restore the electrotechnical artefacts which were the part of above mentioned collection. By way of their study and the study of their functionality, we would like to find out the awareness of electrotechnical engineering at the beginning of their systematical application. **The aims of the proposal:** 1) To develop the information base about the defunct mathematical museum 2) The visual restoration of 3D electrotechnical objects which were the part of the museum 3) To study the collection horizontally and vertically in the time and in the scope 4) On the base of owner change of the collection to follow the migration of information about electrotechnical engineering through the scientific and social area. **Conclusion:** Our contribution offers the new view on electrotechnical engineering history by the way of the closed cycle of original electrotechnical subjects. In many aspects original and symmetry technical artefact enables to see the background of the area in which it arose. Further it was used and closed its life in the collection funds of technical museums. We emphasize not only the technical aspect of it, but also the usage of scientific and technical knowledge. Further its usage in the educative process and its role in the process of knowledge transfer from both local and global view.

INVISIBLE VAPOR: ELECTRIC MOTORS FROM THE PERSPECTIVE OF THE HISTORY OF ELECTRICITY

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The force of attraction observed between pieces of amber and fur when they are rubbed together has been referred to in history as "the miracle of the attraction of amber" in Plato's "Timaeus Dialogue." Gilbert, who coined the word "electricity" from the Greek word *elektron* for amber, named the mysterious power he was yet unable to define "invisible vapor." In this context, the objective of the present study has been to remove the mysterious aura of this "invisible vapor" through a historical perspective and by means of a series of successive activities that will make it visible to everyone and to elementary school students in particular. Thus, what has been intended has been to provide organization, within the framework of the school curriculum and in the context of historical progress, to the knowledge students possess about the subject of electricity by means of instruction on the various discoveries that constitute the basis of the development of electricity and through explanations of historical experiments. Another purpose of the study has been to discuss the historical evolution of the electric motor throughout the course of progress in the field of electricity, and to present examples of electric motors in the contemporary world. The intention has been that, if students' understanding of how scientific knowledge is developed, and of how historical, philosophical and technological contexts influence its development, then they will acquire a more comprehensive view of science and, as a consequence, become more engaged by the learning of science.

As part of the study, four successive experiments related to the historical development of electricity have been designed using a configurative approach in order to stimulate scientific thinking in students. The first experiment involves "Static Electricity" and aims to allow students to observe positive and negative charges in electricity and their effects. The second experiment, the "Oersted Experiment," has the objective of providing an opportunity to observe that an electrical current is not just something that passes through a wire but that at the same time a magnetic field is created around the wire. The third experiment, the "Faraday Experiment," aims to show how a wire through which electricity is transmitted is affected by the magnetic field of a fixed magnet. This particular experiment, whose origin can be dated to the eighteenth century, may be treated as a display of the first electric motor. The last experiment in the study has at its starting point a model of an electric motor that can be easily made by students in their school program and strives to show real-life-integrated examples of the range of ways in which modern electric motors are used.

Students have found these experiments, which employ the simplest and most inexpensive of materials, to be both educational and entertaining. Apart from this, the historically-based electric motor experiments have given students the opportunity to carry their concepts of electricity to a higher level of meaningful learning. Students were able to use these experiments, which are of great importance in the historical development of contemporary technology, to observe and learn basic concepts behind the workings of many complex electrical devices.

SCIENCE STUDENTS' DESCRIPTION OF AN ATOM: A COMPARATIVE EPISTEMOLOGICAL ANALYSIS

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In recent years, the emphasis in science education has been gradually shifting toward a greater concern with an overall understanding of science and of its role in society. In this sense, the school curriculum aimed to educate students scientifically literate and to be able to acquire and extend their scientific knowledge. The introduction of history of science into science education has been advocated in recent years as a way of placing such an emphasis on science education.

The current qualitative study which is conducted with 300 college science students aimed to investigate students' expressed models of atom by asking individuals, to describe an atom on a paper and pencil open-ended questionnaire. In this questionnaire the researchers probed students' understanding of the structure of an atom, its constituents and their approximate locations, the size of an atom, and whether it is concrete or not. The data analyzed in light of historical development of atom concept. The analyzing method is unique; because it is comparison the similarities and the differences between the students' expressed models of atom and the epistemological development of the atom concept. The possibilities of students' models of atom discussed through eight assertions. A way of characterizing such models, based on ancient Greek model, ancient Indian model, Islamic model, Dalton's model, Thomson's 'embedded mass' model, Rutherford's 'nuclear' model, Bohr's 'orbit' model, and quantum mechanic models.

The results of the study showed that given a choice, students prefer models of the atom which are easily visualizable. The students were not realized that their expressed model was a combination of several historical models. Such views may be a consequence of an inadequate understanding of both the historical development of models of the atom and of the epistemological status of models in the development of scientific knowledge by educators and the authors of the textbooks. In this sense, it is important to give place to fathers of the atom theory - Leucippus, Democritus and the other atomist- in science classes. This enables students not only to understand the historical development of the atom but also to comprehend the primary concepts of atom. Several key historical experiments could be done for 'the atom' in classroom. In short, the history of science must be part of chemistry courses in a way that contributes effectively to future teachers' understanding of either the process of construction of scientific knowledge or identification of ideas produced in different backgrounds or contexts.

THE *MODELS OF MATHEMATICAL SURFACES* AND THE *ANAGLYPHS*: THEIR HISTORICAL ORIGIN, DIDACTICS APPLICATIONS, ACTUAL USE IN IMAGE COMMUNICATION

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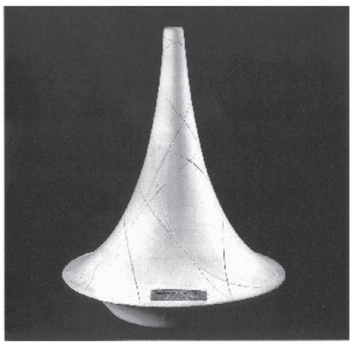
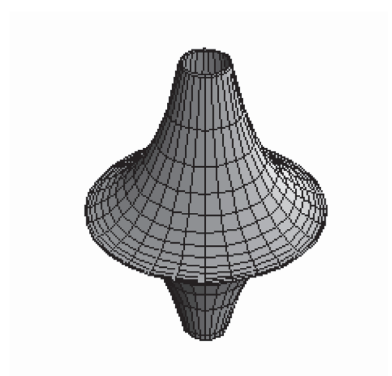
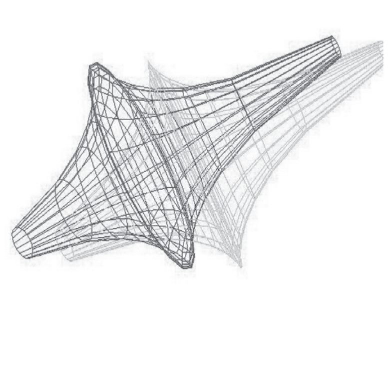
In the history of Mathematics, there are ideas and instruments that are still perfect to be used in the modern context. I want to illustrate here the history of the *Models of Mathematical Surfaces* that were built from the middle of the 19th century through the beginning of the 20th century. The construction and the study of these plaster models were especially popular in Germany, in France and in the United Kingdom and they were used in several filed of mathematics (for research and didactics): Differential geometry and Calculus, Theory of Complex number, Descriptive and Projective Geometry, atc..

In 1912, the mathematician Henri Vuibert published in Paris the booklet *Les Anaglyphes géométriques* where he described optical principles and applications of the anaglyphs, and applied them at the *intuitive geometry*. Vuibert wrote that for a student it is very difficult "voir dans l'espace" objects drawn on a plane and in order to help the students it is possible to construct plaster models of complex surfaces or to use the anaglyphs as Henri Richard – headmaster at Lyceum of Chartres– had thought. The word *anaglyph* derives from Greek áíáãëõöÞ that seems "bas-relief", "chiseling". Vuibert and Richard drew forty anaglyphs that exposed at 5th International Congress of Mathematicians in Cambridge.

Anaglyphs and tridimensional vision are used today in didactics applications and researches in geometry, chemistry, conservation of cultural property, cinema, and so on. In didactics, teachers can use innovative instruments that make easier the learning, in the sphere of the constructivism. The virtual reality is a suitable instrument for this aim. Constructing a surface in 3D and visualizing it like an anaglyph are very interesting possibilities to take advantage of the virtual reality in didactics context**.**

We used the *Virtual Reality Modeling Language* (VRML) to construct some reproductions of the models of mathematical surfaces and to make their tridimensional anaglyphs. For example, by using VRML, we constructed in 3D the Pseudosphere of Eugenio Beltrami (1868) by means of its parametric equation:

		
Model of the Pseudosphere	Pseudosphere by VRML	Anagliph of Pseudosphere

CO-EXISTENCE OF HISTORY OF MATHEMATICS AND EDUCATION OF MATHEMATICS

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Abstract:

Both history of mathematics and education of mathematics is old subject. This question arise that can these two important subject can help each other or not unfortunately this idea made mathematics society into two group one have idea that History of mathematics can help education of mathematics other group have idea that not only history of mathematics can not help education of mathematics but also it make some confusion.

In this article I am going to do some comparison and take some conclusion that history of mathematics can make education of mathematics so active and interesting.

Introduction:

We know that history of mathematics and education of mathematics both is two branch of mathematics science. A lot of Research scholar in word working and doing reasearch in this two branch of mathematics .Question is here that can these two group of researcher can help each other ? Reality is that I n society of mathematics two idea are there on group which had idea that history of mathematics can help teacher of mathematics a lot and in next section we give some example to prove this idea in other group people have idea that history of mathematics can not help education of mathematics and we give some point of their view. In the end in comparison of this idea I give my conclusion.

1- On application of history of mathematics in education of mathematics

1-1-Application of history of mathematics.

What is application of history of mathematics? We know that researcher duty in history of mathematics is to read mathematical manuscript, understand those things and rewrite them in new mathematics so which this work need expert people which know old language and mathematics and some idea about society of that time. For that reason society of historian of mathematics in every where is small in number (compare to other branches of mathematics). And from this small society few people teach mathematics or thinking about education of mathematics now usually %25 of papres in international conference of education of mathematics are about history of mathematics or its application [ ].

So joint work of historian of mathematics and education of mathematics can prepare material for teacher of mathematics and in higschools and . Universities. So when teacher came to know that time is suitable they can explain about history of geometry , algebra , analysis ,graph theory, and so on spicily when students feel tired in classes and still we have time to end of classes. By explain of history of number student not only dose not feel tired but also waiting for next classes to know more about numbers .

Students by knowing life history of, paytogorian, Tales, Aryabahtyia, Ramurajan,Kharasmi , Kashani, Taragellia , …..

Will come to know that science is works of all civilization so they have respect for other nation young people of each civilization by history of mathematics will come to know that his old generation also had contribution on construction of science so they will find confidence.

(Oversized abstract. Please contact the author for the full text)

IDEA OF UNIVERSAL MATHEMATICAL INSTRUMENT IN JACOBI'S TRACTS (1804-1852) (TO 205-TH BIRTHDAY ANNIVERSARY)

Milyausha S. Ananyeva

Perm

Idea about create universal tool to proof theorems and applied problems was appeared many times in mathematics and science. For example, it was "universal characteristic" of Leibniz. In XIX age role of the universal instrument was belong to theory of groups, matrixes and their predecessors – determinants, which was appeared due to research of rational methods to solution algebraic equations and their systems. The theory of determinants was founded by Koshi in 1812 and propagated since 1841 due to Carl Gustav Jacobi, great man science and enlightenment (1804-1852). Dirichlet was expressed himself with the following terms about Jacobi, "he was drew with powerful hand almost anything areas of science … introduce in science new solid ideas that rising mathematical speculation".

Scientist was enriched science with practical results combine new tendencies of mathematical analysis with calculation. He was spread new ideas for this time among their own progeny and A. Krell's popular scientific magazine reader's. His articles "About formation and properties of determinants", "About functional determinates" became handbooks and one of reason to writing them was thought to making common mathematical instrument for solve linear equation systems.

Jacobi was successfully used determinants to draw generalization of theorem about multiplication determinants and examine different cases, for basis of functional determinants – Jacobians and was used it for transform multiple integral, linear transformation, solve linear algebraic equation systems in case number of equations exceed unknown quantities. It was result during observation of heavenly bodies and most of mathematician was solve it with least-squares adjustment. Jacobi succeed in resolving this problem based determinants.

Thanks to idea of universal mathematical tool, expansion of determinant's concept with advent of them special types (Jacobeans and hessians) and using it in linear algebra up to analytical mechanic, research of many problem of analytic geometry, mathematical analyses, mechanics are available. Theory of determinants became mathematical tool of adjacent natural-science branches.

OUTPUTS OF THE SCIENCE HISTORY COURSE: THE SAMPLE OF KTU DEPARTMENT OF COMPUTER EDUCATION & INSTRUCTIONAL TECHNOLOGIES

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Teachers have a great part on shaping society. They are those who are supposed to educate individuals who read, search, think critically and know how to access information. For this reason teachers should be competent both in terms of vocational and general information. Education faculties in Turkey have been altering their curriculums to catch up with these needs. The latest alteration which occurred in 2006 with the framework of the reform process of faculties includes change in curriculums. As an item in these alterations; Science History lesson were set as a compulsory course to increase the general culture levels of candidate teachers. The students of Science History lesson at KTU, Department of Computer Education & Instructional Technologies were made to prepare websites. These outputs of the Science History lesson will be presented with the present study. The websites prepared in 14 weeks in fall term of year 2008 by groups of 3rd year students.

HISTORICAL AND SCIENCTIFIC IN PROFESSIONAL TRAINING OF TEACHERS

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Higher educational institutions play the leading role in training specialist of a new type. The main goal of higher education in this respect is to prepare a professional teacher with high level of humanitarian culture and substantial experience in research work. Higher education is called to provide not only basic and specific professional training, but also foundations for life-long professional learning. Hence, university training is one of the steps in the formation and development of ever improving professional knowledge.

The ideas of humanization of education first and foremost mean that educational process should be oriented to the personal development of a student. For the theory and methods of teaching Geometry such a change has led to new tasks of theoretical, methodological and applied character.

Geometry in the university curriculum deals with systematization and extension of school knowledge, aimed at training skills of doing sums and proving theorems. For students though it should not become just another mathematical discipline, but one of the integral components of general culture. Geometry develops intellectual abilities and mental processing, allowing to cognize the world in a more profound way and prepare for acquiring knowledge and skills in other branches of mathematical science. For any science its own history is not a secondary matter. Defining and characterizing historical stages of the science's development it is possible to improve its methodological viability and provide for historical continuity of its evolution. Understanding of the history of science is an important prerequisite for the development of professional erudition of future teachers. History of Geometry provides invaluable examples not only of mathematical evolution, but also of the development of human culture. Treating Geometry as a cultural phenomenon pleads for inclusion of the material on the history of science into the content of education.

Thus, courses on methodological and scientific history of mathematics are to be introduced into the professional training of future teachers. The place for such courses in the university curriculum may be provided by the variant (or alternative) component in the structure of the National educational standard.

A NATURALIST WHO BECAME A PIONEER OF EXPERIMENTAL MARINE OCEANOGRAPHY IN PORTUGAL. ASSETS FOR SCIENCE EDUCATION

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D. Carlos de Bragança, king of Portugal (1889-1908), was a pioneer oceanographer who dedicated himself to the study of Portuguese coastal fauna. His legacy was remarkable for scientific knowledge and methodological innovation, setting together a naturalistic point of view through scientific illustration, and an experimental approach with a range of collecting procedures whose data he systematically registered. The logs filled with beautiful watercolors, field notes, data and calculations, the zoological collection, and the instruments from oceanographic campaigns he leaded are part of the permanent exhibition of the Vasco da Gama Aquarium located near Lisbon.

The purpose of this paper is to present a set of secondary level Biology curriculum activities centered on biological diversity, systematics and evolution, and the nature of scientific investigation. The activities are based on D. Carlos' scientific work in order to promote students' learning about the nature of science. Students are to explore philosophical, psychological, sociological and historical dimensions of science (Ziman, 1984). The major aims for the inclusion of philosophy and history of science materials are to help students: to understand the role of science in society; to develop positive attitudes towards the study of science; to understand both science content and the nature of science; and to develop science process skills (Wang & Cox-Peterson, 2002; Ziman, 1994; Aikenhead, 1994; Kipnis, 1998; Lin *et al.*, 2002, Höttecke 2003, Solbes *et al.*, 2003, Seker *et al.*, 2005).

The proposed activities include a pre-visit orientation, two workshops performed in the Aquarium and a follow-up learning task. This organization was adopted because previous studies have shown that it could improve the learning potential of a school fieldtrip (Kisiel, 2006; Kubota & Olstad, 1991). In the pre-visit orientation class students perform a directed activity related to text (Solomon, 1993). They are asked to analyse two excerpts of the king's diary related to the 1897 oceanographic campaign (D. Carlos, 1957) and respective laboratory reports in order to discuss different forms of scientific reporting either in the laboratory or in the field; to deal with methods of collection, preparation and preservation of biological specimens in comparison with present ones; and to think about the psychological qualities of scientists.

In the Aquarium, students are supposed to actively participate in two workshops about biological classification and specimen drawing. In the first one, students are introduced to the king's work, collection and scientific methods. Furthermore, they compare actual classification methods with those developed by the king, and classify a group of marine organisms with a dichotomous key. In the second one, the main aspect is the use of scientific drawing as a mean to apprehend the diversity of form, colour and function of the organisms (Weitzman, 2003). In the follow-up activity, students analyse excerpts of texts of a contemporary Portuguese oceanographer, Saldanha (1996), about the king's scientific work. They are asked to reflect about how scientific knowledge is constructed and about the importance of scientific publication. As a final remark in the paper it is stressed the importance of creating activities informed by the history and philosophy of science as a foundation for improving motivation and sustaining effective science teaching and meaningful science learning.

A FEW STORIES FROM BIOCHEMISTRY AND MOLECULAR BIOLOGY

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After many years of working with secondary school students we have come to the opinion that it is very important to explore and teach science simultaneously and alongside the history of science. Most students will find reading the biographies of the scientists throughout history to be boring.

However, some of them are interested in biochemistry and molecular biology related to medicine, biotechnology, forensics (CSI) etc. In an effort to harness that interest and direct it into more focused and successful learning we decided to create a project in which the students were divided into several groups and assigned to research various scientists. In our case the focus was on biochemistry and molecular biology, (a subsection of science that was only recently described, beginning in the early part of the 20th Century) as well as the scientists who were awarded the Nobel Prize for their work in this area.

Each group chose or was assigned a Nobel Prize winner from that era and then proceeded to research that scientist in as much detail as possible. All of these scientists had been awarded prizes for their work in the areas of medicine/physiology or chemistry. For medicine/physiology some of the scientists included Santiago Ramon y Cajal, Otto Warburg, Alexander Fleming, Carl and Gerty Cori, and finally Severo Ochoa. For chemistry they included Eduard Buchner, W. N. Haworth, Vincent du Vigueaud, and Frederick Sanger.

Some of the questions they focused on included: 1) Who was this scientist? When and where was he/she born? What was his/her life, education and work like? 2) What was the discovery that prompted the awarding of the Nobel Prize, and when did that occur? How did his/her discovery advance biochemistry and molecular biology and contribute to society?

In an effort to provide some structure and supervision for the work done by the students, they were given clear guidelines showing the points that were important to focus on in their research and presentation. To better understand their assigned scientist and the entire process the students also conducted the following research: 1) A review and general study of the scientists that have been awarded the Nobel Prize. 2) A study into the way a scientist is selected and some of the significant discoveries that have contributed to biochemistry and society.

We began this project in the hope that by doing so we could increase the understanding, interest and general awareness of biochemistry and molecular biology. By combining the history of this subject with the subject itself we feel that we are taking a step in the right direction to achieve this objective.

EP*Magazine* FROM THE STUDENTS TO THE STUDENTS

Angelo Rapisarda, Isabella Riviera, Viviana Dalmas

Liceo "Boggio Lera", Catania, Italy

This talk is about an educative Project which aim is to invite to cooperate and involve secondary schools all over Europe in order to increase the usage of ICT and the interest for Science and Technology of the European students.

Our main product is a periodical produced 3 times a year made by European students sending us their own scientific - technological research in the field of Science and Technology. An editorial international group of students have been actively involved in planning actions**:** sending calls to European schools to ask articles; receiving and processing them to check their compatibility with our aims; sending contributions to referees; sending calls to European schools about the published periodic and why and what to use for.

The role of teachers are to act as coordinators, burocrats, facilitators for the students of secondary European schools.

The partnerships met twice a year and published a didactically useful paper mainly written and practically made by students of the partnerships as well as of other external European schools.

It is possible to find our material in different web sites: www.epmagazine.org; http:\\epmustafaozkan.com; .

We publish three issues and a multimedia CD in the year since 2003

Each product is recorded and recognized throughout its International Standard Serial Number ISSN.

Every day we try to add European bricks in order to spread our scientific educational products and to expand its didactic use.

We contact many European schools in order to invite and ask them to take in consideration their interaction with us in two possible issues:

To use our Material as educational tool

To ask students to write contributions.

This is a multimedia CD produced yearly and made by the same scientific-educational material hold in the paper-made periodical. It is another, more effective, means of communication and for effectively and quickly spreading the product of our project. People are allowed to ask the CD and to receive it immediately by downloading it from a web address we provide them.

This is our official web site, made and jointly managed by a Dutch student and a few Italian ones. It's possible to find news and invitation about our activities, and the same scientific-educational material hold in the paper-made periodical and multimedia CD Collection. It is a very effective means of communication and widely, effectively and quickly spreading our product. People are allowed to download every kind of contribution, article, news, for their pleasure or educational purposes.

CAN YOU TELL ME WHAT THE SCIENCE IS?

Zeynep HALİLOĞLU TATLI, Alipaşa AYAS, Rabia YILDIZ

Karadeniz Technical University, Türkiye

Abstract: What is science? How has it been improved? What does it concern? Who performs it? These are some of the questions the answers of which have been sought by both scientists and researchers. The present study tries to reveal how children of today; the prospective scientists, perceive historical development of the Science and how they take the concept; history of science.

In this case study, a school chosen from the Eastern Anatolia region, which is referred as privileged region in terms of education for being underdeveloped. The study was carried out project based with 50 students from 6th, 7th and 8th during 8 weeks. In their Information Technologies and Computer courses, the randomly grouped students were assigned to prepare a power point presentation or wallpaper about the given open ended topic: "historical development of the science"

At the end of the period the prepared questionnaire with 11 open ended questions was applied to determine the students' opinions about the science and scientist. The obtained data described, coded and expressed in frequencies. The student presentations are assessed by grouping under the subtitles.

Keywords: Historical development of the science, children point of view about the science, computer & science

HISTORY OF SCIENCE AND PHILOSOPHY OF SCIENCE: ANALYSIS OF CORRELATIONS

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History of science is an object of historiography of science. Historiography of science is a description, an explanation, and a prediction of events of history of science. Science as the historical object of historiography of science interacts with other aspects of society – culture, religion, philosophy, politics, economics, knowledge, etc. Historiography of science has some problems, objects, theories and methods for a decision of its problems. Historiography of science as the cognitive discourse has one actual and constitutive premises – a certain ***concept of science***. Without it historiography of science can't be possible. So historiography of science correlates with philosophy of science. Conversely philosophy of science correlates with historiography of science because sciences are historical (empirical) phenomenon and an object of historiography of science. An investigation of a concept of science is a topic of philosophy of science. For example, interesting philosophical debate about science, scientific method, scientific change was completed by the International Colloquium in the Philosophy of science "Criticism and the Growth of Knowledge" (L., 1965). Popper's "The Logic of Scientific Discovery" was an introduction to contemporary logic, philosophy and methodology of science. Fundamental problems of philosophy and methodology of science (the problem of induction, the problem of demarcation, falsifiability as a criterion of demarcation, etc.) are fundamental topics of historiography of science too. Analysis and evaluation of the naturalistic approach to the theory of a scientific method, a proposal of methodological rules of science as rational motivated conventions are the topics of empirical investigations of history of science. If philosophical ideas have been perceived by scientists' then scientific practice as an object of historiography of science was determined by that philosophical ideas. This is the phenomenon of correlations history of science and philosophy of science on an object level. For example, historiography of chemistry has some topics, problems, objects, theories and methods for a decision of its problems. Advancement from alchemy to chemistry, origins of quantitative chemistry, empirical study of gases and the idea of phlogiston theory, facts of chemical industry, Dalton's atomic theory, laws of combining weights, laws of electrochemistry, the periodic classification of the chemical elements, the birth of stereochemistry, facts of chemical engineering, and events of biotechnology are some topics of historiography of chemistry. Historiography of chemistry as the cognitive discourse has one actual and constitutive premise – a certain concept of chemistry. Without it historiography of chemistry can not be possible. So historiography of chemistry correlates with philosophy of chemistry. Conversely philosophy of chemistry correlates with historiography of chemistry because chemistry is historical (empirical) phenomenon and an object of historiography of chemistry. As a whole philosophy of chemistry investigates metaphysics, ontology, epistemology, axiology, methodology and praxiology of chemistry. Metaphysics of chemistry creates some presuppositions of two types: metaphysics of reality and metaphysics of rationality. Ontology of chemistry is a variable multitude of topics: chemical determinism, causality, laws and events; problems of reality for objects of chemical observations, measurements, experiments, language, facts and theories.

THE EVOLUTION OF MODERN SCIENCE: INTEGRATING SCIENCE INTO THE HUMANITIES

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Modern citizens should be equipped with the scientific foundation to deal with society's problems. Addressing major issues such as global warming, stem-cell research and environmental protection depend upon scientific reasoning but the body politic relies more on doctrine than logic. For example, very few adults presented with longitudinal data on climate would be able to draw any scientifically defensible conclusion.

In this 200th anniversary year of Charles Darwin, the Pew Research Center still finds Americans are still about equally divided on the concept of evolution by natural selection. In fact, state governments in the US continue to pass legislation requiring the teaching of skeptical or alternative explanations of biology in their public schools. Fortunately, these attempts to turn back the clock are regularly determined to be illegal by the courts.

The college scheme of offering general education programs which include two or three courses in some are of science must be declared abject failures, if one looks at the results, because they do not produce scientifically literate graduates. It is time to abandon this convenient but ineffective curriculum and seek new approaches. In this paper, I propose the teaching of science within, instead of outside of, humanities courses.

"The Evolution of Modern Science" is a 300 level (3rd year) general education course that is taught through our History Department and is held to all qualifications of the History Department. The course teaches physics (including astronomy), chemistry, geology, and biology and the processes through which they evolved from mythology to metaphysics to modern science. Mathematics, through calculus and Boolean algebra, are introduced and their essential contributions to science discussed in detail.

In addition to a comprehensive text, students read other books on science by great authors like Sagan, Quammen, and Sobel. They follow and appreciate the work of the greatest scientists including Archimedes, Galileo, Newton, Darwin, Faraday, and Einstein. The historical progression and connectivity of the sciences is emphasized. (e.g. Geological discovery led to natural history which led to biological evolution and genetics.)

In this paper I will describe an approach whereby humanities students become scientifically literate and can contribute to modern society rather than simply being intellectual bystanders.

Regular Session T32
Science in Social Context

PARADOX OF INTERDISCIPLINARITY REVISITED (*CURRICULUM VITAE* OF A DISCIPLINE)

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28 years ago at the ICHST81 in Bucharest, I read a paper on the Paradox of interdisciplinarity. I illustrated the development of an interdisciplinary area from appearence to social acceptance, by which its interdisciplinary existence – as I supposed – ceases in ten stages.

I spent the following years to implement those concepts in a concrete field. Namely, I assisted midwifery and contributed to bring up *symmetrology*. I witnessed all stages of institutionalisation of symmetry studies from birth to full age of symmetrology.

Concepts of symmetry and symmetry principles were present dispersed in several individual disciplines of sciences and arts for centuries. The second half of the twentieth century brought up a series of discoveries related to symmetry and symmetry breaking in apparently distant fields. The nineteen eighties saw a rapid acceleration of closing and overlapping of these apparently less and less distant fields.

Budapest hosted the first complex science-art symmetry event in 1989. Following an odyssey through Japan to the United States, and through Israel to Russia, the event series returned to its birthplace in the early years of our decade. Symmetrology has shed its outdated (and sorrowfully discredited) first coat, lost its milk-teeth, and has revived at its roots in 2003. Symmetrology has grown in full age. It has passed through matriculation, although has not yet got its first degree.

Symmetrology has met the conditions of becoming a discipline of its own right. It has undergone a process of institutionalisation, it has formed its infrastructure. The pillars of this process are the following:

- symmetrology has its publication forum,
  - the Symmetry: Culture and Science in printed form, and
  - the *website* http://symmetry.hu in electronic form;
- *regular meeting forum* to bring together scientists of different disciplines and artists of different forms of art, namely the Symmetry Festivals with their conferences, exhibitions and performances;
- symmetrologists have found their al framework under the umbrella of the International Symmetry Association;
- symmetrology has its specialised *institute*, the Symmetrion;
- it elaborated its *curricula* and entered in university education, assisting to shape the interdisciplinary thinking of the students;
- curricula have been published in *textbooks* in an increasing number;
- the bulk of symmetry related publications shifted from articles in scattered journals first to books of collected thematic essays, then recently to *monographs*, which can be charactarised with multidisciplinarity at an increasing extent.

Symmetry considerations broke through the shells of such disciplines that could have hardly believed before, and appeared in new forms of arts. Over its more or less unified conceptual framework, there have been developed methods, approaches, general principles of symmetrology of its own. Symmetrology has been ready to cease as an interdiscipline.

The structure of scholarly knowledge (often called science) is under change. Symmetrology defines itself as science, met those criteria. And yet, it has found its identity outside the institutional system of science. Its very existence frustrates academic science. Attitudes to it are similar to refusal of impressionism by the academic arts in the late nineteenth century. Canonised science is unable to designate place in its institutional system for newcomers. The new interdisciplinary formations, although exist, nevertheless fall far from the cores of the canonised ones. Perhaps, there was too optimistic, when I prognosticated 28 years ago that institutionalisation will mark the end of the process from the formation of an interdisciplinary field to become a discipline.

The paper will demonstrate on the example of symmetrology that although institutionalisation is necessary, but not sufficient for full right acceptance.

POPULAR INTEREST IN SCIENCE: THE READERS OF THE MAGAZINE *POPULAR SCIENCE* (1948-1960)

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After World War II, education and science were divulged through communication media, primarily in newspapers, magazines, and the radio, important channels of popularization in Brazil. Although the media was not officially associated with formal education, they were capable of disseminating values and standards of behavior, and played an important role in sparking society's interest in scientific knowledge.

The new scientific endeavors led part of the Brazilian population to seek information, believing that science would offer solutions for the development of Brazil. In 1950, Brazil entered a new phase in its modernization when it began producing household appliances, processed food, pharmaceuticals, beauty products, and many other innovations that changed the daily lives of Brazilians. In this context, the magazine, *Popular Science*, stood out as an editorial project exclusively dedicated to the popularization of science. *Popular Science* was a monthly publication edited in Brazil from 1948 to 1960. Its sections dealt with themes related to exact and natural sciences and divulged the technological innovations of the period.

Occasionally, the magazine featured a letters section, a space dedicated to clarify the readers' doubts about previously published articles and publish criticisms and compliments. Under the title of "Letters to the General director", this section also allowed the readers to request themes and the inclusion and exclusion of sections. The magazine director answered all letters with elaborate, well-grounded arguments, and also told the readers whether he agreed with the suggestions and criticisms. The letters published in this section demonstrate the interaction between the readers and the magazine and allow the analysis of some aspects of science divulgation at that time .It is worth noting that in addition to being in charge of all editorial work, the director also defined the criteria for selection of the letters to be published.

This work proposes to survey the letters sent to the director, Ary Maurell Lobo, and define the profile of the magazine's reader. Furthermore, it also seeks to distinguish important science-related themes in the letters during the magazine publication from 1948 to 1960, highlighting the relationship between the magazine's subjects with the events of the time.

THE FORMATION OF A SPACE-ROCKET AND RADIO TECHNOLOGIES: PERSONALITY AND POLITICS

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Radio and astronautics can be described as the quintessence last century of scientific and technological progress. Radio arose at the turn of nineteenth and twentieth centuries as part of the physics. Unwittingly labelling of radiotechnics as the theoretical discipline gave rise to the problem of priorities "Popov-Marconi", as if it was the opening of the new law of nature, rather than the making of a complex technical system, including inventions of E.Branly, O. Lodge, N.Tesla, , G.Marconi, A.Popov.

The introduction of radio in the Navy of Russia, as well as the creation of the first domestic pilot radio production should be considered as the main merit of Popov. Popov was not suitable for large-scale commercial activities because of its nature. Marconi immediately became engaged in a wide demonstration and promotion of their achievements in the world. His name has become identified with radio equipment. Even the Mussolini regime needed in this exceptional person. Nobel Laureate, Marconi was clearly enunciated «the father of radio».

The development of theoretical astronautics also began at the turn of nineteenth and twentieth centuries. Pioneers of rocket technology considered going in Outer Space as the only result of their research. Using the rockets as only way to implement the idea was approved in the same years Rocket technology has been the determining factor the of space investigation development. In the 20-30-ies of last century ideas of space exploration and of use of rocket technology were developed by researchers, working almost alone (H.Oberth, R. Goddard, R. Esnault-Pelterie, K.E.Tziolkovsky, F.A.Tzander, Yu.V.Kondratyuk). The first successful rocket launches have attracted the great attention. The feature of the rocket and space technology to provide an enormous influence upon the public consciousness not so much with the obtained results, but with the very fact of its existence.

The forming of rocket technology as the industry refers to the end of 30 x top 40's of last century. The main works were carried in the USSR and in Germany. Efficiency of these activities has been totally unclear. Therefore, it was not possible to find private sources of funding in countries with market economies. In addition, the complexity of rocket technology demanded nationwide cooperation of industry. Thus only the state could to assume all risks and costs of rocket production. The idea of space flight could not become a catalyst for the successful promotion of a new type of technology in front of the state bureaucracy. But Soviet and German experts have been able to substantiate the prospects of using rockets as weapons. This fairly adventurous step is closely tied development of astronautics to military purposes. That the decision of military problems determined first space boosters development and made possible space flights.

THE ECLIPSE, THE ASTRONOMER AND HIS AUDIENCE: FEDERICO OOM AND THE TOTAL SOLAR ECLIPSE OF 28 MAY 1900 IN PORTUGAL

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On 28 May 1900, a total solar eclipse took place. The Iberian Peninsula was the only European region included in its totality path. Not surprisingly, Portugal and Spain became a focus of international interest. Since the 1860s, with the growth of astrophysics, eclipses constituted exceptional opportunities to observe the sun's corona and prominences, and to analyze the chemical composition of its atmosphere.

In Portugal, the opportunity afforded by the eclipse of 1900 became a matter of national interest, a singular occasion for Portugal to project abroad an image of modernity. In this context, an Eclipse Committee was established, and Federico Oom, one of the astronomers of the Lisbon Astronomical Observatory, became a key player in it. Oom was in charge of organizing the logistics attendant to the expeditions of foreign astronomers and of coordinating a "national plan" for the observation of the eclipse. Thus he emerged as a central figure in the network of professional and amateur astronomers.

Yet, Federico Oom took this opportunity to do much more. He used the eclipse to communicate with the general public. Making use of his status as a professional astronomer in a country where scientific careers scarcely existed, he published explanatory texts on eclipses which were intended for a broad audience. Although newspapers often tended to include information of local interest, Oom's explanatory texts were also used in many newspapers' articles. By so doing, Oom was one of the first astronomers in Portugal to use science communication as a tool to legitimate the professional status of scientists (/astronomers).

In this paper, I use the 1900 total solar eclipse to analyze the public dimension of science in early 20th century Portugal, and particularly, the social and political agendas of scientific elites as well as the relationship between professional astronomers, amateur astronomers and lay people.

SCIENTIFIC ACHIEVEMENTS - THE STARTING FACTOR OF COUNTRY INNOVATIVE DEVELOPMENT

Grigoryev Valery

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The article considers the role of science and scientific achievements providing the innovative development of economy and society on materials of the Chuvash Republic that has fraternal ties with Hevesh region of the Hungarian Republic. Chuvash and Hungarian people have old ethno cultural relations. As far back as during the period of "Great Hungary" (Magna Hungaria) ancestors of Chuvash people - onogurs, savirs, and bolgars - had historical contacts with nomad tribes of ancient Hungarians. Intercultural contacts, communication and interaction of these peoples have amplified in Y - IX centuries when Hungarians settled in the steppes of Black Sea Coast. Linguists have revealed about 300 old Chuvash words in the Hungarian language. The Hungarian-Chuvash parallels are observed also in folk music: in pentatonic and rhythmic structure of songs of «old style», in folklore motives, in the old folk calendar, etc. The Hungarian scientists B.Munkachi, D.Mesarosh, Z.Kodaj, À.Rona-Tash G.Beretski, L.Vikar, K.Adjagashi and other linguists, ethnographers, musicologists have contributed a lot to the studies of the Chuvash language, culture and history. Versatile scientific studies of Hungarian and Chuvash scholars became **an important impulse in sociocultural innovations** of the last third of XX century: establishment of friendly ties between the Chuvash Republic and Hevesh region of the Hungarian Republic (1969); development of economic, scientific. cultural and fraternal relations; creation of the republican Chuvash-Hungarian friendship society (1970), etc.

Value of science as a starting factor in innovations is most felt **in economic development** and **in technological innovations.** Realization of strategy of innovative development of the Chuvash Republic allows to increase **the volume of shipped innovative product**. A share of innovative product in the total amount of production in 2007 made 8, 3 % (average over Russia - 5.5 %); in 2008 ã.-more than 12 %. In 2008 12 innovative projects with the cost of nearby 700 million ruble. were realized in the republic. In the realization of innovative development strategy the leading role belongs to **research institutions, scientists, rationalizers and inventors**. In 2006 the Chuvash state institute of the humanities carried out the questionnairing within the study of sociocultural portrait of the region and it showed that in 2001-2006 **10 %** of questioned in Chuvash Republic **took part in innovative actions**. This parameter quite concurs with J.Shumpeter's conclusion that defines a relation of innovatively active and innovatively passive parts of the population as 1:9.

The president of Chuvash Republic N.V.Fedorov emphasizes that the powerful potential for the further development of the republic is formed today through creation of own technological and research basis, modernization of education system directed to development of innovative potential of the person, development of "healthy way of life industry" and ecological innovations.

INTERPRETING THE CEPHALOSCOPE: INSTRUMENTS, DIAGNOSIS, AND THE MEDICALIZATION OF THE DEAF, 1800-1850

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As material expressions of interaction between science and society, medical instruments embody social meanings on multiple dimensions. This paper examines the social meanings associated with the cephaloscope, an instrument designed and developed by British aural surgeon John Harrison Curtis (1778-1860) as a diagnostic tool to aid aural surgeons in examining structural defects of the ear. Curtis is a pioneering yet controversial figure who devoted himself to the treatment of ear diseases and deafness, established England's first hospital specializing in ear diseases, and published extensively on deafness and aural surgery.

In 1842 Curtis published a description of the cephaloscope and its uses in *On the Cephaloscope*. There he argued that there was a significant lack of medical intervention and prejudice against deafness, which he ascribed to the lack of attention on the physiology and anatomy of the ear among the medical profession of his time. He urged for a newer trend for British aural surgery that modeled precise anatomical, physiological, and pathological approaches of the Paris school. Since many cases of ear diseases were commonly misdiagnosed by practitioners, Curtis argued his instrument would allow the practitioner to discriminate between the various ear diseases. In this paper, I argue that as an object for historical analysis, not only does Curtis' cephaloscope reveal much about the medical practices surrounding aural surgery, ear diseases, and deafness, but it also represents what is perhaps the accumulation of Curtis' social reform attempts for the deaf and dumb.

As a diagnostic instrument, the cephaloscope symbolizes one of the earliest approaches towards the medicalization of the deaf. Curtis emphasized that by properly diagnosing diseases and obstructions of the ear, medical practitioners could not only expand their medical knowledge and expertise, but they could also significantly improve the marginalized state of the deaf and dumb by effectively curing them. As medical practitioners provided greater benefits for restoring deaf children into society, symbolic education declined as the only solution available for socializing the deaf and dumb.

Additionally, the cephaloscope represents Curtis' deeply-seated social consciousness regarding the marginalized state of the deaf. Curtis repeatedly criticized the lack of social reform for the deaf and was particularly dismayed over the number of children entering the London Asylum for the Deaf and Dumb (est. 1807) without proper medical examinations. He believed many of these children could be relieved from their ailment with a simple medical procedure, and he urged the medical profession to take upon an active role in reforming social perceptions of the deaf in Victorian Britain. In functioning both as a means of medicalization of a particular segment of society and providing a means to medically cure a social ill, the cephaloscope therefore embodies an interesting material expression of interaction amongst science, technology and society.

THE ROOTS OF THE MODERN SOCIAL AND WELFARE STATE AND THE IDEAS OF THE VIENNA SCIENTIFIC ESSAYIST ON SOCIAL REFORM RUDOLF GOLDSCHEID (1870-1931)

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The Vienna sociologist Rudolf Goldscheid and his early concept of the modern social and welfare state, which he called "Economy of Human Beings" was recently rediscovered by historical research (Mitchell Ash/ Christian Stifter, Doris Byer, Gudrun Exner, Jochen Fleischhacker, Karin Lehner, Georg Witrisal), but became still before World War II completely forgotten. It proved to be one of the many contemporary essays to compose a concept of the modern state, and a quite sucessful one. "Economy of Human Beings" became quite well known after its publication in 1908 and 1911. Goldscheid tried to lay the mental and theoretical foundations of the modern state.

A social insurance system, labour force protection laws, a public health system, a population policy, public education and the womens' right to vote should on the one hand improve the living conditions of the single person, on the other hand the whole social and economic system.

One of Goldscheid's main ideas was that economy must not produce at the cost of the whole society and must pay for the consequences of "capitalist exploitation" (and indeed, capitalism in 1908/1911 meant something different than nowadays) like invalidity, illness and premature death. Furthermore, economy must not produce luxury goods for a small strata of rich people, but great amounts of useful goods which help to improve the living conditions of the single person as well as those of society as a whole.

At the end of his life Goldscheid summarized his ideas once more in a manuscript of 1,000 pages which was never printed, but saved over the times and rediscovered and is now for the first time presented in the proposed lecture in scientific research. The manuscript consists of 17 chapters, where Goldscheid presents his social system of "Economy of Human Beings" as a third way between the capitalist and the socialist system especially like it was developed by Karl Marx. It is partly a repetition what he says in his books from 1908 and 1911, but much more clearly presented.

In historical research, also the eugenic and even totalitarian component of Goldscheid's "Economy of Human Beings" is stressed. It shall be shown that such ideas were indeed part of Goldscheid's concept, but not its main concern.

ROMANCE OF AN INDIGENOUS CHEMICAL ENTERPRISE IN KOLKATA – CASE OF EAST INDIA PHARMACEUTICAL WORKS LIMITED

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Development of science through the centuries reflects an accumulating body of knowledge to which India has made its contribution. Along with several other traditions, India had its own indigenous medical system with a glorious past. Unfortunately, this system gradually lost its scientific spirit with the advent of the Europeans in this country. Along with their civilization, they brought the western system of medicine which attracted people very much. People gradually took it with the result that the Indian system is dying of inanition. Keeping this backdrop in mind and the broad theme of this conference, the present paper has been visualized.

In the early part of the 20th century Sri Asoke Kumar Sen and Hirendranath Dutta Gupta, inspired by the swadeshi movement, established East India Pharmaceutical Works Limited (EIPW). They utilized indigenous raw materials which the country abounds in, and modern up-to-date scientific ideas and instruments for the manufacture of effective and cheap medicines for the amelioration of the sufferings of countrymen.

However, the present paper tries to show (i) how specific social and cultural factors led to the emergence of specific indigenous chemical enterprise, (ii) nature of its gradual expansion and prosperity and finally (iii) survival strategy in the age of globalization. Case study, direct observation, face-to-face interview were used for data collection.The analyses reveal that the survival strategy of EIPW makes it one of the leading indigenous chemical enterprises in India even in the 21st century competitive environment.

Regular Session T35
Scientific Instruments

THE UNILEVER COLLECTION AND THE DILEMMA'S OF COLLECTING MODERN SCIENTIFIC INSTRUMENTS

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The research laboratory of Dutch-British multinational Unilever, located in the city of Vlaardingen, belongs to the most important industrial laboratories of twentieth century Netherlands. It specialized, in particular, on research on margarine and washing-powder, resulting in such well-known products as Becel and Omo.

In my presentation I will discuss the historical collection of the Unilever research laboratory that has recently been acquired by Museum Boerhaave. This collection reflects the typical challenges put to museums by modern scientific instruments: it consists largely of mass-produced bulk instruments, which are moreover hard to understand for laymen. I will argue that, rather than from their 'intrinsic' qualities (esthetic value, rarity, etc.), the value of these instruments derives from the story they represent. They are 'key-pieces'—-a 'key' to a story behind them—-rather than showpieces.

I will explain how the 'key-pieces approach' has assisted in making an appropriate selection of instruments for the collection of Museum Boerhaave. I will discuss particular examples of instruments that illustrate Unilever research well, and elaborate on the intriguing Unilever-history that they represent.

THE PROJECT "EPMOSPHERE": THE OLD FRENCH ARMILLARY SPHERE OF LOMONOSOV MUSEUM AS THE OBJECT OF THE INTERNATIONAL EDUCATION, RESTORATION, RESEARCH

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The Lomonosov Museum maintains a collection of four French armillary spheres of 18 C. which have been gathered in the period of the organization of it, in 1947-1949. One of them had been bought from private person. It was without current information and had been attributed according signature 'Armillary sphere of French maker Joseph Dupressoir, mid.18 C'.

In 2000s, when this sphere began to prepare the restoration, it had been explored, previously. The result of that study: item consists from three independent parts: sphere, astronomical clocks and wooden base, making by different makers during of the 18- 19 CC.

In 2003, the Swiss delegation of Canton Jura interested this artifact and soon the first Swiss –Russian group for study of it and for the preparing of the complex exhibition project had been organized. This project with the scientific, didactic, restoration purposes under the title "EPMOSPHERE"(abbrev.– Ecoles Techniques, Porrentruy & Morteau + Sphere) had and realized in Porrentruy (Jura, Switzerland) from November 2004 to October 2006 with the support of Jura government, French Ministry of Education, several Swiss organizations and privite persons.

The sphere put into Professional Centre of Porrentruy where students from watch classes of it together with students of Technical school in Morteau (France) learned the construction and mechanism of it, got the consultation from the famous specialists of Switzerland, France, Belgium, Russia. There were several workshops with the participation of the restorers, several meetings with the museum and school curators, researchers and makers from these countries. It was new practice in educational program of two professional schools. Many steps of this part of project reflected in two films, which students made using of modern technology.

The other part of project was historical research. French than Belgian scientists studied of various archives and publications about the sphere. They found historical materials, new historical data which changed the attribution of sphere.

The paper will present the realization of the International project and results of the collaboration with including video installation from two educational films.

GNOMON: A MEDIATING INSTRUMENT FOR DRAWING, THROUGH HISTORICAL ORIGIN, MORPHOLOGICAL CONSTRUCTION AND USE

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A part of our knowledge of the world is mediated through tools, or signs. These are the result of human intentional action. They are constructed for a purpose and validated within a community of practitioners. Humans have established a technological culture in which the manufacture and tool use is central. Tool use and internalization relates to mental models and Vygotsky claimed that individual development and learning are influenced by communication with others in social settings tools or signs.

In a passage of Herodotus gnomon appears as a tool which Greeks learnt from the Babylonians. Gnomon is an artefact that mediates the processes between subject and object since the term mediation requires at least two participants: something/someone mediates something. Historical origin, morphological construction and use of gnomon are important and defining characteristics of students teaching and learning in their skilful use to accomplish tasks. This paper explores the shape of a gnomon as a geometrical drawing instrument, by means of historical aspects.

In addition embodied actions, gestures, manipulation of artefacts and acts of drawing are perceptuo-motor activities. Studies put the incidence of right-handedness at about 90% of human beings. The hand use can be a distinct indicator for both educational and neurobiological processes since asymmetric neural subsystems are involved in the organization of movements. Research has shown that left-and right-handers display important differences in spatial ability. We suggest a new model of gnomon. Students used this model with great ease and effectiveness as an instrument of drawing.

WAVEFRONT SENSING. A NON CONTACT TECHNIQUE FOR THE ASSESSMENT OF OPTICAL INSTRUMENTS

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The study of optical instruments, especially microscopes and telescopes, and its technological development makes it possible to appreciate the possibilities and limitations of scientific research at any particular time. At the same time this study is closely related to the developments in science and technique and their influence therefore is strongly correlated to social changes.

From the scientific point of view the best way to study the optical quality of instruments is their characterization by means of the optical transfer function and some parameters which are related to the description of the optical aberrations. These parameters can give an accurate description of the assessment of how good the images are. Moreover, it is possible by means of computing software, to simulate the images obtained showing more or less blurred images, depending on the quality of the analysed optics.

The common method for obtaining the optical parameters by computing methods requires some data such as the measurement of the diameter, curvature radius, distances and refraction index of the optical components. But this has the big drawback that it implies to dismantle the lenses, which is not always possible in the case of old and rare instruments.

There is a relatively recent technique for analysing optics based on a laser source in front of the objective of the instrument to be tested and a wavefront sensor at the exit of the instrument or where the eyepiece is located. Wavefront sensors show up problems with beams, so when light passes through an imperfect optical component, aberrations (or wavefront imperfections) are generated. Measuring the wavefront of a light beam is critical for assesing the quality of an optical system. The main advantage relies in that the wavefront sensor technique is a non contact method, avoiding disassembling and other critical problems.

In our group, we are researching with a wavefront sensor of Hartmann-Shack type and we are beginning to test this technique in antique instruments. Some preliminary results are presented of a refractor telescope from the end of the XIX Century belonging to the Phyiscs Faculty of the University of Barcelona.

AN APPARATUS FOR DEMONSTRATING THE IMPERISHABILITY OF FORCES OF NATURE

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Technical University of Denmark, Denmark

Mayer, Joule, and Helmholtz are names normally associated with the early formulation of the law of conservation of energy. Less so the Danish engineer and scientist Ludvig August Colding (1815-1888). This is despite the fact that Helmholtz gave "a Dane called Colding" credit for having stated and experimentally collaborated the law formulated by Meyer in 1842 a year after Meyer. This has already been called attention to by Per F. Dahl in his 1972 book and other works.

This paper explores Colding's experimental work and apparatus developed to demonstrate the imperishability of forces of nature. His experiments concerned heat produced by friction. Colding's apparatus was a modification of an apparatus developed by Coulomb. It involved a sled loaded with cannonballs pulled along a track on runners of various metals. The expansion of the track and sled runners produced by friction was measured.

Colding in his first paper read to the Danish Society of Sciences and Letters on the matter in 1843 concluded that the experiments supported "a general law of nature: when a force seems to disappear it merely undergoes a transformation, whereupon it becomes effective in other forms". The same applies to all of his seven papers on the matter between 1843 and 1864. The paper will address whether Colding talking about conservation of forces or energy and will discuss what his experimental results show.

HOW THE INTERFEROMETER CHANGED IDEAS ABOUT NATURE

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In 1803 Thomas Young MD, showed how two lights may interfere and alternately enhance and cancel one another. He called the phenomenon interference, and for its elucidation invented the undulatory theory which required the existence of an all pervasive ethereal aether. The idea of an aether was in the 19^{th} century taken as a fact.

In 1881 Albert Michelson invented a very sensitive interferometer to test the motion of light through this aether. He found that light's motion was the same in direction of the earth's annual motion and perpendicular to it. However, in the winter of 1881 in Paris, Alfred Potier, professor of physics and member of the Academy of Sciences, pointed out to Michelson an error in calculating the motion in the perpendicular direction. In his 1887 paper this motion was therefore recalculated, and the discrepancy expected between the forward and the perpendicular direction was reduced by 50%. Albeit, the forward motion was not reconsidered.

The negative results were so astounding that authors, such as Bertrand Russell, George Gamow, and many others to this day, felt obliged to explain them to the public, and this was done by analogy to swimmers or boats going up and down and perpendicular in a flowing river. Illustrated by the authors' own diagrams, this paper details how these analogies regrettably did not fit the actual circumstances of the experiment, and offers an improved explanation.

In order to accommodate Michelson's curious results, George Fitzgerald and Hendrik Lorentz proposed a new idea according to which at very high speeds the length of bodies contracts in direction of their motion, or time dilates. It required a mathematical transformation of these entities from the old inertial system to this new one, and eventually led to Albert Einstein's relativistic ideas of nature.

Historically it is interesting to see how the interferometer, based on the idea of aether, was used to ultimately bury this idea, and thereby pave the way to new ones. An instructive case perhaps in the advancement of science.

CONTROVERSY OVER THE RELIABILITY OF WIND TUNNELS IN EARLY BRITISH AERONAUTICAL RESEARCH

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The wind tunnel is a basic and important measuring instrument for aerodynamic research. With the invention of airplanes, it was used to measure aerodynamic performance of wings and bodies of the airplane.

In the article, "The Wind Tunnel and the Emergence of Aeronautical Research in Britain"(2000), I have shown that a controversy took place on the scale- effect among British aeronautical engineers during and after World War I, which was mostly solved by the introduction of a new aerodynamic theory developed by Ludwig Prandtl in Germany. Recent archival research provided me a more complete picture on the origin and development of this controversy, which I will present in this lecture.

The Advisory Committee for Aeronautics in Britain established in 1909 built wind tunnels at the National Physical Laboratory, where a team of Leonard Bairstow conducted experiments with wing and airplane models. He succeeded in solving an equation of the stability of airplanes by measuring aerodynamic characteristics of airplane parts and models. Their experimental results and theoretical conclusions were utilized to design more stable airplanes.

After the eruption of World War I, it was realized that the airplane designed on the basis of aerodynamic data from NPL wind tunnels did not show expected performance. The discrepancy between expected performance and the pilots' report led to the doubt about the reliability of experimental data from wind tunnels. Those who performed full scale experiments at the Royal Aircraft Factory in Farnborough tended to doubt the reliability of wind tunnel experiments, while Bairstow as the leader of model experiments emphasized the usefulness of wind tunnel data and insisted that data from model experiments were more reliable than those from full scale experiment. Under the urgent wartime situation, the debate between the two sides proceeded, and the engineer Joseph Petavel played a reconciliatory role between the two, being aptly called "the umpire" in one of their reports.

To search for the cause of the discrepancy, a group under Petavel had to consider numerous factors as a possible source of error, both in full-scale and model experiments. The full-scale measurement of the wings' lift and drag, for instance, required the accurate estimation of drag of whole other airplane parts as well as of the engine power and propeller efficiency, all being difficult to be determined precisely.

The close analysis of the process of their investigation and debate over this discrepancy between the results of the two experimental methods shows the nature of aeronautical research in Britain, the approach to experimentation by engineering practitioners and researchers as well as experimental scientists, and the historical process of the establishment of the wind tunnels as a reliable measuring instrument.

THE *TALY* RANGE – AN INTRODUCTION TO A REMARKABLE FAMILY OF INSTRUMENTS OF PRECISION MEASUREMENT

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In recent decades there has been a conspicuous influx of advanced optical and electronic devices into the consumer market, so much so that the lives and lifestyles of many people have been changed. Less obvious for being 'behind-the-scenes' but also having a large impact in the resulting products have been advances in mechanical techniques that have made sub-micron precision manufacture routine, and nanometric accuracy achievable in specialist areas. This improvement in mechanical techniques has been made possible by the development over the second-half of the twentieth century of precision measuring instruments that work to exquisite levels of detail. Notable among these instruments, and arguably a market leader for decades, has been the *Taly* family of instruments developed by Taylor Hobson and their successors, represented by such products as the *Talylin*, *Talyvel, Talystep*, *Talyrond* and *Form Talysurf*. We suggest that just as Ramsden's dividing engines have become an iconic marker for the improvement in mechanical accuracy achieved towards the end of the 18th century, so the *Taly* family of instruments reflect the improvement in mechanical accuracy that has characterized the second half of the twentieth century.

We outline what the different members of the family are able to do in terms of measurements of flatness, straightness, roundness and surface texture, and give some examples of their use. Although the *Taly* range was of course developed by a succession of commercial teams, it owed a lot to the inspiration and innovation of one man: Richard Reason, whose understanding of the behaviour of materials and his ability to bring together in harmony optical, mechanical and electronic design was crucial in allowing earlier measurement limitations to be broken through. We discuss briefly some of the principles that Reason employed. Illustrations are shown of examples of *Taly* instruments in the 'Natural Philosophy Collection of Historical Scientific Instruments' in the University of Aberdeen that were formerly in the Metrology Laboratory of the Department of Natural Philosophy. This laboratory played a significant roll in developing the original version of the *Form Talysurf*, now the flagship product in the range.

CANTERBURY TALES: MEDIEVAL INSTRUMENTS IN SOCIAL CONTEXT

Silke Ackermann

The British Museum, UK

Early scientific instruments are normally handed down from generation to generation, or preserved in a collection, or sometimes found in an attic - they are hardly ever discovered in the ground. The recent excavation of a medieval astrolabe-quadrant – a sophisticated type of astronomical instrument of which fewer than ten are known to have survived - in Canterbury was thus a huge surprise.

Even more exciting was the realization that this was not one of the exquisite pieces we have come to associate with early instruments. Rather, it is of relatively modest appearance and even shows some faults in the construction. Its undisturbed find-context leads us to believe that it probably belonged to an itinerant scholar, maybe on a pilgrimage to the famous Becket shrine in Canterbury – as so colorfully described by Chaucer in his 'Canterbury Tales'.

The discovery of this amazing instrument and its subsequent acquisition by the British Museum has prompted us to reconsider our knowledge of medieval instruments. Who made them? Who owned them? And, most importantly, what was their role in medieval society?

GEOGRAPHY, ASTRONOMY AND MATHEMATICAL INSTRUMENTS IN 16th-CENTURY EUROPE

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Geography, astronomy and practical mathematics were tightly connected in the sixteenth century. Jim Bennett has drawn attention to Ptolemy's characterisation of terrestrial mapping as a mathematical practice closely linked with the mapping of the heavens. At the global level, the Earth was mapped by reference to celestial parameters, so representing the Earth meant looking at the heavens with the aid of instruments traditionally identified with practical mathematics. We also find that such instruments appear in editions of Ptolemy's *Geography*, as well as in new texts in the discipline.

Disciplinary overlap between geography, astronomy and practical mathematics seems to have had greater impact on the three pursuits than has been appreciated. In particular, craft techniques, modes of projection and methods of publication used in geography were also present in astronomy and practical mathematics. Paper instruments were contrived for astronomical texts by the same schools who worked on maps and instruments.

Overlap that we perceive in the products of past activity can be traced back to the involvement of individuals in a range of projects. Perhaps the most obvious example is Gerard Mercator, remembered chiefly for his maps, but also responsible for the production of several surviving mathematical instruments. Mercator was not an exception though – several other European instrument makers were also involved in cartographic engraving, including Thomas Gemini, Humfrey Cole and Christoph Schlisser. In some case, activity in both practical mathematical and geography even led to the publication of geographies, such as those of Johannes Werner and Peter Apian, which introduced the authors' own innovations in mathematical practice. At a more basic level, instruments such as compendia and dials incorporated maps in many cases.

In this paper, I will explore the relationships between geography, astronomy and practical mathematics in sixteenth-century Europe. On the basis of these investigations I hope to be able to make some suggestions as to how recognising the overlap between these fields of enquiry can lead us to a history of instruments that takes social context seriously.

THE PLANETARIUM OF HARTOG VAN LAUN

Hans Hooijmaijers

Museum Boerhaave, Leiden, The Netherlands

The instrument maker Hartog van Laun devised a special table for a planetarium, a lunarium and a tellurium. Although he also made other instruments, these planetariums seem to have been the main part of his business. Van Laun made these instruments for educational purposes, but what makes the planetariums so interesting is the great variety and accuracy of demonstrations one can perform with them.

In this paper I will deal with Hartog van Laun and his two sons, who joined the instrument makers business of their father. I explain the design of the planetarium and some of the firm's other instruments. I furthermore will show that in the special case of the planetarium, the detailed description made by professor Jan Hendrik van Swinden boosted the spread of the instrument.

TELESCOPES AS DECORATIVE ART

Marvin Bolt

Adler Planetarium, USA

Important histories of the telescope, such as those by Henry King and Rolf Riekher, have concentrated on the evolution of its optical elements. In particular, they have addressed various issues relating to the physics of light and to the technical strategies developed to overcome them for the objective and for the eyepiece unit. Several collaborators and I are taking a complementary approach that in addition to investigating the optics of early telescopes, looks also at these artifacts as part of the decorative arts. Whether made for private or public display, for diplomatic exchange, for viewing, or for other purposes, telescopes provide interesting subjects as objects of material culture

SCOPING LONGITUDE: OPTICAL DESIGNS FOR NAVIGATION AT SEA

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The British Longitude Act of 1714 specifically aimed to encourage and support work towards a solution to the age-old problem of determining a ship's position at sea. As part of the Act a group of Commissioners for the Discovery of the Longitude at Sea, better known as the Board of Longitude, was set up to investigate all claims for prize money from inventors and instrument-makers. The Board continued to function in a range of related capacities until 1828.

While two methods – longitude by lunar distance and by artificial timekeeper – ultimately proved successful, a huge range of other proposals was put before the Board during its working life. While the Commissioners decided that many of these were 'impracticable', the failed proposals reveal a great deal about the interests and concerns of eighteenth-century instrument makers and inventors and the technical challenges they faced. Some previous treatments have concentrated on the more fanciful examples, but a more studied analysis shows that many arose from very serious and practical ideas. This paper will concentrate in particular on some of the telescopic devices put before the Board. As it will show, these reveal a great deal about the history and state of development of the telescope and related instruments in a period that saw significant advances in the manufacture of optical devices.

ASTRONOMICAL INSTRUMENTS FOR GAZING AND MEASURING

James Caplan

Observatoire astronomique de Marseille-Provence

Lord Kelvin's famous dictum* about measurement implies that *real* science requires numerical results. How does this apply to astronomical instruments?

Prior to the invention of the telescope, astronomy was essentially quantitative. Then, four centuries ago, Galileo made his revolutionary telescopic observations, which were mostly qualitative. But for the next two and a half centuries the most important work done with telescopes involved accurate measurement of angles in the sky (and also time, which is equivalent). With the rise of 'astrophysics' in the nineteenth century, emphasis shifted slowly from angles to photometry and spectroscopy, but the quantitative aspects were uppermost, and drove most advances in astronomical instrumentation - with the possible exception of the push for larger aperture telescopes.

I shall discuss the interplay between qualitative and quantitative aspects of astronomical instrumentation, and the relative roles of engineers and scientists, up to the present day.

*Lord Kelvin said that 'when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind'.

THE SCHMIDT TELESCOPE - A HIGHLIGHT IN ASTROPHOTOGRAPHY

Gudrun Wolfschmidt

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Bernhard Schmidt (1879-1935) was born in Estonia. After a few years of studying engineering he ran an optical workshop in Mittweida, Saxonia, between 1901 and 1927. Astronomers appreciated the quality of his telescopes. Starting in 1925, on behalf of Hamburg Observatory, he developed a short focal length optical system with a large field of view. For this purpose, Schmidt moved his workshop to the observatory. He succeeded in inventing the ``Schmidt telescope'' which allows the imaging a large field of the sky without any distortions. Schmidt's first telescope (spherical mirror 44-cm diameter, correction plate 36-cm diameter, aperture ratio 1:1.75, and focal length 62.5-cm) has been used since 1962 at the Boyden Observatory in Bloemfontein, South Africa, now in the Schmidt museum of Hamburg Observatory. Apart from his 36-cm telescope, Schmidt produced a second larger of 60-cm. Shortly after Schmidt's death, Richard Schorr, director of Hamburg observatory, published details on the invention and production of the Schmidt telescope.

Independent from Bernhard Schmidt other more or less convincing solutions for wide angle photography were suggested. After World War II, Schmidt telescopes have been widely used. The first large Schmidt telescope was built in 1948, the ``Big Schmidt'' (126-cm), Mount Palomar, USA. The 80-cm Schmidt telescope of Hamburg Observatory, planned since 1936, finished 1954, is on Calar Alto, Spain.

TEACHING AND RESEARCH: SHIFTING TRAJECTORIES OF SCIENCE AT GEORGETOWN UNIVERSITY IN THE NINETEENTH CENTURY

Dana A. Freiburger

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Telescopes tell an intriguing tale of science at Georgetown University in Washington, D.C., during the nineteenth century. In 1843, this Jesuit university built and equipped a state-of-the-art observatory to support "the instruction of students" in astronomy. Under long-time observatory director Rev. James Curley, S.J., students had access to first-class astronomical instruments from makers like Troughton & Simms of London and put them to good use in learning to compute transits of the moon and stars. However, in the late 1880s new director Rev. John Hagen, S.J., instigated a shift away from student usage towards scientific investigation. With the "aim of doing some higher work," Hagen supervised the installation of new research-oriented instruments from American telescope maker Fauth and Company to support his new observing agenda.

My talk will investigate these shifting trajectories of science between teaching and research at Georgetown. I will discuss factors influencing each trajectory and explore their context, either scientific, social, or religious, as it concerns the need for scientific instruments in a higher education setting. At the same time, I want to bring out details on the largely unseen student experience of studying science at Georgetown to ask how much astronomy did students really learn, were they able to put this knowledge to use in some meaningful way after graduating, and did the 'higher work' of research harm or enhance their learning opportunities. Last, I will talk about how this episode aligns with our understanding of the place of science in the American Catholic higher education enterprise.

RANKING THE STARS, THE MAGNUM OPUS OF J.C.KAPTEYN

Jan Waling Huisman

University Museum Groningen, the Netherlands

It was in the year of 1878 that the University of Groningen appointed its first professor in astronomy: Jacob Cornelius Kapteyn. Although the creation of such a faculty was decreed by the dutch government, they did not supply any funding, so the freshly appointed professor had to make do with the outdated instruments already present. The fact that Kapteyn nowadays is regarded as the father of dutch astronomy and the founder of statistic astronomy shows that he was not at all let down by the marginal position of his observatorium.

Instead he concluded that trying to get an observatory of his own was a waste of time and he had to made do with the resources he had. From this thought he founded the first astronomical laboratory. His first job was also the largest he would have to undertake: cataloguing the photographs taken during the Cape Photographic Durchmusterung. In 1885 the Scottish astronomer David Gill had finished photographing the complete southern hemisphere from the Cape of Good Hope. His only problem was that his team was not up to the task of processing the results. This was where Kapteyn came to the rescue: he offered to do this job for Gill, who gratefully accepted.

To make this job easier, Kapteyn designed an ingenious instrument. Nowadays it is known as “the parallactic instrument”. Based on the stand of an old comet seeker and parts of various other instruments he had it made a local blacksmith. With it went a pair of stand for the photographic plates.

There are no pictures of the instrument in action, nor any written accounts such as invoices or inventorybooks which can shed light on the cannibalised instruments for example. There is only one contemporary drawing of the instrument, used in every publication refering to it. Over the years the CPD instrument has been cannibalised too, so it is getting harder to understand its function.

This remarkable instrument is an icon of astronomic research, which made it possible to establish the coördinates directly from the plates of 454.875 stars! Besides that, it put Kapteyn in a position from which he was able to promote international coöperation between astronomers and observatories, which in turn led to some of the greatest astronomical discoveries in their time.

In my talk I will try to explain the function of this remarkable instrument, with up to date pictures and the missing pieces (or at least copies of them) where they should be.

ASTRONOMICAL SITES AND INSTRUMENTS AS WORLD HERITAGE: THE CASE OF 19TH AND 20TH CENTURY OBSERVATORIES

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Jean Davoigneau

Ministère de la Culture, Paris, France

After the foundation of the Pulkovo observatory in the 1830s, many observatories all over the world have been inspired by this “astronomical centre of the world” desired by the Russian tsar and designed by Wilhelm Struve.

We shall examine as many of these observatories as possible and identify traits – whether sites, instruments, observations, organization, etc. – which could help define an analysis grid in view of contributing to the thematic study needed to establish a Tentative List for the UNESCO World Heritage Committee.

ADVANCED INSTRUMENTS AND INFORMAL SCIENTIFIC BODIES: THE FIRST OBSERVATIONS OF VENUS AND MERCURY BY RADAR

Vasily Borisov

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Attempts of radar detection of Venus were being undertaken from 1958. And the first reliable observations of Venus were made in 1961 by groups in the USA -W.K. Viktor, R. Stevens et al., in the United Kingdom - J.H. Thompson, J.E.B. Ponsonby et al., and in the USSR - V.A. Kotelnikov, V.M. Dubrovin et al.

The observations carried out by these groups and other workers in the period from 1961 to 1964 allowed obtaining many new data. The analysis of radar echoes from Venus contributed to determination of the Solar parallax. The observations made it possible to calculate much more precisely the value for the astronomical unit and showed that it was close to 149 598 000 km.

Radar astronomy helped to settle the question of Venus' rotation that could not be solved by optic observations for more than 300 years. Venus ground-based radar measurements taken in the 1960-s showed that the period of Venus' rotation was 243 earth days long and the Venusian day was about 59 Earth days. A certain information concerning the position of the Venus pole had been obtained.

Russian workers under the leadership of Vladimir Kotelnikov were the first to observe radar reflections from Mercury (1962). They reported that the value for the astronomical unit obtained was consistent with that derived from observations of Venus.

In 1984 Russian workers (V.A. Kotelnikov, E.L. Akim, Yu. N. Aleksandrov et al.) published results of radar observations for the “north” part of Venus transmitted by the “Venera-15” and “Venera-16”spacecrafts. The unique data became the ground for the first “Atlas of Venus’ surface” edited by V.A. Kotelnikov .

In the early 1990s the Venus orbiting Magellan spacecraft produced spectacular high resolution images of the planet's surface. The computer generated picture of Venus’ surface with Magellan radar data was based on the information transmitted by the Soviet Venera landers.

INSTRUMENTS OF MUSIC AS INSTRUMENTS OF SCIENCE: HERMANN VON HELMHOLTZ'S SOUND SENSATION STUDIES, HIS CLASSICISM, AND HIS BEETHOVEN SONATA

Alexandra Hui

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The young Hermann Helmholtz declared in an 1838 letter that he always appreciated music much more when he played it for himself. Though he frequented concerts and operas throughout his life, and would in 1863 publish *Die Lehre von den Tonempfindungen*, a highly influential work that connected tone sensation to music theory, it is likely that Helmholtz's enduring engagement with music began with this very personal relationship of playing a musical instrument for himself. This paper develops this idea, shifting the discussion of Helmholtz's work on sound sensation back to its origins, to his initial relationships with musical instruments, with music itself and examines the role of his material interaction with musical instruments.

In the mid-nineteenth century the music world experienced several significant changes. Tuning systems were in flux as musicians shifted away from just intonation to equal temperament. This meant that pitches themselves were not fixed, neither standardized between instruments nor within individual ones. Additionally, a growing interest in non-Western music at this time further destabilized acceptable harmonies with the introduction of entirely new sounds. These changes had implications for both composers and instrument manufacturers. The piano in particular underwent significant design changes, altering both its sound and cost. These alterations in turn fueled its increasing dominance of the music world. Helmholtz commented on many of these developments in the music world and mobilized them to support his scientific work. His musical aesthetics, his musical practice, his extensive understanding of musical instrument construction, and his participation in the music world framed his study of sound sensation. Helmholtz sought a law-like, physiological theory of sound sensation that explained the shifting and jarring new harmonies heard in the music world.

Helmholtz thought of sound in musical terms. His classicist musical tastes as well as his deeply personal interaction with musical instruments allowed him to reconcile his conception of sound as physical object with his conception of sound as music. Helmholtz's physiological theory of sound sensation was both the product of and constitutive of how he heard sound and how he created sound. This paper argues that Helmholtz embodied the reconciliation of his physiological theory of sound sensation with a historicist conception of musical aesthetics.

So for Helmholtz, music was a valid avenue through which to approach and understand the sensation of sound, music and sound were treated as interchangeable investigative objects. Sound sensation was not only an object of investigative study but also a *means* of investigative study. Not only were musical instruments employed as scientific instruments but music itself was an instrument of science. Helmholtz's use of music, of musical expertise, in science, and the acknowledgment of the specificity of individual experience, motivated the development of new theories – both physiological and musical – as well as a new awareness of the historical and cultural contingency of sensory perception.

THE EARLY YEARS OF HISTOLOGICAL RESEARCH AT GHENT UNIVERSITY (BELGIUM)

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At the Medical Faculty of Ghent University (Belgium) the first independent histology course is believed to have been organized in 1871 by Charles Van Bambeke (1829 – 1918). Prior to this, histology was already taught as part of other courses. At the Science Faculty Van Bambeke organized his first course in histology, entitled 'Anatomie de texture', no earlier than 1876. By then, he had already published several research papers dealing with histological and embryological subjects. In 1867, for example, he produced a nearly perfect series of histological sections of toad eggs. To this end, he simply used a handheld knife. Indeed, Van Bambeke purchased his first automatic microtome (a Rivet-Leyser microtome) no earlier than 1880, this Rivet-Leyser microtome is still found at the Museum for the History of Sciences (Ghent University). Amongst the collaborators of Van Bambeke illustrious Belgian scientists, such as Julius Mac Leod (one of the pioneers of biostatistics) and Camille De Bruyne (later rector of the university), are found. One of them was Omer Van der Stricht (1862 – 1925), who performed groundbreaking work concerning ovogenesis.

The Museum for the History of Sciences holds several historic microtomes, nicely illustrating the rise of histology. Different types of cutting engines (as microtomes were called up to 1839), are on permanent display in our museum, demonstrating both manual and semi-automatic methods. Such cutting engines had been around for quite some time (as far back as 1770 Cummings introduced an instrument for cutting wood sections), when the real breakthrough was realized ca. 1860 – 1870. At that time, both Rivet (in 1863) and Leyser (in 1870) introduced a new design, based on the ideas of Capanema that dated back to 1848. This instrument comprised an elongated profile with an inclination on the side, along which the embedded tissue was pushed towards the knife. Such an early sliding microtome by Leyser, dating back to 1870, is also on display in our museum. Other instruments in our collection clearly demonstrate the basic microtome types on which current microtomes are still based: the sliding microtome, the rotation microtome, the rocking microtome and the Becker microtome.

The collection of the Museum for the History of Sciences also holds a large number of histological sections produced by the early histologists Van Bambeke and Van der Stricht. Not only their individual sections were preserved, but also the remaining tissue blocks that were discarded after sectioning. We also have many of their embedded tissue blocks that were prepared but never sectioned. Although both Van Bambeke and Van der Stricht were physicians, their histological legacy cleary shows their interest in general biology. Van Bambeke, for example, produced many microscopic preparations of fungi. Indeed, these scientists not only triggered the rise of histology at the Medical Faculty of the university, but also initiated histological research at the Biology Department of our university.

BRINGING PHYSICS TO THE PHYSICIANS

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Founded more than two centuries ago, the College of Physicians of Philadelphia carries National Historic Landmark status as the birthplace of medicine in the United States. The main historical assets owned by the College are its historical library, once the primary medical reference library in the USA, and the Mütter Museum, founded 150 years ago, a collection of anatomical and pathological specimens and medical instruments. One feature of the collections is the cabinet of mementos, a "repository of historic souvenirs," which was assembled a century ago and maintained through assignment to the College's "best men." Although part of the museum collection for over 70 years, the cabinet remains in the vestibule of the College, a thing apart from other collections.

The cabinet's mementos include relics of the great men of medicine: a shoe buckle and watch owned by Benjamin Rush; Edward Jenner's inkstand and a lock of his hair; Joseph Lister's surgical tools and his glass tubes for tests of lactic acid fermentation; Pasteur's model of a tartrate crystal; and a quartz piezo-electric apparatus presented by Marie Curie and made by Pierre Curie. A tool for measuring the strength of an electron discharge from radium, this relic seems out of place. Why is this device part of a cabinet of medical mementos? How and why was this apparatus enshrined as a relic of medical history, and why did the College of Physicians seek a memento from Marie Curie, who presented it to the College in person? This paper argues that Dr. Robert Abbe, a Fellow of the College, who assembled the mementos, sought the Curie instrument to enhance his own standing as a pioneer in radiotherapy, and to signal to the medical professions the importance of radioactive substances to the 20th century physician's repertoire of tools and techniques. Abbe held radiotherapy as the most important new area of medical research for the 20th century.

"WHAT HAPPENED ON THE EAST RIVER: THE SYNERGY OF SCIENTIFIC INSTRUMENT DEVELOPMENT AT THE ROCKEFELLER INSTITUTE AND THE VIRUS LABORATORY OF THE ROCKEFELLER FOUNDATION, 1928-1948"

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The co-location (along the East River in Manhattan, New York City, New York, USA) of the scientific laboratories of the Rockefeller Institute for Medical Research, and of the Virus Laboratory of the Rockefeller Foundation, created one of the most fertile sites for the development of scientific instruments in the 20th century in the twenty years from 1928 to 1948. Collaboration and interaction between the two programs initiated important steps in the development of the ultracentrifuge, the Tiselius apparatus, in tissue culture technology, in the use of oscilliscopy for nerve-conduction studies, and in electron microscopy.

While abundant funding was available to support the development of scientific instrumentation, it would not have occurred without the interactions of the instrument-makers, the commercial suppliers, the scientists and engineers, and the philanthropic professionals that this paper will highlight. The particular significance of international connections, particularly with Scandinavia, will also be examined.

The scientific instruments developed by the synergy of the Institute and the Laboratory were fundamental to some of the most important biomedical research events of the 20th century. The advanced ultracentrifuges and Tiselius apparatuses that were available to Oswald T. Avery and his team at the Institute were crucial to their identification of DNA as the genetic material (1944), the first step in the molecular biology revolution. The application of oscilliscopy to nerve-conduction studies underlay the research that led to Herbert Gasser's Nobel Prize. The installation of one of the first electron microscopes at the Virus Laboratory made possible the earliest photographs of cellular structures, which were crucial to the new field of cell biology. The development of tissue-culture technologies led to the standardization of laboratory procedures and the creation of a global tissue-culture regime.

The paper will comment on the intellectual and social environment that promoted the interaction of two scientific programs, and will suggest the applicability of this case study to understanding similar episodes in the history of science and technology. Because very little has been published on the history of the Rockefeller Institute for Medical Research (since 1965 The Rockefeller University), and there is no scholarship specifically on the Virus Laboratory, this paper will illuminate a virtually unexplored topic in the history of science and technology, and will make a significant contribution to the history of scientific instruments in the 20th century.

This paper, which will be illustrated, will be based on research in the archives of the Rockefeller Foundation and the Rockefeller University.

DOING IT BY THE BOOK

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The instructions which accompany scientific instruments, whether as separate printed material or integral to the object, encode a range of assumptions about the users of the instruments. These assumptions include the level of importance which will be attached to the instructions themselves as well as the level of experience and knowledge (tacit or overt) of the users. Since the mid 19th century the instructions accompanying instruments have changed greatly, reflecting the social change in the users of instruments as well as the technical development of the instruments. This paper will explore some aspects of the changing face, over this period, of instruction manuals for both mass produced and more specialist instruments.

LIEBIG'S KALIAPPARAT: A CASE STUDY ON THE MATERIAL CULTURE OF CHEMISTRY

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Justus von Liebig has always been recognized for his work in several fields such as organic analysis, agricultural and animal chemistry, experimental chemical education, industrial chemistry and chemical technology. In the later, one of his most important achievements was a glass apparatus used in combustion analysis: the Kaliapparat.

Based on one of Lavoisier's combustion apparatus, Liebig's creation, a five bulb piece of glassware, became an instrument of major importance in organic analysis. With it, chemists were able to transform an extremely complex and long experiment into a simple and routine operation. This increment in speed made it possible for organic chemistry itself to take a giant leap forward.

This paper intends to expose the contribution of Liebig's apparatus, making a parallel with the precedent methods and understanding the development of this combustion device in order to trace its history, hence making society aware that are small steps such as these that have led to chemistry as it is known and taught nowadays.

References:

Annalen der Physik und Chemie (1831) **21**, 1-43

BROCK, William H. (1992), *The Fontana History of Chemistry*, Fontana Press, London.

BROOKE, John H. (1971), *Organic Synthesis and the Unification of Chemistry*, British Journal for the History of Science **5**, 363-392.

PARTINGTON, J. R. (1961), *A History of Chemistry*, Macmillan, London.

BUYING INSTRUMENTS: COSTS OF AN EXPERIMENTAL CULTURE THE CASE OF THE PHYSICS LABORATORY AT PADUA UNIVERSITY (1847-1857)

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What financial resources were available to a physics laboratory in the mid-nineteenth century? Where did these resources come from? How did local physicists use them? In this paper I will try to answer these questions looking at Padua University's physics laboratory.

I will focus on the decade between 1847 and 1857: in this period there were increasingly pressing needs to improve both teaching and research techniques. This drove the Padua University protagonists towards an international market where they could find the expertise and technical abilities that local artisans were no longer able to provide. Laboratory diaries, scientific trade catalogues, the scientific correspondence and objects still stored in local museums allow us to analyze how these physicists tried to face the situation. Moreover, these resources let us describe in detail where Padua University physicists bought their instruments, how much they paid for them and which professional instrument makers were regarded as the most prominent in Europe.

My paper also aims to draw a map of scientific geography on which Northern-Italian science has to be placed: Vienna, Munich and Paris represented the most important network reference to the local scientists. However, the choice of this area did not depend only on the fame of manufacturers and the quality of their instruments. Elements that may seem minor, such as transportation costs, frequent damages caused to increasingly sophisticated equipment and difficulties in quickly obtaining the purchased materials, influenced scientists choices. These problems led them to favor bordering countries, while England remained an ambitious destination rarely visited.

EN ROUTE TO THE „GERMAN CHRONOMETER“: THE INTRODUCTION OF PRECISION TIMEKEEPING IN THE GERMAN MERCANTILE MARINE AND IMPERIAL NAVY IN THE 19th CENTURY

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The introduction of precision timekeeping in the German Mercantile Marine and Imperial Navy is an interesting case study for the establishment of a highly demanding and specialized manufacture between governmental regulation and technical limitations.

Soon after the formation of the Reich in 1871 ambitious efforts started to build up a Navy, and the Imperial Admiralty called for a self-sustaining manufacture of nautical instruments and chronometers. Moreover, registered tonnage of the German mercantile marine increased sevenfold between 1850 and 1910 and created heavy demand. England, and (to a lesser extent) France, dominated fabrication and trade of nautical instruments and chronometers however, and therefore local makers were encouraged to secure supplies. In 1875 the German Hydrographical Institute (Deutsche Seewarte) was founded and annual competition trials for testing chronometers were arranged. Many makers relied on movements and spares from England, but regulations were intensified gradually and "German work" was defined more and more precisely. Chronometers with imported parts were excluded from the annual trials, which led to shortages. Solving the technical problems involved with manufacture of special parts and establishing an adequate vocational training could not be simply decreed, and compromises had to be found. In 1899 an association was founded with the objective to establish the fabrication of blank movements in Germany. The factories of Lange & Söhne and Strasser & Rohde in Glashütte exerted themselves in making movements, but could not meet the demand satisfactorily. Therefore Hamburg shipowners planned large-scale production of chronometers and founded the "Hamburg Chronometer Works" in 1905. But the technical problems involved were immense, and only three years later the factory reverted to manual production.

MODELS AS MATERIAL IDEAS. TEACHING USEFUL KNOWLEDGE WITH IRENICAL INSTRUMENTS IN THE EARLY ENLIGHTENMENT

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Models made out of wood, wax, cardboard or cork have served, over time, as much more than physical stopovers on a journey from conceptualization to application, or from theory to practice. Although still very often treated as instruments that help simplify ideas, newer scholarship is showing that models do much more than bring abstract knowledge down to earth. As mediators, write Margaret Morrison and Mary S. Morgan, models are autonomous agents that are dually reliant upon and independent from both theory and substance *at the same time.* They are instruments that have acquired the ability to help both articulate and to resolve longstanding tensions between singularity and diversity, or between materiality and rationality. Models reconcile. They assimilate. And they possess a unique ability to improve the viewer's grasp of both concepts and natural processes. There are many discussions underway in the history of science and technology about how models have functioned in a variety of contexts in order to synthesize, produce, and transmit knowledge. I aim to contribute to these discussions.

My paper explores a critical moment in the history of model-making and viewing: the early eighteenth century. It looks carefully at the models and techniques of a „school of the real" founded in the German city of Halle by a mathematician-technician named Christoph Semler in 1707. After explaining the extremely high ontological status Semler attached to models as material objects, I focus on his most famous one: a large wooden model of Solomon's Temple. The philanthropic community that employed the structure used it to do much more than communicate Baconion ideas about the organization of knowledge or certain moral precepts articulated in the Bible. Instead, I argue, they integrated the structure into their efforts to make real ideas, experimenting with its potential as a conciliatory engine. Philanthropists invested the structure with the ability to improve the quality of viewers' desires so that they, too, would want to become model builders and practitioners of „useful science." Semler's enormous model of Solomon's Temple also made confessional union visible, thereby helping to generate it. His confidence in the autonomous powers of conciliation this model possessed contributed to the primacy of place he afforded material ideas more generally—including model humans and machines.

Derived from my current research project, this paper considers the status of Semler's material models as scientific objects (or instruments) in context. It will elucidate relationships between the production of these material ideas and the contours of philanthropy as a coherent movement, expressed through the founding of model communities in the German states, Russia and the Atlantic world.

THE INCLINED PLANE: A NEW LOOK AT A (VERY) OLD INSTRUMENT

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In the 1890s American science education was transformed by the introduction of the student laboratory. One of the effects of this transformation was a sudden demand for large numbers of cheap, relatively accurate and extremely rugged "student" scientific instruments. The ways that businesses changed to serve this new market profoundly affected the way scientific instruments were manufactured in America. Surprisingly, much of this story can be seen in the history of one of the simplest instruments – the inclined plane.

SCIENTIFIC INSTRUMENTS IN THE POLYTECHNIC SCHOOL OF LISBON: THE 19th CENTURY COLLECTION OF OPTICAL INSTRUMENTS

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In the reserves of Museum of Science of the University of Lisbon there are a great number of scientific instruments used in research and teaching in different areas of Physics and Chemistry in 19th and 20th centuries in the Polytechnic School. Among them a balance collection, optical, photographic, spectroscopic, acoustic, heat, pneumatics, mechanic, and electrical instruments as well as a large collection of scientific glass equipment can been mentioned. A significant part of those instruments is not yet completely identified and catalogued.

In this talk we intend to present the study involved a part of these instruments: the optical collection of the 19^{th} century. This work includes a research in Professors' textbooks, in catalogues and in the archives of the Polytechnic School, in order to identify them and to trace their history.

History of Science in Portugal, and its teaching, cannot be approached outside the European scientific context. That's why we endeavoured to get acquainted with that context in the referred period, how it developed and which relations arose between the different characters of this same history: scientists, scientific instrument's manufacturers and teachers.

References:

BERNARDO, L. M. (2007). *Histórias da Luz e das Cores*, vol. 2, Editora da Universidade do Porto, Porto.

BRENNI, P. (1996). "19th Century French Scientific Instrument Makers. XIII: Soleil, Duboscq and their Successors". *Bulletin of the Scientific Instruments Society*, 51: 10.

PERES, I. M., COSTA, F.,(2006). "Historical Note on Optical Methods and Related Scientific Instruments for Chemistry used by Lisbon Polytechnic School on the Final XIX and Earlier XX Centuries", *in* Proceedings of the *5th International Conference on History of Chemistry: Chemistry, Technology and Society*, Aveiro, pp. 314-322.

PERES, I. M.(2006) "O Ensino da Análise Química Espectral: Um compromisso entre Químicos, Fabricantes de Instrumentos Científicos e Professores", DQB, FCUL (Master Thesis).

VIDAL, A. P.(1895). *Tratado Elementar de Óptica*, Typographia da Academia Real das Ciências, Lisbon.

SKINNER BOX IN PSYCHOLOGY DIDACTIC LABORATORIES IN BRAZIL *

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The goal of this work is to build a historical narrative on the uses of "Operant conditioning chamber" in Psychology laboratories in Brazil. Data were collected from a variety of methods such as interviews, visits to laboratories, analysis of documents such as photographs, reports, proceedings of conferences etc.

The operant conditioning chamber (also known as "Skinner box") was chosen as the main item in this analysis for being a canonic icon of Skinner's theory and therefore provides components for a deeper understanding of Behavior Analysis history. The temporal focus lays on the 60's because it was in 1961 when the first Skinner box was brought to Brazil by Fred Keller, a North American psychologist.

It was late in the 1950s and mainly in the 1960s, when the first Psychology courses were established in Brazil. In almost all of them, at least one laboratory was included. Most of those laboratories were equipped with Skinner boxes imported from the United States. Those imported boxes where basically designed to be used in researches but, in Brazil, they where mainly used in didactic laboratories. This anachronism can be understood from different perspectives. One of them is the fact that in Brazil, at that time, there were a few number of Psychologists with specific training in experimental laboratories of psychology. The other is the fact that psychology research in laboratories where extremely expensive for Brazilian standards.

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Regular Session T36
Studies in the History of Metrology

FOUNDATION FOR TRADITIONAL CHINESE METROLOGY MUSEUM

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Abstract: The museum of traditional Chinese metrology was founded last year in China Jiliang University in Hangzhou, China, which is the only one of university in the education of metrology. It is the first museum in the world that presents perfectly a long-standing histry in metrological technologies which encompassed time, measures and weights originated from the ancient China and developed in the modern times, throughout five thousand years of the Chinese civilization. There are six sections for showing the traditional Chinese metrology in the form of the display board with characters and pictures, metrological standard apparatus and 3D video animation equipments in the museum as follows:

1. The formation of the traditional metrology. It is mainly introduced to the information of the earliest measuring and weighing apparatus in the Xia, Shang and Zhou Dynasties at the beginning of 2070 B.C..

2. The Emperor of Qin Shi Huang's standardization of the measuring and weighing systems, which is an important event of the metrology in ancient China. It is shown to the three sections of the standardization of the measuring and weighing systems, the standards of measure of fields were unified and standard measuring apparatus are adopted,

3. It is presented that Luo Qin arranged the system of measures and weights of Qin and Han Dynasty to the documents. The theory of the measuring and weighing systems, which was named as the standard pitch of Huangzhong in the Han Dynasty China, was established to the end of Qing Dynasty.

4. Many metrological apparatus of the customization of capacity, the regularity of weights, the armillary sphere and the clepsydra etc. were invented from the Han Dynasty to the Qing Dynasty.

5. The traditional metrology trends to the modern one. It is indicated that the methods of angular metrology and time metrology HMS system and so on, are introduced from the Ming Dynasty to the Qing Dynasty.

6. The modern metrology. It includes to the development of the metrology system and the metrology technology.

RÉSOLUTION NUMÉRIQUE D'UN PROBLÈME MÉTROLOGIQUE : LE PIED, LA PERCHE ET L'ACRE D'ANGLETERRE

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Les mesures du pied, de la perche et de l'acre d'Angleterre sont mentionnées dans plusieurs sources remontant au XIII^{e} siècle et elles se sont perpétuées jusqu'à nous. Pourtant, les explications avancées à propos de leurs origines, de leur raison d'être et de leurs dimensions comportent toutes une part hasardeuse, pour n'être pas reliées assez solidement à la métrologie agraire de l'ensemble de l'Occident.

La restitution de cette métrologie foisonnante en un système cohérent et unifié amène à considérer que des mesures agraires peu nombreuses, issues de prescriptions étatiques aux temps carolingiens, se sont par la suite multipliées, tout en procédant historiquement les unes des autres par des conversions numériques rationnelles. L'Angleterre en présente un exemple.

L'acre recouvre précisément une unité de superficie attestée depuis le IX^{e} siècle, très répandue en Allemagne, en France et en Italie. Diversement reconvertie, elle a cours en particulier en Normandie et dans les provinces françaises au pouvoir des Plantagenêt. En Angleterre, elle prend une configuration originale pour retrouver l'aspect de la mesure germanique fondamentale, l'*ancinga* citée au VIII^{e} siècle.

La résolution numérique de cette conversion implique la création d'une perche tout à fait nouvelle par un procédé géométrique. Mais la division de cette perche en proportion d'un pied existant précédemment a causé l'inconvénient si souvent relevé du compte fractionnaire de 16 ½ pieds à la perche.

Les résultats atteints, d'une précision étonnante, soutiennent l'idée maintes fois émise mais tout autant combattue d'un lien entre la métrologie anglaise et les usages du Continent.

LA MÉTROLOGIE HISTORIQUE EN FRANCE DEPUIS UN DEMI-SIÈCLE

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(la communication sera présentée en collaboration avec Bernard Garnier, trésorier du CFMH et Pierre Portet, secrétaire-général du CFMH).

En France, pays où fut fondé le système métrique décimal par la Révolution française, les institutions métriques demeurent très actives et concourent aux réflexions des institutions internationales qui élaborent et affinent les unités qui composent le système international.

Les historiens ont fondé le Comité français de Métrologie Historique pour célébrer le bicentenaire de la Révolution française (1989) et organiser des rencontres scientifiques, lors de congrès nationaux ou internationaux.

Ce Comité dispose d'une revue, les *Cahiers de Métrologie*, publiés à l'Université de Haute-Normandie à Caen et soutenus par le Centre National de la Recherche Scientifique. Vingt-cinq numéros sont parus de 1983 à 2007.

Il a organisé en 1989 au Conservatoire National des Arts et Métiers à Paris, en présence de Louis Marquet, le colloque national *Genèse et diffusion du système métrique,* Paris 1989, en 1993 à l'Université de Lille le colloque international *Une activité universelle. Mesurer et peser à travers les âges,* Caen 1993-1994, et l'année suivante à Douai le colloque international *Diversité régionale et locale des poids et mesures de l'ancienne France*, Caen 1996-97.

Chaque année il réunit à l'Université de Paris I à la Sorbonne un séminaire ouvert où de jeunes chercheurs viennent présenter et soumettre à la discussion leurs travaux qui sont ensuite publiés dans les Cahiers de Métrologie. Les sujets abordés couvrent tout le champ historique depuis la Mésopotamie et abordent de plus en plus une problématique d'histoire sociale.

Enfin chacun des auteurs a publié des ouvrages de métrologie, sous forme de livres (Hocquet) ou de CD/DVD (Portet et Hocquet), la métrologie historique s'est fait une place dans les travaux de recherche historique où elle est invitée à présenter ses résultats, à l'échelon national ou international (Italie, Mexique par exemple) ou dans des expositions scientifiques. Les activités du CFMH n'épuisent pas toute la recherche, d'autres auteurs, des scientifiques, des enseignants, des collectionneurs d'objets, de poids et balances, d'instruments de mesure, publient aussi des travaux de qualité.

LA COORDINATION MÉTROLOGIQUE ET LA SPATIALITÉ DANS LE CAS DE QUELQUES PETITES ÉGLISES ROMANES EN BOURGOGNE

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Dans cette communication, nous montrerons des résultats de métrages effectués *in situ* dans des petites églises du type de nef unique en Bourgogne au Moyen Age. Les plans des églises de ce type que l'on imagine trop souvent, pour la raison de son extrême simplicité, réguliers présentent en réalité beaucoup d'irrégularités. Ces irrégularités se trouvant dans la composition simple du plan nous permettront d'aborder la question des mesures lors de la mise en œuvre des chantiers médiévaux.

Nous verrons que les chiffres de nos relevés, convertis aux unités médiévales, nous montrent que les nombres choisis comme cotes par les bâtisseurs médiévaux ont tendance à être uniformes et qu'ils suggèrent une symbolique religieuse riche. D'autre part, d'après l'analyse des cotes converties, nous montrerons la grande probabilité du système de la coodination spatiale exprimée dans les nombres utilisés, ainsi qu' avec figures géométriques simples pour déterminer le plan des églises.

Nos relevés de mesures effectués sur une trentaine d'églises bourguignonnes nous permettent finalement de retrouver quelques systèmes de mesure architectural en tant qu'une coodination spatiale de l'époque ainsi qu'une superposition de significations spirituelles dans l'utilisations des mesures de l'époque médiévale.

A STUDY ON *YING BIAO YI* – A NEW VIEW ON THE IMPORTANT DOCUMENT IN THE HISTORY OF METROLOGY IN CHINA

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The article is a study on Shen Kuo's *Ying Biao Yi*. The Article discussed the great innovation of the gnomon made by Scientist Shen Kuo in Song Dynasty and his contribution to the history of metrology. Shen Kuo is one of the greatest scientists in the history of science and technology in China. Shen Kuo has written three important articles to describe his viewpoints in astronomy and metrology. The three articles has been collected in *Er Shi Wu Shi*, which is the most important document in China. The first two articles have been thoroughly studied by earlier researchers. As the last article, *Ying Biao Yi* has only been researched in the purpose of explaining. This article would put forward a relatively new view on *Ying Biao Yi*, the important document in the history of metrology in China

Ying Biao Yi has made great contribution to both astronomy and metrology in ancient China. In the article, Shen Kuo first pointed out the deficiencies of the method in gnomon observing used by earlier people which could lead to observation errors. He putted forward some ways to improve the instruments for time measuring and keeping including the modification of the structure, reading set and observing methods. The earlier researches gave a quiet clear view on the improvements putted forward by Shen Kuo without clearly explaining the reasons of the improvements. That is just the point my article focuses on. After analyzing the improvements Shen Kuo had made, this article raises a view that the main cause for Shen Kuo to make the improvement of observing with three gnomons lies in the fact that he believes the ground is flat. The three gnomons observing method actually has the same essence with observing in the center of the earth.

ON HISTORICAL DEVELOPMENT OF CHINESE METROLOGY

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Metrology is a technical guarantee of maintaining the normal running of the state machinery. It is also a basis for a country to develop its science and technology and economy. It is clear that the study of metrology should certainly play an important role in the history of science and technology. In order to research the history of metrology, we should know its historical stages at first. That is why this paper was written.

This paper takes Chinese metrology as a researching object. It makes explorations on the historical stages of Chinese metrology. The author thinks that Chinese metrology could be divided into two categories in general. One is traditional metrology and the other is modern metrology. The period of traditional metrology in China could be divided into some stages. The forming stage of it is from far ancient times to the time when Qin Shihuang (the first emperor of Qin Dynasty) unified China. The need to satisfy the socialized production and the running of the original state machinery sprouted the primary metrology. The ancient Chinese paid great attention to the advocate of the stability of units for weights and measures. There is a famous remark in Lun Yu (The Quotations of Confucius) that says "setting rigid rules of weights and measures, strengthening the legal system, so the government decrees will be carried out in all directions." Some statesmen such as Shang Yang and Qin Shihuang made powerful push to standardize the system of weights and measures by using the imperial rights, which leads to the birth of unified system of traditional measures and weights in ancient China. Time metrology had also formed its shape during that period. Those marked the formation of the traditional Chinese metrology.

The second stage of the traditional Chinese metrology is the Han Dynasty. It is a period of development and maturation for the traditional Chinese metrological theory. Liu Xin and Zhangheng's theory and practice in metrology marked the maturation of the traditional metrological theory in China.

The third stage of the traditional Chinese metrology is a stage for alteration and development, which lasted for as long as near 1500 years. Under the impact of social alteration and the restraints by traditional theory, Chinese metrology changed greatly and developed itself gradually in that period. The metrological science developed greatly in the period.

From the end of the Ming Dynasty to the end of the Qing Dynasty, the traditional Chinese metrology experienced the stage of transition. On one hand, the Qing Dynasty emphasized to establish its system of weights and measures in accordance with traditional method. The Qing government wanted to show their attitude of respecting for the system of rites of traditional Han national culture in this way. On the other hand, the contents of traditional metrology changed with the western missionaries entering China. For example, the concept of the angle of circle center had been

established, the system of time had been renovated, and some kind of new apparatus had been made, and so on. These changes extended the range of the traditional metrology and prepared the basis for it to transit to modern metrology. But the transition had not become true during the period for the reason of the Qing government itself.

In the period of the Republic of China (1912-1949), the traditional Chinese metrology went to its end. The symbolical matter in the period was that Nanjing government decreed the Law on Weights and Measures in the Republic of China and made great effort to bring it into effect. The system of weights and measures didn't achieved standardization in China in that stage but it declared the death of the theory and the system of traditional Chinese metrology.

After the establishment of the People's Republic of China in 1949, Chinese metrology began a new dates and entered its modern and contemporary era. Especially in 1978, China began to reform its old policy and opened its door to outer world. Since then, Chinese metrology has speed up the pace to go to its legal system. The most important things are the decrees of the Legal Units of Measurement in the People's Republic of China and the Law on Metrology of the People's Republic of China in that period.

Key Words: Metrology, History of Metrology, Historical Stages

MATERIAL METROLOGY AND THE STRANGE PYRAMIDOLOGY OF C. PIAZZI SMYTH

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In November of 1864, Charles Piazzi Smyth, the Astronomer Royal for Scotland, embarked on a six-month expedition to measure the Great Pyramid of Giza. The expedition came amidst a veritable crisis in British Imperial metrology. Earlier that year, Parliament had passed a permissive Weights and Measures Act legalising the metric system for contracts and commerce. The Act followed a half-century's troubled effort to produce an acceptable set of material standard measures, and underscored the immense difficulties, both practical and theoretical, plaguing the British metrological enterprise. Extant scholarship concerning Piazzi Smyth's expedition has centered around his eccentric arguments, popular for decades after his return, linking British measures to their Great Pyramid counterparts. His advocacy has been seen as an attempt to derive a historically legitimated foundation for Britain's embattled standards. These accounts, however, tell only half of the story behind the astronomer's sweeping metrological ambitions. To the well-documented and analysed political circumstances of the expedition, I propose to add an account based on the practical and material exigencies of Piazzi Smyth's work.

In particular, I argue that the astronomer's largely neglected writings concerning his specific material apparatus for linear measurement reveal a close concern over the difficulties of producing and maintaining useful material standard measures. The choice of material was of special importance to him. While still in Edinburgh, he devised a measuring system which was to employ a stone standard scale and a variety of wooden and ivory scales adapted to different purposes. To his dismay, his commissioned stone scale and primary wooden reference scale were not made to his exacting specifications (left unspecified in his writings) by the time of his departure, and he was forced to improvise replacements while in Egypt. The astronomer's substitute for the stone scale, a roughly worked fragment of basalt, joins with detailed discussions of its fabrication to invoke a rich theory of the encounter between the natural world and human practical action and error. The stone came to stand for the timeless perseverance of the Great Pyramid as a "metrological monument", even in the face of the Pyramid's own decay after years of human abuse. It was to be a lasting testament to the fleeting means of measurement available in the Egyptian desert.

The basalt standard, for Piazzi Smyth, offered a distinctly material diagnosis and solution to the problem of national metrology. The astronomer's writings ruminate obsessively on the challenges of casting national linear standard measures in the right materials, and invoke a spectrum of geological and historical reasons in support of worked basalt as a metrological panacea. Piazzi Smyth's story offers a rare case study in the ways in which the very material basis of the metrological enterprise is bound up in questions of nation, colonialism, orientalism, science, time, and place. Not even the stones scattered about the Great Pyramid escape the astronomer's metrological gaze, and all that he sees is tied up into a programme for universal metrology meant to bring to a close the British metrological crisis.

THE MANAGEMENT OF CHINESE TIME METROLOGY IN THE PERIOD OF THE TANG DYNASTY – ADMINISTRATIVE ORGANS, SYSTEM AND LEGAL PRECEDENT OF CLEPSYDRA

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In this paper Chinese time metrology in the period of Tang Dynasty is studied. The administrative organs, system and legal precedent of clepsydra are discussed. Through the research of many historical materials concerning the clepsydra, the different characteristics in organizational system and managing duty are compared among three organs of the management of clepsydra, technical management system and legal precedent relating to the clepsydra timing in Tang Dynasty are elaborated.

The administrative organs of the management of clepsydra were the *Ministry of Sacrifice*, the *Astronomical Bureau* and the *Crown Prince Shuai Geng Temple*. The *Ministry of Sacrifice* was in charge of the affairs of clepsydra in all sorts of sacrificial ceremonies and the number of officials relating to clepsydra was the least among three above-mentioned administrative organs. The *Qie Hu Zheng* being under the command of the *Astronomical Bureau* managed the comprehensive affairs concerning clepsydra. There were the maximum departments and officials of managing clepsydra in the *Qie Hu Zheng*. And the *Crown Prince Shuai Geng Temple* supervised the administration of clepsydra relating to the activities of imperial kinsmen and crown prince. Generally, the *Astronomical Bureau* managed the technical direction about clepsydra. The *Ministry of Sacrifice* and the *Crown Prince Shuai Geng Temple* took on the concrete management of clepsydra being aimed at specific demand.

The timing system of Hundred Mark Chronometry was practised in Tang Dynasty. The technical management of clepsydra was administrated by the *Astronomical Bureau*. Moreover the decree on the basis of clepsydra as a technical instrument of timing was also worked out and issued as well as enforced strictly in Tang Dynasty.There was a legal precedent that an official managing the clepsydra was penalized because he slept on both ears and forgot to give the correct time.

THE EMERGENCE OF MACROSCOPIC QUANTUM EFFECTS AND THE NEW INTERNATIONAL SYSTEM OF UNITS (SI_{2011}) BASED UPON FUNDAMENTAL CONSTANTS

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Stimulated by excellent reproducibility of two macroscopic quantum phenomena, the tunnel effect of Cooper pairs (1962) and the quantum-Hall effect (1980) - accentuating the relevance of the Josephson constant and the von Klitzing constant to the definition of the units of voltage and resistance, respectively -, the concept of "natural" physical units took a new shape in recent years. Ever since Max Planck's initiative to introduce natural units (1899) the collection of fundamental constants in its entirety is considered the only known system of physical quantities entitled to universal significance.

Planned to be proclaimed in the year 2011 a new version of the International System of Units (SI_{2011}) is discussed presently which directly relates the base units (with exception of the units for the atomic timescale and for the luminous intensity) to fundamental constants. The new version takes advantage of the self-consistency of the adjusted system of all fundamental constants available (CODATA-table), and, for the first time in the history of metrology, it offers an "universal" approach free from anthropomorphism. The price to be paid is the binding adoption of an algorithm of unprejudiced analysis of the uncertainty of measurement data as based upon statistical information theory (Jaynes 1957). In this way the concept of standard uncertainty becomes a constitutive element. (For instance, if a base unit is to be referred directly to the *numerical value* of the Planck constant $h = 6.62606896 \times 10^{-34}$ *Js* - as suggested for the unit of mass (kg) - the corresponding relative standard uncertainty $u_r(h) = 5.0 \times 10^{-8}$ is involved simultaneously, being the *metabase* which indicates the significance of the Planck constant within the self-consistent system of fundamental constants - the best information on nature available at the time.)

The reduction of the physical units to the numerical values of the fundamental constants (well known self-consistently in each case), in the sense of the mathematical balancing procedure applied, represents an irreducible realization of the claim of validity of the metrology within the framework of physics as a whole..

The paper (i) reports on the physical history of both the macroscopic quantum effects under the common aspect of Aharonov-Bohm systems which are characterized by the magnetic flux as the leading dynamical variable. Furthermore, (ii) the meaning of Jaynes's principle of maximum information-entropy is discussed as the metaphysical argument which gives reasons for the definition of the quantity of standard uncertainty of empirical data.

HISTORY OF PRECISE READING FOR MEASURING INSTRUMENTS

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Having searched for the history of measuring instruments including Astrolabes, Quadrants, Surveying Instruments, Metrological Instruments, Electrical Instruments and Digital Instruments, it was found there were several kinds of precision reading scale divisions such as the Nonius Scale, the Diagonal Scale, Vernier Scale and the Micrometer Scale and Today's Digital Scale.

It was found that the Nonius Scale invented by Pedro Nunez in 16th Century was used as precision readings of Circular Instruments, however, Diagonal Scale invented by Levi ben Gerson in 15th Century spread it's application from Linear Scale Division to Circular Scale Division. After the development of the Diagonal Scale, it has been employed for the precision reading of many kind of measuring instruments such as Astronomical Instruments, Navigational Instruments, Geodetic Instruments, and Electrical Instruments in Europe, the US and Japan for long time over 500 year, from the 15th to the 20th century.

This research analyzed the reason of long time usage of the Diagonal Scale and found there were different features between Diagonal Scales used in Astronomical Instruments and used in Electrical instruments. Former application focused on uniform precise scales for angle measurements which stand for star positions and later application focused on not only linear but also non-linear scales which stand for Electrical Value Indications.

Furthermore, from the study of the Analog/Digital conversion techniques applied for Electrical Measuring Instruments and it proved out that the technology of precise reading the value less than one bit resolution of Digital Conversion was developed looks like the similar method of the Diagonal Scale applied for Analog Instruments. It is expected that competition between Analog and Digital high resolution readings lasts forever.

ON THE EVOLUTION AND ITS IMPACT OF THE METROLOGICAL UNITS OF TRADITIONAL CHINESE MEDICINE IN ANCIENT CHINA

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From the metrological unit system including both the units of measuring and weighing and the traditional Chinese medicine special-purpose units to the system in which the units of weighing are primary, the units of Traditional Chinese Medicine in ancient China evolved. Because the metrological units of Traditional Chinese Medicine is relating to the drug efficacy of the traditional Chinese medicine formula, in ancient China, the development of the Traditional Chinese Medicine depended much on the improvement of the metrological units of Traditional Chinese Medicine. It is a must to converse the value of the metrological units of Traditional Chinese Medicine when use the ancient medical prescription for reference.

ON THE METROLOGICAL LEGAL SYSTEM IN QIN DYNASTY: THE INITIAL FORMATION TIMES OF ANCIENT CHINESE METROLOGICAL LEGAL SYSTEM

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This article analyzed the origin and the causes of the metrological legal system in Qin Dynasty, discussed the form of the metrological legal system in Qin Dynasty and expounded the specific content of the metrological legal system in Qin Dynasty on three aspects: the legal system of metrological units , the legal system of metrological instruments and the metrological legal liability. Finally, it discussed the impact of the metrological legal system in Qin dynasty on the later generations.

THE PORTUGUESE *MARCO* – THE FIRST MEASUREMENT STANDARD TRAVELLING AROUND THE WORLD

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The universal acceptance and use of a single system of units of measurement still is today in the XXI century something difficult to foreseen in a next future. After the celebration of the Metre Convention in 1875, Anglo-Saxon units, the large decimal multiples and two different ways of writing decimal numbers still consist in the three major obstacles to achieve that goal. But this effort to use a unique language in metrology already made a long way since the very beginning.

Up to the XV century the measuring standards had a local or limited regional application and acceptance. It was the Portuguese saga of the Discoveries that made a first effort to change this panorama. Two major strategic decisions contributed for this achievement: the decision on the adoption of a national standard for the weight and the decision to go all around the globe to discover new territories, to contact other civilizations and what is relevant for this subject to establish trade agreements with different peoples using weighing instruments and standards.

In fact that first decision to adopt a national standard made by king João II in the provision of 1488, unifying the value of the local standards all over the country became effective in 1499 when king Manuel I ordered the manufacture of the national standard for the *marco* and the manufactures of copies distributed to each county and in all the trading applications. This decision had been taken several times before by other previous kings but without success, mainly due to the local power of the nobles, the bishops and other masters, interested in cheating weights and measures for a bigger income from the taxes and rents collected.

The second strategic decision was a royal national mission, taken by successive kings and adopted with enthusiasm by the Portuguese, to leave their small and poor territory and go all over the world spreading their faith and establishing commercial and cultural relations. It is now almost admitted by all, after documented research work that America, Australia, Japan and other continents, territories and nations were firstly touched by the Portuguese. There are descriptions of these travels and the relations then established with other peoples that are the best evidence of this mission and in some cases describe the differences found in other local measurement standards.

In the recent discover of a large Portuguese vessel shrunk in the first part of XVI century at the shore of Namibia, a copy of the national standard of king Manuel I was found intact. This is the best proof one could present of those national commitments. The fleet vessels were provided with a sample of these standards to be used all over the trading acts whatever their destiny and purposes were. A description and photos of this copy are presented and the results of comparison with the 1499 national standard values, which original masterpiece is kept today in the Metrology Museum of IPQ.

THE MEASUREMENT OF THE STANDARD TIME IN THE REPUBLIC OF CHINA

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In the Republic of China, the standard times pass successively from apparent solar time to mean solar time, from local time to Coast time, from Coast Time to five time zones . In this paper, the author analyses a lot of materials, gives a clear picture of changes about these standard times, and affirm that the Nanjing government not only divided entire country into five time zones in 1939, but also simultaneously decided “in the Sino-Japanese War period, the nation all temporarily used for one kind of time that taken the Gansu Suchuan time zone as the standard”. The author pointed out historical fact that Japan once force our country Northeast three provinces used the east longitude 135°as standard time which the Japan used during Japan invading our country Northeast three provinces in 1937.

HISTORICAL REVIEW ON PRE-METRIC METROLOGY IN THE NETHERLANDS

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This paper presents a historical review in the field of metrology with special emphasis on the vestige of the pre-metric length units in the Netherlands. In 2008, the author had investigated collections and materials illustrative of the historical metrology in the Netherlands and England at the Museum Boerhaave (Leiden), the Technical Museum (Delft), and the Science Museum (London). This inspection was aimed particularly at a vestige of pre-metric length units in European world around the Netherlands. The Netherlands were the first country which had legally adopted the metric system, earlier even than France, its country of origin. This paper makes the causes of the adoption of the metric system quite obvious.

Though the introduction of the metric system went relatively smoothly in the Netherlands, it is not to say that there were not any difficulties. In order to understand the circumstances under which the Netherlands overcame many difficulties, it may be useful to remember the historical background around the 17-th and 18-th centuries in European world.

In the 18-th century Europe, there existed a great diversity and confusion of weights and measures. Not only did the units differ in name and value in different countries, but they also frequently differed either in name or in value, in different parts of one of and the same country. In the Netherlands, various suggestions were made by remarkable scientists to eliminate the existing confusion by a simplified unified system. None of these suggestions bore fruit until the French Revolution in 1789. It is for a great part due to three wise scientists that the introduction of the metric system was vigorously promoted: Simon Stevin (1548/49 ~ 1620), Christiaan Huygens (1629 ~ 1695), and Jean Henri van Swinden (1746 ~ 1823).

In connection with the historical review in the Netherlands, a few words may be added about the development of the metric system in France. The existence of the French around the 18-th century was made miserable by differently named measures and untold units of the same name but different sizes. This target of the French Revolution was directed against the foggy and feudal metrology of the Ancien Regime.

The search for suitable and reproducible units of length has gone on for many millennia. Typically three types of approaches can be recognized: dimensions of parts of the human body, dimensions of the botanical plants and seeds, and dimensions of the Earth. By 1789 the French had made three measurements of arcs along the meridian passing through Paris. In the summer of 1792, Mechain set out for Spain and Delambre started north to measure the distance from Dunkirk to Barcelona by triangles based on the meridians already determined. The Academy determined the length unit to be one ten-millionth of the distance from pole to equator, since one year ago (1791). It was beyond comprehension.

The seconds pendulum had been proposed as a length-standard for over a century. The committee supported the pendulum to be the ultimate arbiter of length. This proposal was rejected by the Academy. Their objections to the pendulum may suggest a hidden agenda. There are a lot of mysteries around the metric system.

Regular Session T37
Controversies and Methodology in the History of Science

LEIBNIZ'S METHOD OF CONCILIATION OF THE OPPOSITES IN A SCIENTIFIC CONTROVERSY

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Leibniz's intensive participation in the scientific, philosophical, theological, juridical, and other controversies of his time has been the focus of much recent research, in the wake of the growing interest in the contribution of controversies to the development of ideas. In this paper we analyze two different ways in which Leibniz attempts to overcome the allegedly irreconcilability between mechanistic and teleological forms of explanation in physics. Unlike his contemporaries who engaged in this controversy and espoused one of the conflicting positions and entirely rejected the other, Leibniz believed that each of them makes useful contributions for the understanding of physical phenomena. Consequently, he undertakes to show how these contributions can be combined ("The best plan would be to join the two ways of thinking", he says), in such a way that its respective benefits can be taken advantage of.

While one of the papers we analyze belongs to a specific physical domain, namely, optics, the other is rather meta-theoretical and to a large extent metaphysical, for it consists in a discussion of the notion of nature itself. In his paper *Unicum Opticae, Catoptricae, et Dioptricae Principium* ('The one and only principle of Optics, Catoptrics and Dioptrics'), Leibniz shows how the law of refraction can be demonstrated through the use either of final causes or of efficient causes. In *De ipsa natura* ('On nature itself'), Leibniz tackles the ongoing debate provoked by Boyle's claim that nature should be understood in purely mechanistic terms. In the former paper, he preserves the integrity of each of the two derivations of the law of refraction, recommending that each be used when it is suitable. In the latter, he undertakes to create a middle way synthesis of the opposites by rejecting, on the one hand, the view that the non-mechanical governs the mechanisms of bodies, while, on the other, arguing for a higher metaphysical source for their origin – "an active created force inherent in things".

We conclude by discussing the possible reasons for the differential treatment of conciliation by Leibniz in the two cases here analyzed. Our suggestion is that underlying the differences observed one can detect a deeper, metaphysical connection between the two strategies of conciliation Leibniz employs, the one consisting in minimalist and the other maximalist – the former focusing on the mere coexistence of the opposites, the other creating the conditions for their union and actual interaction.

METAPHYSICS, PHYSICS, AND METHODOLOGY IN THE VIS VIVA CONTROVERSY

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A long tradition of distinguished writers claimed that the vis viva controversy was a mere dispute of words. This controversy, initiated by Leibniz in 1686, was primarily concerned with two questions. First, how to define and measure the force of a body in motion; and second, which one of the two quantities that the parties to the controversy hold to be the correct measure of that force is conserved in nature. It was thought that the controversy is a mere dispute of words because "force" was not directly accessible but had to be defined by its observable effects, and it was argued and shown by experiments that both rival Cartesian and Leibnizian quantities can be measured as effects of forces.

This line of thought is attributed most prominently to Jean d'Alembert, who is conceived by many to be the resolver of the dispute. Equipped with an uncompromising positivistic approach, d'Alembert sought to exclude obscure or metaphysical concepts from mechanics, the notion of force included. If anything, the word "force" can be taken to refer to the observable effects of the putative entity which presumably caused them. Now both the Cartesian and the Leibnizian quantities are in fact measurable effects. Moreover, they can be reduced to Newtonian terms: the former is the product of the Newtonian force and the period of time of its application, the latter is the product of the Newtonian force and the distance through which it was effective. Hence, d'Alembert concluded, arguments with regard to measures of force are useless in mechanics.

D'Alembert's denunciation of the controversy in his *Treatise on Dynamics* of 1743 was held by historians of science to have persuaded his contemporaries of its futility and to effectively put an end to it. I would like to argue, that this line of thought cannot solve *Leibniz's* problem. For Leibniz had already argued, half a century before D'Alembert's solution, that when investigated quantitatively indeed both forces turn out to be true and legitimate. But it was precisely the metaphysical consideration, which D'Alembert wished to bypass, that Leibniz had been seeking to bring to the fore, in order to determine which force should be given priority over the other. Indeed, Leibniz could have spared his contemporaries and successors much of the ado, had he publicly emphasized the genuine nature of his problem, as he did in some of his unpublished papers.

HUME'S EXPERIMENTAL METHOD

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The subtitle of Hume's *Treatise on Human Nature* announces the introduction of the experimental method into moral subjects. However, it is not *prima facie* clear what this experimental method could be. Thus there can be, and indeed is, a suspicion that by claiming to follow this method Hume plays only marketing tricks: he pretends to fit into a respected and successful tradition of research thereby trying to increase the authority of the arguments he presents.

Now I would like to argue that it is possible to make substantial sense of Hume's explicit commitment to the experimental method, and find a place for him in the context of a controversy between mechanical experimental philosophy and Enlightenment vitalism. I shall argue that Hume's experimental method runs parallel with the one advertised in Newton's *Opticks,* which Hume was certainly acquainted with. Due to Newton's famous aethereal speculations, this work has a reputation of initiating experimental study of "imponderable fluids" (e.g. heat, magnetism, electricity) that could not be studied within the mechanical tradition. This line of research, which flourished in eighteenth-century Scotland, fit into a more general trend of Enlightenment vitalism that denounced mathematical-mechanical schemes of explanation and returned to historical (Baconian) study that was thought to be suitable to nature's complexities.

Hume's project fits into this tradition. On the one hand, some of his arguments can be seen as challenging the epistemological and metaphysical presuppositions of the mechanical tradition, including some of Newton's central concepts. On the other hand and more importantly for the present case, his experimental method leads to a qualitative account of human nature that portrays the human being as an internally driven dynamic complex of functional subsystems. Exploring their balanced interaction is the central task of a Humean science of human nature. The resulting image of man can be contrasted with alternative mechanical accounts, like that of e.g. La Mettrie, and can be seen on par with eighteenth-century attempts at re-vitalizing nature.

METHODOLOGY AS AN ARGUMENTATIVE TOOL IN DEBATES AROUND NEWTON'S THEORY OF LIGHT AND COLOURS

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The paper focuses on the optical debate that followed Isaac Newton's publication of his „New Theory of Light and Colours" in 1672. This was one of the first major public debates in the newly established form of publication, the scientific journal. During this exchange of letters in the 1670s, many of Newton's pronouncements on scientific methodology show marked changes. Do these changes testify to changes of position? Are these signs of Newton's methodological development? And are these developments due to the development of Newton's scientific views, his rhetorical techniques, or to the critique of the antagonists? To what extent do these changes have argumentative functions in the debates, or are they to be taken at face value? I aim to explore such questions via the analysis of Newton's debate with Robert Hooke and the Liège Jesuit community, especially with Anthony Lucas. This debate has recently been re-evaluated by well-known historians (Shapiro and Schaffer), but with radically different conclusions. In the paper I critically investigate these rival readings and argue for the adoption of a fine-grained method of analysis of the discursive practices of the discussants that allows for the 'radical contextualisation' of philosophical and methodological notions articulated during scientific controversies.

Investigating how methodological norms are influenced by the textual fabric of debates can show how an analysis of scientific controversies can move away from treating positions in an abstract space of ideas and how the analyst can find contextual cues in the argumentative discourse. Via this 'radical contextualisation', methodological norms can be seen and interpreted as responding to the argumentative context (especially if inconsistencies in the use of norms can be found). The paper focuses on well-known issues: Newton's conception of crucial experiments, his coupling and/or decoupling of his theory of light and his anti-modificationist theory of colours, and his views on demonstrative knowledge.

I will argue that there are strong reasons to believe that Newton adopted a specific philosophical and methodological stance in reaction to and as a result of the attacks made by his critiques. If tenable, this reading not only throws light on the functional role of methodological views in scientific controversies, but utilises a model where intellectual credit in a controversy is distributed and where the analysis of the argumentative moves of actors enables us to evaluate the moves made by the participants. The conclusions aim to enrich both the historiography of the specific period and debate, help to re-evaluate the critics of Newton and further the theoretical frameworks used for the study of scientific controversies.

CONTROVERSY STUDIES: ANOTHER FIELD OF SCIENTIFIC META-EXPERTISE?

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A number of partly distinct, partly interwoven disciplines – such as history of science, philosophy of science, social studies of science – function as cognitive enterprises conducting inquiry into the nature of the most distinguished cognitive enterprise of our culture: science. These fields have become institutionalized scholarly frameworks of what is currently referred to as 'meta-expertise', i.e. the knowledge and experience of those things that are needed to successfully cope and navigate in the world of epistemic experts. Various representatives of these academic fields emphasize the role of arguments: that there are argumentative and dialectical forms or performances which substantially affect the epistemic quality of expert claims, and that explicit familiarity with these factors lends operative tools to both professional meta-experts like historians of science and members of the informed public. In short, argumentation studies and controversy studies might contribute to our meta-expertise of assessing expert opinions.

However, each discipline have different perception of the argumentative dimension of scientific activity. For philosophers, arguments are quasi-logical arrangements of propositions that provide reasons for accepting or rejecting claims; for historians, they are concrete textual entities in which the actor's intellectual potential is embodied; for sociologists, they are rhetorical vehicles transmitting interest and power. Moreover, different traditions in argumentation analysis may also disagree in their basic conceptions and orientations: controversy studies, more closely linked with the social and historical studies of science, are focused on the descriptive enterprise of examining the specific technical and cultural effects of argumentative performances, while argumentation studies, such as the pragma-dialectical approach, often explicate normative intentions to identify and prescribe context-transcendent argumentative forms of rational discourse. Conceptions of what it means to be an expert on arguments and controversies, and, therefore, how such an expertise may facilitate deeper insight into the workings of expert culture, largely depend on how arguments are approached.

The paper investigates the promises and potentials that different trends and traditions in argumentation and controversy studies can offer to the study of expertise in general, and scientific meta-expertise (i.e. professional disciplines examining science) in particular. While a sufficiently detailed comparative study of the relevant disciplines exceeds the scope of this paper, some basic distinctions may shed light on both the potentials and the limits inherent in such a meta-approach to expertise.

Regular Session T38
Scientific Controversies

THE DISPUTE ABOUT CULTURE(S). CONTROVERSIES IN THE SOCIAL AND CULTURAL SCIENCES AND WHAT WE CAN LEARN FROM THEM

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The western world likes to attribute to itself the ideal of the "civil society", whose central institutions are the market, the forum (for the institutions of the political public) and the stage (for the locations of the cultural public). And it is on the basis of these institutions that the promotion of the idea of the free individual in free interaction takes place. However, when "migrants" or the life of people in other continents are concerned, they are fast turned into "foreigners" or even "enemies" of civil society. The parallel on the political level is that in our globalized world the fight over life chances and distribution of resources is increasingly carried out as ideological "fight of cultures".

In this context social and cultural scientific discourses play a double role. Instead of fulfilling the role of critical enlightment for a critical public, they often reinforce the so-called cultural fronts and barriers by means of binary codings, such as "East-West", "Ours- Alien" and in general by means of an essentialist culturalism.

A critical reflection about the assumptions and circumstances of discourses of this kind may have a clarifying and democratizing function. It can also show that the cultural point of view may serve as a fertile starting point for investigations of a theory of science. This conclusion will be demonstrated by means of three exemplary controversies: the cultural and social-anthropological controversies between Ernst Gellner and Clifford Geertz under the motto "The Limits of Pluralism"; the dispute between Marshall Sahlins and Gananath Obeyesekere over the details of Captain James Cook´s death in the Hawaiian Islands; and finally, the fight over an "Asiatic" Homer that has been initiated by the philologist and author Raoul Schrott.

SCIENCE BETWEEN EMANCIPATION AND ADAPTATION

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Using the example of the University of Vienna, this paper shows how an institution originally sponsored by the Pope and financed by secular leaders rapidly emancipated itself to join the intellectual avant-garde. The students, doctors and professors who taught and learned at the university rejected the monopoly on truth claimed by the Pope and the Catholic Church, as well as scientific restrictions placed by secular leaders.

Humanism, counter-reformation enlightenment and liberalism were developmental steps toward the constitutional guarantee of freedom in science and in teaching. This process was not, however, linear. It was continually beset by backlash and political repression, obstacles which still – in other, economic forms – threaten to return in the twenty-first century.

INTUITION VERSUS SCIENCE: THE LIMITS OF REASON IN A WORLD OF EMOTIONS

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I shall start with a reconsideration of how science in a "very broad sense" works. Then I shall show "how" we try to grasp some of (the) ***Intuitions*** underlying successful problem solutions with the help of so called scientific methods. The aims seem to be (sarcastically) formulated that one wants to reproduce acceptable solutions/results in a controlled manner "without caring" about necessary changes in the background knowledge of the user of certain scientific methods.

Emotions as "reflective" means of correcting blind (cold) reasoning should help to establish a feeling for the limits of the application of pure scientific approaches in the sense that "Intuition without reflection can be blind" but on the other hand "reflection without intuition will most definitely be empty" (rephrasing Kant). In trying to understand the success of "Intuition" we will find that the rigid application of rules with no enrichment or change of background knowledge (improving the epistemic resolution level of the concepts of users) will not work in the long run. "Success" (in general) does not depend on stubbornly/mechanically applying rules but on understanding the limits of application and evaluation both of results as well as the methods leading to results. Thus we have to become aware again of the limits of reason in a world of emotions if we want to survive in a world of change.

PSYCHOLOGICAL OR PHYSIOLOGICAL: WHICH SUIT SHOULD WE WEAR?

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From the very beginnings of psychology as a science the relations between the psychological and the physical approaches have been unclear. Psychology started as a discipline focused on « psychological » processes but the physiological aspects were lurking behind, both in regard to the purely experimental domain as well as the clinical domain. In the course of time the issue of psychology versus physiology got different forms and underwent different transformations, ranging from weak science versus hard science, through fantasy versus hard facts to mind versus body. In parallel, there were also various attempts at solutions, which included the famed reductionism (i.e., all is physiology) as well a models of interactionism, parallelism and others. The problem and so also the controversy became even more intense in recent years with the exceptional developments in physiology (e.g., genetics, brain processes).

The talk will present the problem, describe some of the transformations it has undergone and discuss major solutions offered to it, especially in recent years.

The good news is that the problem has survived all its vicissitudes ; the bad news is that up to now no solution has been forged that is positive from the point of view of the advancement of science.

THERAPY ACCORDING TO DIAGNOSIS OR VICE VERSA?

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Medical systems are constructed in certain cultures at certain times on the basis of the predominant worldview, concept of a person, epistemology, and philosophy of science. In present-day Western biomedicine this is often overlooked. Its methods of gaining knowledge, the consultation procedures, and modes of treatment are regarded as being right for the whole mankind, and everything that is different is seen as undeveloped, irrational, magic, or simply false.

With examples of traditional healing in Nepal it will be shown that even basic assumptions about the functioning of medical systems are culture dependent. Even diagnoses are no necessary premises for therapeutic actions. This also means that symptoms are not always of primary importance and, furthermore, that diagnostic categories are neither seen as communication system for specialists nor as explanatory statements for clients. Rather, a diagnosis is used to motivate the relationship partners of the patient to take part in the healing sessions, provide required resources, and help to create a new environment for the patient.

SCIENCE OR PSEUDOSCIENCE: THE STRANGE CASE OF PARAPSYCHOLOGY

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Since the establishment of parapsychology at the end of the 19th century a vehement dispute has emerged in regard to considering parapsychology as a scientific discipline or as pseudoscience. After presenting a short history of parapsychology some aspects of the controversy about its status as science will be outlined. Arguments for and against parapsychology as they are discussed in scientific papers will be analysed. It will be shown that on the surface level the controversy seems to be totally rational manifesting a great number of difficulties which render a solution almost impossible.

From a deeper level point of view focusing on the psychodynamics underlying the controversy, affective variables seem to be involved too. In the course of making the implicit affective side explicit an alternative view concerning the status of parapsychology will be developed and discussed. It is argued that considering the underlying affective layers provides the chance for more open-minded discussions and fruitful future directions.

MILLER'S EXPERIMENTS: A RELATIVISTIC CONTROVERSY

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Between 1902 and 1926, Dayton C. Miller (1866-1941) made several ether-drift experiments similar to the more famous 1887 Michelson-Morley one. Miller's results, on the contrary of Michelson-Morley's ones, showed a periodic second-order effect that he interpreted as a proof of the absolute motion of the Earth. Since the fringes shift he measured corresponded to a velocity of the Earth lower than the one expected in a fixed-ether theory, he argued the existence of an ether entrained by the Earth. In 1925, Einstein himself wrote in a letter to Edwin Slosson: "Should the positive result be confirmed, the special theory of relativity and with it the general theory of relativity in its current form would be invalidate […]".

Miller's data were explained in the context of the relativistic research program only in 1955 by Shankland, McCukey, Leone and Kuerti.

My study has the aim to broaden the understanding of what happened between 1925 and 1955:

1) Knowledge and interpretation of Miller's data inside the international physics community;

2) Why Miller's experiments didn't become *experimenta crucis* against Einstein theories.

The themes I am willing to analyze are important in developing the history of relativity and for their raising interesting epistemological questions about the theory-experiments relationship.

ENERGY CONTROVERSY

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Energy is a unifying concept that spans all the sciences, and is of fundamental importance in issues of social concern such as the environment and the use of fuel resources. Energy is well-known concept. Everybody has an understanding, and the majority has a well-defined, contradiction free concept. As a physicist, I had a very clear notion, too, but the interdisciplinary work on the relation of economics and thermodynamics lead to the realisation, that the energy concept of economists is different. A systematic survey leads to the result that there are at least six different categories of the energy [1]. All these energy concepts have some relations (historical or factual) with each other, but from scientific point of view, they are different concepts – and the common name causes serious difficulties. The problem of the different connotations was already mentioned in 1914 by a Hungarian writer [2]. Ferenc Móra wrote a short article in a newspaper about Robert Mayer, with a sound introduction of the First Law of Thermodynamics, but he stated the grave conceptual problem as: "If I say now that I do not believe in the conservation of energy than the Professors of Physics will say that he is asinine, as he is a layman. If I say that I do believe in the conservation of energy than the Reader of this Journal will say that He is asinine, as he is a scientist."

We propose a scheme for the classification of the different concepts – all bearing the name energy. There are at least six distinct concepts to be distinguished. Three of them are scientific concepts to be differentiated. The physical (conserved) energy belongs to the realm of the first law, the energy as the ability to perform (physical, chemical) work belongs to the second law, while the third the economic (biological) capacity for actions belongs to the (Darwinian Law).

The first three groups are the non-natural scientific notions of energy, namely:

E1) *Energy The Colloquial*
E2) *Metaphysical Energy - Energy As Archetype*
E3) *Pseudoscientific Energy*

The scientific energy concepts are, as follows:

E4) *Conserved Energy*
E5 *Energy As A Capacity To Perform Work*
E6 *Useful energy – biology and economics*

References

[1] Martinás, K., Energy In Physics And In Economy, Iterdisciplinary Description Of Complex Systems 3(2), 44-58, 2005
[2] Móra, F.: The conservation of energy.(In Hungarian) Szegedi Napló, 1914, junius.

CONTROVERSIES IN THERMODYNAMICS

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Thermodynamics is a very particular discipline. Its peculiarity consists in the fact, that in some very important respects it is similar to a usual scientific discipline but, unlike other branches of science, it is a collection of several rival, often opposing, coexistent trends. These trends may differ from each other so radically - in their conceptual structure, methodology, etc. - that it is not very easy to find the common content of them. Fifteen - twenty trends can be distinguished.

There are very big differences among trends in their mathematico-logical structure. As László Tisza mentioned in a discussion it is not too correct to say that "thermodynamics is" (in singular) because of the lack of a universally accepted and observed logical structure. The methodological diversity of thermodynamic trends is also a very common experience of physicists.

So the unity of trends within thermodynamics is, from an epistemological point of view, completely unavailable. On the basis of a classical positivist philosophy of science one has to accept only one of these trends as real science and has to reject the other twenty odd trends as non-scientific approaches to the problem. Usually this is what happens. But, how can one choose, and select the right trend?

We have neither experimental evidences nor strict logical rules or prescriptions, so it seems to be a matter of tastes, interests, and purposes. That is to say, in this situation the influence of ideologies, philosophies, and world views becomes significant because these are nothing else then rationalisations of our "non-scientific" determinants, i.e. interests, purposes, values and aspirations. It is very natural that in this way the possibility of sharp debates and struggles between the different trends appears; thermodynamicists do indeed that, they are constantly debating and struggling against each other.

How could we understand this very peculiar situation? What are the causes of these continuous quarrels about the concepts, the methodology and structure of thermodynamics?

It can be shown that the world view of thermodynamics describes the world of the Many, which is similar to a postmodern world. The world view of a society in crisis is very similar to that. In this way thermodynamics is a science in crisis and a science of crisis, moreover thermodynamics expresses the world view of social crises on the language of physics. The quarrels and controversies among the representatives of different trends in thermodynamics comes from this crisis situation. If we take a glance at the history of our subject we can get an impression of the validity or limitedness of these ideas. For this purpose a short outline of the history of thermodynamics will be presented.

Regular Session T39
History of Cognitive Science

INTERDISCIPLINARY ISSUES IN EARLY CYBERNETICS

Leone Montagnini

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The relations between Early Cybernetics and Cognitive Science represent an interesting historiographic topic. In any case in this paper I assume provisionally that the former can be considered one of the most significant pre-historical root of the latest (see for an analogue stance the Dupuy's book *Aux origines des sciences cognitives*, focused on the Macy Conferences on Cybernetics). On the contrary this paper focuses on the role played by interdisciplinarity in Early Cybernetics. It will start considering the many aspects regarding relations among disciplines in Norbert Wiener's intellectual itinerary, until the cybernetics of the postwar period.

In Wiener's intellectual itinerary (regarding this itinerary, see the Montagnini's book *Le Armonie del Disordine*) one can point out various issues concerning relations among disciplines: humanities and sciences *strictu sensu* (Wiener received a Ph.D. in philosophy, and worked as a mathematician), between pure and applied sciences (he collaborated with engineers for over 40 years), between social and human science and "hard" sciences; the importance of a social context in which putting together scientists from different disciplines was more normal than elsewhere (from the Royce's seminars on scientific method of 1911-13 up to the postwar Macy conferences), etc.

During the 1930's Wiener and the physiologist Rosenblueth elaborated an interdisciplinary epistemology that I would call the "Oregon epistemology". They thought that in science existed "no-man's lands" colonized by different disciplines, in which happened something similar to "what occurred when the Oregon country was being invaded simultaneously by the United States settlers, the British, the Mexicans, and the Russians - an inextricable tangle of exploration, nomenclature, and laws". Therefore "important work has been triplicated or quadruplicated; while still other important work is delayed by the unavailability in one field of results that may have already become classical in the next field" (Wiener, *Cybernetics,* "Introduction"). Wiener in particular had personally experienced that "hybridization" in scientific fields is very productive, and the successes of his strategy are irrefutable. The same early steps of cybernetics - from Wiener(-Kolmogoroff)'s prediction theory to the creation of von Neumann's computer - were the result of these kind of "hybridization". But, actually, "Oregon epistemology" contains a fallacy as well, and the metaphor itself helps us to understand it. In fact, in a way, Oregon was not the same land for British, Mexicans or Russians, and this constructivist opinion can explain the deep difficulties of communication that the "cyberneticians" met very precociously and already during the Macy Conferences. Difficulties stemming from different way of thinking that the participants had inherited from their different disciplines (or - in some case - from a different approach to the same discipline). Therefore while all of them used to speak using the same worlds (e.g. "feedback", "energy") they put them in different mental frames. Interdisciplinarity is not a luxury. We need it. But it entails a really steep training to construct common languages.

ON THE CRITERION FOR DECIDING WHETHER MACHINES CAN THINK

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The question whether a machine is able to think might be thought to be decidable by looking whether a computer can pass a test. The test, that later got the name after the person who suggested it, Alan Turing, was to examine whether human beings interacting with computers are able to distinguish them from their own kind. The idea behind this test was that thoughts could be attributed to an object if what the object expresses is interpreted as thoughts. A variety of philosophers have criticized the significance of this test, among them Searle, Fodor, Boden.

Davidson's assessment of this criterion of ascribing thoughts seems to me to be the most interesting one. His view of Turing's Test is, but, ambiguous: on the one hand Davidson follows well-known criticisms of this test and argues that it "is inadequate because it deprives the human interrogator […] of knowledge he must have to decide what the object thinks and means." On the other hand he credits Turing for „taking as the only test for the presence of thought and meaning the interpretative powers and abilities of a human interpreter." (Davidson: Turing's Test. 1990).

In my talk I want to explore the second aspect of Davidson's assessment. For Davidson thoughts can be attributed to an object only on the basis of a triangular structure, which requires at least two interacting creatures and a set of common objects in the world. Following this requirement, a digital computer could only be said to think if it adopted the role of a creature taking part in the process of interpretation. In my talk I therefore want to discuss Davidson's alternative suggestions for a modified test for deciding whether a machine can think. I am going to present two versions of the triangular: 1) the „interpretative version" with the digital computer as an „interpreter" and 2) the „epistemological version" with the digital computer as an object, which has thought. I want to argue that the step toward interpretation is a crucial one. Davidson's version does not only show why Turing's Test is inadequate to answer the questions raised at the outset, but shows, too, what would be required to maintain adequately that „a machine thinks".

HISTORY OF HUMANOID ROBOTS

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The history of humanoid robots goes back to 1497 as Leonardo da Vinci designed a mechanical armored knight robot on paper aiming to move like as if there was a real person inside.

As can be seen from the ancient manuscripts, the history of human passion testifies the desire for autonomous machines that could look and behave like human and could apply human skills for specific tasks. The very first example of such a human-like autonomous machine that is implemented and achieved to walk is the "Steam Man" (George Moore, 1893).

Although the biped robot studies had been started more than 500 years ago, it had been speeded up and achieved maturity only in the past thirty years. During the development phases in the last 500 years, the studies were limited to the parts of the overall system due to the complexity of the robotic implementation of human. The research of the entire system became feasible only with the development of high performance computers. However, the complete modeling and enhanced performance implementation of the human cognitive behaviour is still stays as a goal to achieve in the future. Despite the fact that there have been thousands of examples produced which achieved to walk and realized limited cognitive tasks, the practical use of the models up to now is limited to the education, entertainment.

This paper aims to give the detailed historical development process of humanoid robots and critical analysis of current state of achivements, mainly in terms of cognitive implementations.

ANTHROPOMORPHISM AS A DEMARCATION CRITERION IN THE HISTORY OF THE HUNGARIAN COGNITIVE DOG-ETHOLOGY

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My presentation is based on my PhD research. From 2005 to 2007 I spent three years at the Department of Ethology at Eotvos University, Budapest to observe from a sociological point of view how ethologists worked on dogs.

One of the most controversial territories of ethology is cognitive ethology that is the study of animal-mind. First of all it questions the human superiority comparing to animals when animals are attributed with such cognitive abilities as feeling, or the ability of thinking. The group I was observing - the Comparative Ethology Research Group, HAS - observes dogs, which are the less accepted research objects even in cognitive ethology.

The so called 'problem of demarcation', that is the distinction between science and non-science is not only a philosophical problem but it has very practical consequences too for the scientists themselves - as sociologists pointed out: it determines who can get social and financial supports, resources that are essential for a scientific research.

Anthropomorphism in ethology (the phenomenon of attributing human characteristics, human nature to animals, such as human types of feeling) is one of the most important issues of demarcation debates. Anthropomorphism is our natural inclination, so we often anthropomorphize the objects around us. Even at the shaping of ethology the very first thing the researchers refused was anthropomorphism. However anthropomorphism still plays an important role in cognitive ethological researches.

In my presentation I shall sum up the different types and levels of anthropomorphism appearing in ethology starting with its mildest form, when animals are given a name to its most interesting form when it determines researches. Through a case study I shall show how tradition can overwrite science.

PREHISTORY OF COGNITIVE SCIENCE

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A great deal of cognitive work was done during what some call the prehistory of cognitive science, roughly the period prior to 1900. Some leading figures include Aristotle, Hobbes, Descartes, Hume, Kant, Darwin, Wundt, Frege, Freud, and James. We recently published a volume of specially-commissioned essays, one on each figure, called *The History of Cognitive Science* (A. Brook, ed., Palgrave Macmillan 2007). Noam Chomsky, Marcelo Dascal, Stellan Olhsson, Andrew Brook, Patricia Kitcher and five others contributed essays. All contributors are active cognitive researchers in their own right and assessed their historical figure through the lens of their own work. For the ESHHS session on the history of cognitive science, I will give an overview of the project and of the contributions made during the prehistory and discuss the ongoing influence of this work in contemporary cognitive science.

BEHAVIOURISM AND COGNITIVISM

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The origin of the research project „cognitive sciences“ was the aim to provide a description of cognitive capacities. This goal was explicitly meant to stand in strict opposition to behaviouristic accounts of human behaviour that sought to avoid to appeal to elements of “the old faculty theory” in order to explain thought, action, and language.

But as it has been criticized often in the last two decades the result of this move inwards to “the mental” as a condition for explaining human behaviour was not judged to be fruitful one: the “cognitive sciences” did not succeed in presenting a theory of cognition in which the thinking subject is able to understand itself as being related to the external world by its actions, thoughts, or utterances. The assessment of the significance of the interdisciplinary project of “cognitive sciences” is therefore not entirely positive and discussions about the possible reason for the partly failure still dominate the philosophical literature (H. Putnam, J. Searle, R. Cummins, D. Chalmers, T. Nagel, J. Campbell).

I want to show, following M. Boden, H. Putnam, J. Searle, that this negative result is the consequence of viewing cognition as a mechanism that processes uninterpreted data as “inputs” into “outputs” that are to be described in an intentional vocabulary. In distinction to the named authors, though, I want to suggest that the answer to the question why this model of cognition was put forward is not so much explainable by adopting an uncritical mechanical picture of the mind, but is due to considerations concerning the conditions under which investigations of the mind are to be carried out. Why these conditions conflict with the aim of cognitive sciences and that having chosen them expresses that the criticism of behaviourism was ultimately not “deep” enough will constitute the final part of my talk.

FROM TODAY’S CRISIS IN COGNITIVE SCIENCE TO YESTERDAY’S CRISIS IN PSYCHOLOGY

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The current generation of cognitive scientists face a growing conceptual problem of navigating the by now highly diverse field of (the) cognitive science(s). There is very little in the conceptual work done in contemporary philosophy (and history) of cognitive science that prepares one to make sense of the concerns of the increasing number of novel multidisciplinary research programs that have sprung up in the last 15 years.

When the scope is broadened beyond the internal perspectives adopted by cognitive scientists, it quickly becomes clear that many of the core problems that characterize the mainstream as well as the fringes of cognitive science are variants of other problems that have been discussed in related fields for quite some time. A glimpse of a more integrated view on these problems is given critical investigations of the history of psychology, philosophy, and related traditions.

In addition to illuminating the past and present conceptual problems and the positioning of psychology and cognitive science the past offers inspiration for possible solutions of current problems. It is in this context that we present a re-appraisal of Karl Bühler’s open generative framework first spelled out in his *Krise der Psychologie* (1927) and later sketched in a more positive way in a short essay on the future of psychology (1936). While the combined impact of his ideas was huge, they were mainly carried forward by his students and clleagues from various fields (such as Brunswik, Frenkel-Brunswik, Lazarsfeld, Lorenz, Popper, Jakobson...) who picked out specific aspects of his ideas and adapted them to their respective time and region. Bühler's original framework had a wider scope in that it was aimed at organizing and relating the very different research programs practiced in the 1930ies. Bühler was not able to establish a lasting legacy in psychology after he was forced to flee Vienna for the U.S. in 1938. His contribution is still valuable today as inspiration for arriving at a more even-handed analysis of current problems and the motivation behind current trends.

References

Bühler, K. (1927/2000). *Die Krise der Psychologie*. Weilerswist: Velbrück Wissenschaft.
Bühler, K. (1936). *Die Zukunft der Psychologie und die Schule*. Wien, Leipzig: Verlag für Jugend und Volk.

MODELS OF THE MIND THROUGHOUT THE HISTORY OF COGNITIVE SCIENCE

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Throughout the history of cognitive science, research has been guided and shaped by various, and not always compatible, models of the mind. Which model of the mind was most popular at a given time was largely due to which subdiscipline was most successful, or at least most dominant, at that time. From the point of view of the history of science, it is interesting to try to disentangle in exactly what way theoretical thinking about the mind has been shaped by the development of cognitive science from a conglomerate of loosely associated disciplines in the 1950s to the early 1970s into a full-fledged scientific discipline in its own right nowadays.

In the very early days of cognitive science, AI was the dominating discipline, and with it came *computational* approach to cognition, combined with a *representational theory* of the mind. Cognitive processes were understood as *computational processes* over internal states with representational content. Accompanying this classical 'rules and representation' approach to cognition characteristic of GOFAI was what Susan Hurley has called the 'sandwich model of cognition': cognition is that which mediates between input (perception) and output (action). After GOFAI came *connectionism*, and the rise of which as a leading paradigm of cognitive science research was accompanied by the rise of neuroscience as the central discipline: since it was the 'decade of the brain', it was no longer the computer that dominated theorizing about cognition, but the brain. But what remained unchanged was the focus on computations and (subsymbolic, in the case of connectionism) representations that remained central concepts for theorizing about cognition. With the rising dominance of robotics, things changed in the 1990s, especially when Rodney Brooks attacked both the 'rules and representation' approach of classical AI and the 'subsymbolic representation' approach of connectionism and argued that we must seek to understand how real, *physically embodied* agents engage in '*online cognition*', i.e., how they achieve sensorimotor control in real-time interactions with the environments into which they are embedded and which they themselves shape and create with their actions, often in ways that enhances cognitive problem solving by 'offloading' cognitive work onto the body/environment. Being influenced by dynamical systems theory, such approaches tend to be skeptical of the notions of computation and representation without, however, having to offer anything else regarding the nature of the cognitive. In recent years, defenders of the so-called 'Extended Mind Hypothesis' have radicalized the insights of those who argue for an embodied or embedded approach to cognition, suggesting that *external processes* can be part of (the vehicles of) cognitive processes, so that in a quite literal sense cognitive processes extend beyond the boundaries of the brain and the body. Again, however, little is usually said concerning what exactly the nature of cognitive is that would allow it to be extended in this way over processes spanning brain, body, and environment.

Apart from the historic lesson to be learned from this endeavor into the history of cognitive science, there is also a systematic lesson. Accompanying the various different models of the mind was a change in the way cognitive scientists have thought about their proper subject matter – *cognition*, or *cognitive processes* – itself. Strikingly enough, after half a century of cognitive science, there is still no received answer to the question What is Cognition? and part of the reason is that, as I will show, what answer you get still depends upon what discipline the person you've asked comes from.

Having a look at these historical developments helps, I argue, to understand (1.) the various models of the mind that have been suggested in the past; (2.) why the question What is Cognition? is still on the table; and (2.) how to answer it.

THIRTY YEARS COGNITIVE STUDIES OF CATEGORIZATION: WHAT'S BEHIND THE REPORTED PROGRESS

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Although the intellectual roots of the categorization debate could be traced back at least to the times of Plato and Aristotle, the revival of the debate in the field of cognitive science in the 1970s was inspired by the empirical findings of E. Rosch and her collaborators. In the first representative review of the literature on categorization in cognitive science E. Smith and D. Medin [1981] identified as central for the debate the questions how people represent the categories and how they use/process these representations. They also identified three different views providing different answers to these questions: the so-called "classical view", the "probabilistic view(s)", and the "exemplar" view. Respectively, they discussed the available empirical evidence in respect to its contribution to the confirmation/disconfirmation of the alleged rival views.

One might expect that in the following years the research on categorization in cognitive science had been directed to the search for new, more decisive evidence for or against the particular views on categorization, or to the elaboration or synthesis of some of the existing views, or to the search for a completely new theory of categorization. In the latest substantial review of the literature in this area, however, G. Murphy surprisingly made the following important confession: "One might have hoped that twenty years after Smith and Medin's review, the field would have sorted out many of the issues their book raised. However, there is as much, and perhaps more, dissension now as there was then. Focusing on theories, therefore, is not the best way to document the important progress that has been made ... Many interesting principles and generalizations have been discovered", which "have been a real advance" although they have not contributed to the solution of the problems stated as central by Smith in Medin in 1981 [Murphy, 2002; 4]. Murphy's confession raises a lot of interesting questions. One particularly interesting is: if the recognized progress in the study of categorization is not theory-driven, what then has made it possible?

The aim of this paper is to throw light on what is behind the reported progress in the study of categorization for the last 30 years. First, it will be shown that some of the most interesting results of the cognitive studies of categorization have been achieved by following a much broader agenda than the one envisaged in [Smith & Medin, 1981] and centered around the questions how different categories are mentally represented and how people use these mental representations. Second, it will be demonstrated that one of the most fruitful questions belonging to the broader agenda of categorization research has been the question "Why/how people tend to view some groups of objects as naturally detached from other objects or groups of objects?" It was this question that inspired interfield cooperation inside cognitive science and it was this cooperative research that led to the most impressive results.

Smith, E., Medin, D. (1981). *Categories and Concepts*. Cambride, MA: Harvard University Press.
Murphy, G. (2002). *The Big Book of Concepts*. Cambride, MA: The MIT Press.

ANIMAL MEMORY AND THE ORIGINS OF MIND: THE CONCEPTION OF LAJOS KARDOS, A HUNGARIAN COMPARATIVE PSYCHOLOGIST

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Lajos (Ludwig) Kardos (1899-1985) has been both the mentor and the savior of Hungarian experimental psychology acting as chair of psychology at Budapest University between 1947 and 1972. Starting as a student of Karl Bühler he has been well known through his monograph on light constancy phenomena, the role of shadows and brightness constancy in object perception (Kardos, 1934). He was among the first ones among perceptual psychologists to combine the attitudes of careful experimentation with that of courageous mathematical modeling, basically claiming that constancy can be rendered with a mathematical model comparing the light input form a surface with that of the neighborhood (Kardos, 1934).

From the 1950s on under the impact of his American travels he has started to work on animal learning and memory. Through 30 years of experimental studies in maze learning using ingenious techniques he has shown that animal memory is place tied, rats being unable to learn different targets being on the same place if the place was reached by different routes. Rodents have an image-like memory that stores things together with their localizations. He proposed a mnemonic theory slightly different from the cognitive maps of Tolman: Kardos (1988) was claiming that rodents basically are maintaining memory images as vivid as their percepts. He proposed a relationship between spatial orientation, lifestyle and memory system in rodents claiming for memory maps of a more concrete visual nature than the cognitive maps proposed by Tolman (1948). Kardos interpreted rodent memory in the framework of a locomotory ecology contrasted to the more manipulatory way of life of apes and humans. The advent of cognitive psychology was of course welcome by the senior cognitively oriented comparative psychologist.

In his late years partly turning back to the Bühlerian heritage he elaborated an even more general information and guidance related vision of the birth of the mind. In his theory, mental or as he called them, neuropsychological phenomena arise in the animal life when corrolary, adjacent informations about the environment become to be used and detached in a scheme he calls adiaphoric determination become guidance points for animal behavior Kardos, 1980). Mental life gradually evolves as a consequence of using predictive information available in stimulus arrays. This theory has interesting parallels to similar claims proposed by Dretske.

In the paper the importance of Kardos as a mentor for the new cognitive movements in Hungary together with his substantial claims shall be analyzed.

References:

Kardos L.(1934): Ding und Schatten. Leipizig, (1980): The Origins of Neuropsyschological Information. Budapest: Akadémiai, (1988): Az állati emlékezet. ‘Animal memory.’ Budapest. Akadémiai

COGNITIVE SCIENCE BETWEEN BIOLOGY AND THE SOCIAL SCIENCES ABSTRACTION, ISOLATION, RE-OPENING

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In this paper we adopt an *outside perspective* on cognitive science and its history. This includes “taking a step back” and broadening the scope to include (1) other scientific traditions (here we focus on biology and the social sciences) and (2) placing an emphasis on the prehistory as well as current trends and future perspectives (here we focus on the embodied action and situated cognition trends).

The history of psychology before the “cognitive revolution” was instrumental in setting the stage for cognitive science. Fundamental conceps (such as the reflex) and methodologies (the laboratory tradition) were imported from the biological sciences (especially physiology). Subsequent developments inside of psychology have refined these concepts and methods and the connection was blurred and finally broken altogether (which essentially isolated psychological theory and history from further developments in biology). Another feature emphasized by critical historians of psychology is the lack of concern for the social and cultural pecularities implicit in the laboratory setting (Danziger, 1997)?.

During its institutionalization, the scope of classical cognitive science was narrowed considerably in comparison to the wealth of approaches that characterized the period of the cognitive revolution (Dupuy 1999). This was hailed as bestowing the necessary autonomy to the cognitive science enterprise, keeping it separate from the “biological or neurological, on the one hand, and the sociological or cultural, on the other” (Gardner 1985). From a historical perspective, this process only further enshrined the isolation of the (cognitive) psychological conceptual framework.

We propose that the recent trends of embodied action and situated cognition are at their roots attempts to (re-)introduce elements of biological and socio-cultural thinking and practice into cognitive science. For the first time in its history, the implicit positions, concepts, and the model of scientific practice that has been inherent in the field since its import from (neo-behavioristic) psychology, are beginning to be seriously debated. A critical history of cognitive science can thus be instrumental not only for illuminating the past, but also for interpreting and making sense of current challenges and possible future directions in cognitive science.

References

Danziger, K. (1997). *Naming the mind*. London: Sage.

Dupuy, J.-P. (1999). *The Mechanization of the Mind: On the Origins of Cognitive Science*. Princeton: Princeton University Press.

THEN AND NOW: COGNITIVE SCIENCE AND ECONOMICS

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Cognitive science became a key component of interdisciplinary research carried out in the field of economics in the late twentieth century. The goal of these programmes was to increase the explanatory power of economics by providing it with more realist psychological foundations, to gain more insights into the behaviour of socio-economic agents and the mechanisms behind choices, cooperation and competition. Since then, so-called behavioural economics and neuro-economics have been gaining ground. It is seldom forgotten, however that projects carried out in the nineties and new behavioural and psychological trends in economics are heirs of a long tradition that is to be traced back to Nobel laureates such as Friedrich Hayek and Herbert Simon who have made seminal contributions to the then emerging field of cognitive science.

The goal of this paper is to link past and present, trough an overview of the paths opened up by Hayek and Simon, an appraisal of results yield by projects carried out recently and a critical assessment of future prospects for this burgeoning interdisciplinary field of research.

Keywords: cognitive science, economics, interdisciplinarity.

THE RIGHT HEMISPHERE OF COGNITIVE SCIENCE

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The various schools of psychology presented different key metaphors in their interpretation of the mind: their scientific reduction led to various sets of concepts that can be viewed as conceptual-metaphoric mappings of certain relatively plausible concepts (e.g. reflex, cognition) onto a variety of human functioning (e.g. behavior, perception). These plausible concepts also serve as target domains for metaphorical mappings, which ground them into source domains of sensorimotor experiences. Based on these mappings, we can create a metaphorical cortical map, hence identify the neural dispositions of the different schools of psychology.

Classical cognitive science's key metaphors, among others, were computers and the language module itself. The concepts of serial computation, generative grammar, and the modularity (decomposed structures compared to holistic processing) all point towards a left hemispheric perspective in scientific understanding – compared e.g. to gestalt psychology's holistic, and so right hemispheric perspective, or behaviorism's concept of conditioning, reflecting a "subcortical approach".

This shift of perspective enabled researchers for the first time in the history of science, to address questions of *mental phenomena* and still remain within natural science in a strict sense. The tools of the left hemisphere that played a key role in natural science in general (logical reasoning, outward orientation, casual sequences, conscious thinking) could be deployed on a great variety of psychological questions. This step lifted the research of mental life on the rank of a natural science via the tools of cognitive science. These tools, the interest in mental phenomena, and the left-hemispheric, scientific perspective can be suspected behind the interdisciplinary aspect of cognitive science: this umbrella hosted a variety of human sciences under methodological consensus.

On the other hand, from a historical perspective, cca. two decades later a need arose to address the "silent part" of the mental world, the emotional, hazy and less understood right-hemisphere. Cognitive science turned towards other metaphors, like parallel distributed processing of connectionism, where attention shifted from the series of (grammatical) rules of programming to an architecture of elements with hidden layers, or the study of implicit processes (as opposed to explicit, verbal knowledge), and in cognitive linguistics towards metaphor itself, which also seems to involve right hemispherical processing.

Although cognitive science still experiences some trouble with such "soft" themes as emotion, empathy, intuition or creativity (of the right hemisphere?) the considerable change in its perspective might reflect the need to address the "hidden" (non-verbal, non-conscious, or even non-cognitive?) regions of the human mind. It is up to research to decide whether this effort turns into progress, or the cognitive approach, or even natural science can or should not address such issues.

Regular Session T40
Pioneering Ideas and Methods in the History of Earth Sciences

ANALYTICAL METHOD OF MINERAL WATERS DEVELOPED BY KÁROLY THAN CHEMIST (1834-1908)

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In the XIXth century in the period of important scientific and technical discoveries an eminent chemist Károly Than played a very important role in the analytical chemistry. Mr. Than was born in the year 1834 in Óbecse (today Serbia). In the early years of his career he worked as a pharmacist assistant then in Vienna he was student in the Faculty of Arts. He made his doctor's degree from chemistry in 1858. He studied chemistry in Heidelberg at Professor Bunsen then he habilitated in Vienna as academic private professor. From the year 1860 in the Pest University he was extraordinary then ordinary professor in the Faculty of Chemistry. In the same year he was corresponding member and later full member of the Hungarian Academy of Science.

Károly Than made his important contribution to almost all kind of Chemistry. Numerous excellent and even today up to date and actual analytical methods was developed by himself but probably the most important of them is: "Construction of Chemical Analysis of Mineral Waters." This was presented on the meeting of the "Hungarian Doctors and Investigators of Nature" in 1864 in Marosvásárhely. This work was printed in the year 1865. He suggested a new method for the "real characteristics" of mineral waters to express not only the chemical concentration (expressed in mg component/1000 g samples) but the relative valency values as well.

According to him two important aims should be reached at the analysis: the components of the different mineral waters should be comparative to each other and the real components should be traceable as well. His excellent method was used parallel by the analytical chemists for a long period even by himself since 1865 when Vilmos Zsigmondy mining engineer made deep drillings for water research. After 1929 three columns are used for the water analysis protocols: the concentration units in mg/L; the equivalent values in meq/L and the equivalence percentage (eq%) units. If the eq% exceeds 20% the character of the water sample can be classified and compared to other water samples.

Károly Than emphasized the importance of the knowledge of the chemical composition of mineral waters for the medical practice. That was obvious for both the drinking and the bath cures since different water types are useful for the treatment of the different diseases.

HISTORY OF THE GEONOMICAL CONCEPT AND THE HUNGARIAN SCOOL OF GEONOMY IN THE SECOND HALF OF XXstCENTURY

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The concept of Geonomy has been highly changed in the history of Earth sciences.

The term of Geonomy appeared in the middle of the XIXst century in the USA as a synthetisizing concept between the geography and the physical geology (to-day tecnonics) for study of the origin of continensts and oceans of the Earth. This firth scool of Geonomy was based by the first edition of James Hall' book Geonomy (1859) (The second edition was edited in 1869). To this scientitific scool belonged J.S. Grimes (Philadelphia), as well, who developed further the geonomical concept in his work (Geonomy: creation of the continents by ocean currents, 1889). In 1884 N. Yak.Grot, a russian natural phílosopher coined the term „geonomy" to designate a geoscience to be born in the XXth century, aming at establisching „lows" concerning the evolution of the Earth.

After a long silence in the middle of the XXst century· the second appearing of the concept of geonomy originated from J.T . Wilson.(1968) who considered it as the integration of earth sciences - in particular structural geology and geophysics- looking for causal interpretation in view of the moving and colliding continents. In the seventies this idea bacame rather popular in the USSR, as well. In (Soviet) Armenia A.T. Aslanian (1974) even proposed to introduce Geonomy as an independent subject of the university curricula of the Earth sciences.

In Hungary this up to date concept had got an exceptional in that time acceptance by Elemér Szádeczky-Kardoss (1903-1985) , academician , professor on Petrology and Geochemistry of the Eötvös Lorand University (Budapest) and the chairman of the department of Earth sciences of the Hungarian Academof Sciences. He began organise the co-oparation of the scientists of the different disciplines of Earth Sciences for study the interactions of the geospheares and „ the total activita of the planet playing a decisive role in the self-forming and evolution of Man" In 1974 published his book „ Geonomy „ for integration the knowledge of different geoscientific disciplines and planetology for understand the Earth planet characteristics. He organised a series (yearly from 1970 up to 1985) of interdisciplinary symposie at the Academy of Sciences under the title „Material and Energy Flows of the Earth „ He has set up the multidisciplinary Comission on Geonomy of the Hungarian Academy of sciences, which is still activ. It was realised that this high level of synthesis may have a conscience-forming effect on the society as a whole. For this reason, considerable efforts were made to introduce Geonomy in the secondary scool (first time in the world !).Experimental instruction of Geonomy was started in twenty grammer scool of Hungary, replacing general geography. But the counter-attack of the opponents of the idea was succewsfull and the experiment was cancelled after two years.

As a result of the fluorishing fifteen years of the Hungarian scool of Geonomy has developed the attitude of multidisciplinarity and integrity in the Hungarian Earth scientific life.

GIUSEPPE FOLGHERAITER THE ITALIAN PIONIER OF ARCHAEOMAGNETISM

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Giuseppe Folgheraiter (1856-1913) was a respected member of the Presidential office of the "Società Italiana per il Progresso delle Scienze". Today it is universally accepted that Giuseppe Folgheraiter has been also the first scientist that tempted to date archaeological object (ceramics) by means of its magnetic properties. In this sense GF is one of the father of that portion of palaeo-magnetic sciences known as Archaeomagnetism.

The theoretical bases of this scientific field have to be positioned at the end of the XIX century. In that period a number of scientists are working on the magnetic field characteristics (Joseph Fournet, Achille Joseph Delesse, Macedonio Melloni, …), but only the Folgheraiter researches result to be particularly addressed in considering the magnetic properties of volcanic deposits and dating ancient pottery by means of the magnetic properties of materials.

The starting point of Folgheraiter studies on rock magnetism are centred on the volcanic rocks of Latium and are strictly related with the Macedonio Melloni finding on Vesuvius lavas, that volcanic rocks are affected by a permanent magnetization (the TRM). But is a Folgheraiter intuition that lightening is able to strongly influence the magnetic properties of lavas. The researches Folgheraiter performed on Etruscan "bucchero" pottery are centred on the definition of the temperature threshold that hallows clays to assume a TRM.

Even if nowadays a number of the Folgheraiter conclusion have to be regarded as incorrect, a great portion of the developments of the modern archaeomagnetic techniques origin from the Folgheraiter experiments and intuitions, that will be developed in the first half of the XX century by Emile Thellier (1904-1987). Actually, the well known Thellier work, resulting in the birth of the Saint Maur archaeomagnetic laboratory at the Institut of Physique du Globe de Paris, had as a starting point the theories and suggestion developed by Giuseppe Folgheraiter. Thellier work firstly concentrated on the acquisition of the thermoremanent magnetization by pottery, and then applied to fiery archaeological structures and volcanic deposits. From these studies derived the built of the first Secular Variation Curve for France.

RELEVANT CARTOGRAPHICAL MAPS MADE AND USED BY GEOGRAPHERS IN THE CARPATHIAN-DANUBIAN-PONTIC AREA, IN THE 17-20th CENTURIES

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Geographically, Romania is a *Carpathian, Danubian and Pontic country* for the following reasons:

1. The preponderance of the Carpathic relief and the greatest part of this mountain chain lying on the Romanian territory;
2. The longest segment of the Danube forms the frontier of the country, Romania's territory lying almost entirely in the Danube's hydrographic basin and in the river's mouth area (the Danube Delta);
3. Although the Romanian Black Sea coast is relatively short, Romania can be considered a Pontic country.

The *main human geography characteristic feature* of this area is its being inhabited by a neo-Latin population, representing the *Oriental Romanity*.

Historically and ethnically, too, this territory is a unitary one. *The cradle of this people, its culture breeding cell and civilization matrix is the very Carpathian-Danubian-Pontic area*. It is within this space that, throughout the years, a number of people carried out their activity, whose cultural work is relevant for the geographical science. This paper presents, as outstanding examples, the following scholars: Honterus, Cantemir, Milescu the Spatharus, Mehedinþi and Simionescu, on account of their geographic, especially cartographic work.

Regular Session T41
Some Methodological Aspects of History of Science

WHY DOES THE TRADITIONAL DISTINCTION BETWEEN INTERNAL AND EXTERNAL HISTORY NOT HOLD?

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Imre Lakatos' Methodology of Scientific Research Programmes was built on insufficient explanations concerning the hard core and the negative heuristic. In fact, Lakatos seems to introduce two meanings of the latter [methodological decision and metaphysical "conceptual picture"] and an incomplete definition of the former. In the light of the concepts of "metaphysical heuristic" and "inter-translatability" I propose to merge the two negative heuristic's meaning. Therefore, both the positive and the negative heuristics are methodological rules deriving directly from a common metaphysical principle. Consequently, the traditional distinction between internal and external history becomes untenable.

1 – Introduction and Criticism to Lakatos' Account.

According to Lakatos's account, the typical unit of science is not an isolated hypothesis, but rather a *research programme* consisting of a developing series of theories, characterized by a continuity which evolves from a proto-programme adumbrated at the research's start.

Lakatos laid down rules for appraising programmes, which he divided into either progressive or degenerating ones.

As it is well known through his special jargon, a programme is *theoretically progressive* if each modification leads to new unexpected predictions. It is *empirically progressive* if at least some of these novel predictions are corroborated[i].

The programme's structure consists of[ii]: the "Hard Core", the "Negative Heuristic" and the "Positive Heuristic".

According to his paper, *Falsification and the Methodology of Scientific Research Programmes*[iii], one apprehends that every research programme may be characterized by its hard core, whose negative heuristic forbids us to refute it by means of a methodological *ukase*. Therefore Lakatos affirmed that the negative heuristic *specifies* the hard core of a programme.

Both Lakatos and Elie Zahar in *Why Copernicus's Programme Superseded Ptolemy's* stressed the point that the demarcation between hard core and heuristic is frequently a matter of convention as they suggested in their historical analysis of the Pythagorean-Platonic programmes.

Returning to Lakatos's MSRP, a research programme may be defined as a set of methodological rules otherwise called heuristic: the *negative heuristic* «tells us what path of research to avoid»; the *positive heuristic* «what path to pursue»[iv].

Lakatos brings to our attention "Cartesian metaphysics" as an example of a particular research programme, that is, the mechanistic theory, according to which the universe is a "huge clockwork" and a *system of vortexes*. It played both the positive and the negative heuristic's role[v].

It discouraged work on theories incompatible with it [Newton's theory of action at a distance], and it encouraged work on auxiliary hypotheses which might have saved it from apparent counterevidence [Keplerian ellipses].

But I want to emphasize the negative heuristic's meaning. Lakatos termed it the *methodological decision* «not to allow refutations to transmit falsity to the hard core as long as the corroborated empirical content of the protecting belt of auxiliary hypotheses increases»[vi].

The above-mentioned definition, from my point of view, does not throw light on the point because the negative heuristic is also the metaphysical expression of a "conceptual picture" which affects the research's path. As it is exampled by the heuristic role of the mechanistic theory of the universe in the Seventeenth Century.

What is the epistemological statute of such a heuristic?

One may hypothesize that the two meanings of negative heuristic could be bridged by considering such a methodological decision as metaphysics in the sense that the decision is inspired either by scientists' (personal) convictions or by "philosophical" doctrines. Thus, metaphysics would be nothing but scientists' "general ideas" about science: determinism, indeterminism, atomism etc.

(Oversized abstract. Please contact the author for the full text)

PRINCIPLES OF DETERMINATION OF DISCOVERY CONVENTION PRIORITIES. (BASED ON DOCUMENTS OF HISTORY OF ELECTRIC COMMUNICATION AND ELECTRONICS)

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In process of creation of technical inventions one can distinguish two periods, as it shown by history of electric communication, including radio communication and electronics. The first period is the prehistory of invention. During that time scientific knowledge is accumulated and some small inventions of scientists and engineers are made forgoing the given discovery. Later, after the process of knowledge is completed which includes the finding of key technical solution, the second period, the period of development and improvement starts. The completion of the process of knowledge together with its technical implementation is the most significant element of the process of invention and its author (or authors) becomes the owners of invention priority. In the period of development the given invention receives improvements directed to increase its efficiency and suitableness to the industry production. Several authors could be involved in two periods, mentioned above, and the inventions itself which leads to various prolonged priority disputes.

The difficulty of determination of invention priority is lying in the identification of key technical solution. The most complicated part of it is the analysis of particular inputs of authors at the period of prehistory. The study of the process of forming new scientific and technical ideas (directions) which is illustrated on the example of history of fiber optic communication, very high frequency and radio communication(initially as wireless telegraph), as well as invention of telegraphy, tv, radiolocation, personal computer, transistor, and microchip and laser, shows the possibility to have the factor of functional usefulness as one of the criterion of invention priority. This factor allows to draw the first practically useful solution – the invention – from all the efforts of predecessor. In the period of improvement the problem of determination of priority consists in the establishment of technical solution with acceptable level of industrial realization, which is particularly important for high technological inventions.

Complex criterion of invention priority, obtained here, includes factors of creative solution of technical problem, as well as functional usefulness, possibility of further development, and industrial realization. In particular, bases upon this criterion,.it is confirmed the priority of P.L.Shilling (telegraph), A.S.Popov (radio), V.K.Zvorykin (tv), and others outstanding inventors.

METHODOLOGICAL ISSUES OF THE HISTORY OF SOVIET PSYCHOLOGY BETWEEN THE TWO WORLD WARS: CASE STUDY OF VYGOTSKY CIRCLE

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Lev Vygotsky (1896-1934), the founder of the Soviet cultural-historical psychology, is recognized as one of the most influential scholars in the field of the human sciences nowadays. The volume of publications in "Vygotskian tradition" keeps growing, which is quite remarkable in itself given that Vygotsky died more than seventy years ago and the first major publications of his works would not emerge from behind the Iron Curtain until the 1960-70s. Quite a few most important studies on Vygotsky and his legacy have been published to date. However, most of them share the emphasis on the heroic figure of Lev Vygotsky as the lonely thinker and fail to take into account the essentially collaborative nature of Vygotsky's most ambitious scientific project aimed at reforming the psychology of the day (see, e.g., Stetsenko, 2003).

This study presents the first ever systematic investigation into the history of the Vygotskian psychology in the Soviet Union in the 1920-early 1940s. First, I analyze the "canonical" history of "the school of Vygotsky-Leontiev-Luria" in the making during several decades of Soviet postwar historiography from the 1950 to date (e.g. in Luria, 1979) as well as the "perestroyka" critique of the Soviet historiographical tradition. Second, I demonstrate the omissions and—deliberate or involuntary—factual mistakes of both conflicting research strands in historiography of Soviet psychology and discuss major methodological problems of both these approaches that place too much emphasis on a couple of key protagonists and their intellectual struggle during the period. Third, following the proposal of a cultural-historical approach to the history of Vygotskian psychology (Cole, 1998; Stetsenko, 2004; Stetsenko & Arievitch, 2004) I present an alternative research program that seems to show promise to successfully complement the traditional historiographical accounts. This work follows the lead of those historians of science who treat science as social production (e.g. Latour & Woolgar, 1979; Knorr-Cetina, 1981; Shapin & Schaffer, 1985), and put the emphasis on the investigation of the complexities of the inner workings of research groups and their scientific practices (e.g., Kohler, 1994; Todes, 2002). I argue that this approach is particularly well suited for historiographic research of the traditional Russian scientific grouping of scholars known as Circle (*kruzhok*) such as the Bakhtin Circle, or Moscow Linguistic Circle (see Brandist, 2002; Brandist, Shepherd, & Tihanov, 2004). I introduce the notion of Vygotsky Circle and propose that scientific practices of the scholars of the Circle comprise 1) experimental designs and practices, 2) the "moral economy" (Kohler, 1994) within the group, and 3) social strategies of interacting with the larger world of the Stalinist Science and society outside of the group (Krementsov, 1997). Finally, I illustrate the advantages of this methodological orientation with the brief outline of the history of scientific practices of Vygotsky Circle in the 1930s.

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