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PL Plenary Lectures

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Conference Presentation Ceremony

Ibn al-Zarqalluh's Astronomical Doctrines on Both Sides of the Mediterranean

Julio Samsó University of Barcelona,
SPAIN

Science and the Eastern Orthodox Church during the 17th-19th Centuries

Efthymios Nicolaidis National Hellenic Research Foundation,
GREECE

Scientific Objects and Scientific Identity of a City. Prague as a 'Chemical City'

Sona Strbanova Academy of Sciences, Prague,
CZECH REP.

S01 The Different Historiographies of Science. Their Advantages and Shortcomings

Coordinated by **Michal Kokowski (Polish Academy of Sciences, Poland)**
Raffaele Pisano (Université de Nantes, France)
Hayo Siemsen (Ernst Mach Institute for Philosophy of Science, Germany)
Chaired by **Michal Kokowski (Polish Academy of Sciences, Poland)**

The history of science and related branches of knowledge, such as the philosophy of science and the sociology of scientific knowledge, have been developing dynamically in many countries throughout the world for many years.
These branches interact with one another. As a consequence, there are various approaches to the history of science, different methods of researching the history of science and of writing about it, based on different combinations of internal and external factors. Finally, there is a wide spectrum of different interpretations of the history of science, which includes a number of different historiographies of science, such as:
-the positivistic historiography of science, which we may define as the Whewellian, Tannerian, Machian, Sartonian, Conantian, Duhemian, Crombian, ..., historiography,
-the historiography of science written from the point of view of the historiography of ideas, which we may define as the Lovejoyan, Koyrian, ...,
-the philosophical historiography of science, which we may define as the Popperian, Kuhnian, Lakatosian, Feyerabendian, ...,
-the external, social, sociological, or socio-political historiography of science, which we may define as the Marxian (Hessen's, Bernal's), Bloorian – Barnesian – Shapinian (The Strong Programme in Sociology of Scientific Knowledge), Collinian (The Empirical Programme of Relativism), Latourian – Woolgarian – Knorr-Cettinanian (Ethno-methodological Approach), Callonian – Latourian (Actor-Network Theory),
-the cultural historiography of science or the socio-cultural historiography of science (which is the historiography of science written from the point of view of cultural studies of science) – see Dear (1995),
-the whig and prig historiographies of science – see Russell (1984), Harrison (1987), Hughes (1997),
-the modernist and contextual historiographies of science – see Brush (2007),
-the postmodernist historiography of science (propagated by "Postmodernists", but criticised severely by the "Friends of science" in the quarrel of the 1990s called the "Science wars") – see: Sokal & Bricmont (1997), Sokal (2007),
-the rhetorical historiography of science, which we may define as Prellian, Grossian, Dearian, Woolgarian, and Mossian – see: Haris (ed.) (1997), Fahnestock (2008),
-the objective historiography of science (recorded in text-books as a list of data along with the corresponding mathematical laws, and taught through its techniques and objective concepts), the subjective historiography of science (that is the history of the thoughts and experiences of the scientists), and the effective historiography of science (that is the historiography (a) of epistemic concepts, (b) of the objects of scientific inquiry, and (c) of the dynamics of the scientific developments, as they can be extracted from an analysis of scientific texts or practices) – see: Hacking (1992), (2002), Sturm, Feest (2008), Pisano, Gaudielo (2009) fn. 22–23, Kusch (2009).
The great diversity of approaches to the study of the history of science brings about both positive and negative consequences to research in this branch of knowledge – both profits and losses, so to speak. On the one hand, the plurality of attitudes can create new promising perspectives in research, when, for example, such approaches are complementary to each other. On the other hand, however, it can be very destructive to research, because it allows for instances of relativism, overspecialization, or for the ignorance of authors and propagators of falsely based assumptions (that, nevertheless, have great influence on the broad public).
In this context, many questions arise regarding the fundamental issues in cultivating the history of science and teaching about this branch of knowledge today. It is worth discussing these issues in detail.

The Different Strategies in the Historiography of Science. Tensions between Professional Research and Postmodern Ignorance

Michal Kokowski Institute for the History of Science,
Polish Academy of Sciences,
POLAND

The history of science, as a branch of knowledge, is a discipline of two countenances.
On the one hand, as a kind of history, it is one of the humanistic disciplines. As this type of discipline it interacts with the other humanistic disciplines, such as general history, the methodology of history, philosophy (including epistemology, methodology, rhetorics, ...), sociology, the theory of literature, the theory of cognition, etc. Moreover, the history of science is one of the branches of knowledge called sciences studies or the science of science, which also include the philosophy of science (with epistemology, methodology, rhetorics, ontology, ethics, the theory of values), the sociology of scientific knowledge, and the politics of science. It develops in strict relationships with them.
On the other hand, as a kind of reflection on science, the history of science interacts with science itself (or speaking precisely with particular sciences themselves) also.
Such a dual nature of the history of science lays the groundwork for the various approaches to this branch of knowledge, the different methods of researching the history of science and of writing about it, based on different combinations of the so-called internal and external factors.
As a consequence, we observe the existence of a wide spectrum of different interpretations of the history of science. The spectrum mentioned extends from a detailed, professional case study approach, to the ignorant postmodern approach.
This paper will develop the issues sketched.

Towards a Classification of Approaches to the History of Science

Bart Karstens Ma Institute of Philosophy,
University of Leiden,
THE NETHERLANDS

Over the years a great abundance of approaches to the history of science has emerged. Historians have focused on a variety of subjects ranging from scientific ideas and their epistemological content, scientific practice, to socio-cultural contexts in which science operates or, upon another view, of which science is simply part. The many perspectives show how rich the field of inquiry is with each new view contributing to our understanding of science as a whole. Still we may wonder if all these perspectives are really complementary. Various debates in which the writing of 'proper' history of science was at stake show that there is no consensus on this matter among historians.
In my paper I want to contribute to the discussion by offering a classification of the approaches to the history of science. The classification is based on two ideas. First it lists all the factors that have been said to play a role in past science. These include natural factors (or the world), cognitive factors, socio-cultural factors and personal factors. Second, borrowing an idea from Ian Hacking, with respect to each factor one or more 'sticking points' are formulated. Choices made with respect to these factors yield the respective historiographical approaches.
With this model in hand I want to discuss three further topics. First, the enterprise started out as descriptive work. However we may wonder if the resulting classification is also prescriptive, i.e. if it generates all positions towards the history of science one can possibly hold. Second, one of the leading ideas behind the model is that, although claiming the right way to depicture science, each approach is nonetheless unstable and therefore 'triggers' a subsequent approach. Third, 'the circulation of knowledge', as one of the most recent approaches to the history of science, can also be seen in this light. It is a reply to problems experienced within the dominant localist approach to past science. However 'the circulation of knowledge' brings its own problems. These problems will be addressed in light of the proposed classification.

Epistemological Aspects of the Historiography of Science in Greece

Constantine Skordoulis National & Kapodistrian University of Athens,
GREECE

This paper examines the controversial epistemological aspects of the course of development of the discipline of History of science in Greece during the 20th century.
Starting with the work of the first Professor of History of Science, Michael Stefanidis, appointed in the University of Athens in the beginning of the 20th century, this paper examines the transition from a discipline of History of Science dominated by the "admiration of the ancients" and the attempt to establish the continuity of Greek Science from the ancients onwards up to the last decades of the 20th century when a new generation of Historians of Science, which appears on the scene in the late 1970s, originating politically from the left prevailed in the cultural life of Greece.
This new generation considers the argument for the "continuity" as an ideological construction, and turns its attention in the study of the post-Byzantine era, in a period that has been called "Neo-Hellenic Enlightenment" and focuses on the study of the reception and assimilation of the ideas of the 17th century scientific revolution in the Hellenic communities and in the European scientific history.
Furthermore, this work focuses on the relations developed in the last decades between the communities and journals of the Historians of Science and the Philosophers of Science and their interactions in the course of their maturity.
Finally, this work examines the newly established relations between the Historians of Science and the Historians of Science Education considering the study of the two fields tightly connected in the Greek framework and discusses the epistemological problems arisen from proposals and attempts to incorporate History of Science in the Teaching of Science in line with the developments in the international community.

Knowledge and Space. Between New Paradigms and Old Schemata

Jan Surman Department of History,
University of Vienna,
AUSTRIA
Center for Austrian Studies,
University of Minneapolis,
USA

Last years experience a considerable growth of research on spatial distribution of knowledge and processes of its transfer and diffusion. In this respect not only history of science and knowledge produced interesting insights, but also social geography, where interest for mobility of knowledge grew considerably. Finally, sociological concept of constituted space brought new ideas in reconsidering the interdependence of science, cities and architecture. The paper reassesses the characteristics of the „spatial" approaches and analyses tensions and contact areas between them.
Originating from the seminal works of Michel Foucalt and Henri Lefebvre, the spatial turn, the idea of spatial diversity of knowledge production and dissemination, largely entered the research on knowledge and science. The science in situ (Finnegan 2008) is concerned with interdependence between production sites and the outcome, enlarging the anthropological research on laboratory culture. Buildings, furniture, cities or gardens are here not mere the background, but render the social space of scholars, interact in the process of science making and stabilization of results. On the other hand, analyzing science in motion is devoted to dissemination of knowledge in space and between cultures. The research on scientific migration, networks, geographies of reading, relations of cultural power and knowledge transfer etc., brought valuable results to recognition of importance of cultural and linguistic values and questioned the notions of objectivity and impartiality, largely associated with science.
While still on the margins of the history of science, the spatiality of knowledge/science helps reconsidering some criterions of research. On the other hand, it largely disregarded the ideas from linguistic or postcolonial turn. I argue, that the failure of associations with those largely related turns results from accepting the space but rejecting its social dimension, and thus only partial revelation of potential spatial turn could have.

Historiography, Method and Erkenntnis-Theory: What is General in Science?

Hayo Siemsen Ernst Mach Institute for Philosophy of Science
and INK, FH Eden/Leer,
GERMANY

What is “general” in science? What is general in the science of history? What is general in history of science? The following article is based on the assumption that science is “one”, i.e. that different sciences are called “science” for a joint reason and that the world they describe is the same, although the perspectives on it might differ. Epistemologically, such a world view is called “monistic” (as for instance used by Sarton 1916). If additionally no science is considered a priori foundational, it is called “neutral monistic”.
In such a world view, one searches for the most fundamental and general ideas, those which describe the most facts and are still internally consistent. The method of this search will in the following be called “erkenntnis-theory” (the German Erkenntnistheorie is a concept in-between the meanings of theory of knowledge, cognition, epistemology and philosophy of science). It is a general, i.e. (meta-)method of science, which – applied to the point of view of history as a science – could be called meta-historiography. It is a meta-method, because it comprises several methods as perspectives in one world view. Koselleck (2003) called these perspectives “time-layers”. The following article will try to elaborate, how such time-layers can become erkenntnis-theoretically as consistent as possible and therefore monistic and general. In a metaphor used by Koselleck, such an erkenntnis-theoretical view adds “tracker actions” (in the sense of action potentials) to the organ on which the historian plays the “melody of world history” (a metaphor used by Rosenstock 1961, see also Siemsen 2009). For more complex melodies, several actions have to be used.
The central concepts for such an “organic” view are “time” and the relation between the concepts of “history” and “evolution”. “Time” is the perspective defining the view of the historian. The view of historiography, i.e. that the historian is part of (his/her) time is a result of the realization that Darwin’s idea of evolution implies the evolution of human knowledge and scientific (as well as historic) knowledge as part of it (see also Zilsel 1942). This view, as well as the modern, i.e. relative, concept of time has first been elaborated by Ernst Mach (see Mach 1863, Einstein 1916, Siemsen 2009). The historiographical understanding and consistency of the conceptual meanings of “time”, “history” and “evolution” is in turn fundamental for an erkenntnis-theoretical understanding of historiographies. If one considers these concepts as “general” in science (i.e. the concept of time in physics must be the same as in history or the concept of evolution in biology must be the same as in history), only the double-dependent application of both – erkenntnis-theory and historiography – can supply a scientific world view, which is the most consistent and general (relative to other world views).

Keywords: Erkenntnistheorie, historiography, method, Reinhart Koselleck, Ernst Mac

Prosopography as a Method of Historiography of Science

Antonin Kostlan Centre for the History of Sciences and Humanities,
Sona Strbanova Institute for Contemporary History of the Academy of Sciences of the Czech Republic,
Prague
CZECH REP.

Prosopography (or collective biography) is a special historiographical method used in the research to analyse biographical data of a larger set of personalities. Claude Nicolet defined its aim as "the history of groups as elements in political and social history, achieved by isolating series of persons having certain political or social characteristics in common and then analyzing each series in terms of multiple criteria, in order both to obtain information specific to individuals and to identify the constants and the variables among the data for whole groups." Prosopography is commonly used for research in the field of history of science, too. Paper is based on the evaluation of three prosopographical projects, which the author carried out or have been involved:
1) analysis of European intellectual networks of early modern period (16th-17th cent.) in which participated Czech protestant scholars (project is based on an analysis of a book of friends of a Moravian scholar Jan Opsimathes, research of cca 700 people)
2) project focusing on the victims of Nazi regime in the Czech lands from the intellectual and scientific elite,1939-1945 (mostly lecturers and professors working in Bohemian and Moravian universities, research of cca 200 people)
3) project focusing on the departure of prominent Czech scientists into exile during the Communist regime, 1948-1989 (refugees from the former employees of the Czechoslovak Academy of Sciences, research of cca 700 people).

On the Historiography of Mathematics in Italy

Maria Teresa Borgato Department of Mathematics,
University of Ferrara,
ITALY

The historiography of mathematics in Italy has a long tradition dating back to the Renaissance (Bernardino Baldi, 201 biographies in his Vite de' matematici). Moreover, Italian scholars contributed to the transmission and history of science with translations, commentaries and editions of ancient classics, and chronologies were included in encyclopedic treatises in the sixteenth century.
In a modern sense, however, the historiography of mathematics begins in the eighteenth century, when the history of mathematics was considered an area of the history of human thinking. In Italy it was initially developed as a part of Italian literature and inserted into general works (Giovanni Andres, Girolamo Tiraboschi). Critical analysis of mathematical theories and their historical foundations can be found in works of mathematicians like Joseph-Louis Lagrange, Gregorio Fontana, and Pietro Cossali. Giambattista Guglielmini, at beginning of the nineteenth century, provided, with his eulogy of Leonardo Pisano, a widely followed model in the historiography of the century: expositive text and extensive bibliographic notes. An important work, which combined general overview, technical and archival investigation came out later: the famous Histoire des sciences mathématiques en Italie by Guglielmo Libri (4 volumes 1838-41). The historiography of mathematics developed in the second half of the century, after the political unification of Italy, with Baldassarre Boncompagni's foundation of the Bullettino di bibliografia e di storia delle scienze matematiche e fisiche (20 volumes), which supplied both an international diffusion and primary sources. Antonio Favaro was the editor of Galileo's collected works, and Pietro Riccardi published a bibliographic work still of great importance, the Biblioteca matematica italiana. In the first half of the twentieth century, two mathematicians became the main historians of mathematics: Gino Loria and Ettore Bortolotti. The historiography of mathematics in Italy has increased with the publication, from 1981 on, of the Bollettino di storia delle scienze matematiche (29 volumes).

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S02 Cross-National and Comparative History of Science Education

Coordinated by Josep Simon (Université Paris-10, France)

Chaired by Antonio García-Belmar (Universitat d'Alacant, Spain)

Cross-National comparison was a major driving force in nineteenth-century educational organization. Educationists circulated across national boundaries and compared different educational systems, producing official reports aimed at informing educational reforms in their own national or local contexts. This method has survived up to our days, giving raise to well-established academic fields such as comparative education.
Historians of education have often approached the study of science from the point of view of institutions and curricula, producing in certain cases large scale international comparisons, and mainly focusing on primary education, and increasingly, secondary education. In contrast, historians of science have favoured tight accounts of pedagogy and training in local context, and commonly focused on higher education. In the last decade, some major works in this field have produced international pictures on science pedagogy, through the study of the circulation of scientists and pedagogical tools. However, approaches are still too often restricted to local or national contexts, as they are in the history of science at large.
The aim of this symposium is two-fold: First, contributing to the promotion of further cross-national and comparative in history of science and history of education, and second, to promote interaction between these two disciplines.
Some of the objects suggested for cross-national comparison are:
-Pedagogical practices
-Curricula
-Pedagogical tools (teaching collections, pedagogical diagrams, pen and paper technologies, etc.)
-Institutions
-Examination frameworks
-Textbooks
-Teaching spaces
-Teachers
-Students
-Comparisons by contemporary circulating or transnational actors (teachers, students, educationists)
-Interactions between Pedagogy and Research

The Co-Creation of Physics and School Science. Pedagogical Tools and Discipline Shaping in France, England, and Spain

Josep Simon Institut de Recherches Philosophique,
Université de Paris-10,
FRANCE

The aim of this paper is to build a comparative analysis of the making of physics as a discipline through secondary school pedagogical practices in France, England, and Spain. My main argument is that the simultaneous establishment of secondary education and school science subjects had a major role in the shaping of physics as a discipline.
By using a cross-national and comparative approach and focusing on education, I intend to propose new ways of writing the history of nineteenth-century physics. In my opinion, the standard historiography of the making of physics as a discipline is afflicted by a simplistic conceptualization which especially affects its national distribution, its periodization and its focus on theoretical foundations. This is due to a lack of comparative and cross-national work and the establishment of artificial boundaries between teaching and research in scholarly research on nineteenth-century physics.
In this paper I challenge the standard historiography of physics by comparing three countries during the nineteenth century. My focus on pedagogical practices rather than research, allows for a more balanced and consistent use of cross-national comparison, since standard issues of research leadership are left behind. In this context, I analyze comparatively the impact of the French, English, and Spanish contributions in this field, respectively. My focus of analysis is the school physics cabinet, considered as the fundamental tool which drove the pedagogical practice of physics in secondary education, and a site for negotiations on the conceptual structure of physics as a discipline. Accordingly, I will compare the making, development and uses of school physics collections in France, England and Spain. For this purpose, I will analyze printed sources (official publications, physics cabinet catalogues, textbooks, trade catalogues, examination papers, syllabus, school publications, notebooks, diaries, memoirs), manuscript sources (collection inventories, correspondence) and material culture sources (school physics collections).

'A Mediator between Different Nations?' The Implementation of Laboratory Instruction in Belgian and German Secondary Education (1880-1914)

Sofie Onghena K.U.Leuven,
BELGIUM

The introduction of laboratory education at Belgian secondary schools during the years 1880-1914 was strongly influenced by German science education. A large part of school books and textbooks used by Belgian science teachers were translations of German publications and the laboratory apparatus in Belgian school laboratories was to a great extent of German origin. Belgian academic scientists got acquainted with German science education combining research and instruction during post-academic training at German universities and laboratories. Fascinated by the integration of experimental and instrument manipulations in German science education - in Belgium hitherto rather unusual -, they did not only stimulate practical courses at Belgian universities since 1870, but they also ardently pleaded for the introduction of laboratory instruction at secondary schools, created from 1880 onwards at state schools. According to German tendencies, the creation of practical science lessons at Belgian secondary schools also threw doubt upon the ideal of classical education.
Therefore my paper will explore to what extent the German education model was exemplary to the implementation of laboratory instruction in chemistry and physics at Belgian secondary schools, by examining traces of German influences in Belgian textbooks, notebooks of teachers and students, teaching collections, pedagogical reports and official circulars. I will use the already existing (inter)national historiography of the German influence on Belgian university education as a background; in contrast with this scholarly work the study of the German impact on Belgian secondary education resulting in the introduction of laboratories remained rather neglected. My analysis of the German model as being most influential will also investigate differences and lead to the uniqueness of Belgian secondary science education, influenced as well by French and Dutch science, illustrated by the following quote of a Belgian scholar concerning disseminating science: 'Belgium is surprisingly well placed to serve as mediator between different nations.'

Swedish in Name Only: The International Education of Nineteenth-Century Swedish Medical Students and Practitioners

Stephan Curtis Department of History,
Memorial University of Newfoundland,
CANADA

This study examines the experiences of several nineteenth-century Swedish physicians and medical students who travelled to renowned European universities and medical institutions on the continent as part of their medical training or to enhance their knowledge while pursuing their careers. This project demonstrates that this oft neglected 'peripheral' part of Europe was much more firmly integrated into the development of medical innovations occurring particularly in France, Germany, and Austria than is often believed. In so doing it demonstrates the limitations of thinking in terms of national types of education and medicine and illuminates the international character of medical practice in nineteenth-century Europe.
The applications for travel grants and the written reports that medical practitioners submitted to authorities in Stockholm, and which form the foundation for this research, frequently suggest the authors' perceptions about the shortcomings of their medical education and the state of medicine in Sweden. In this way each practitioner was making implicit comparisons between personal experiences and what he imagined to be the case elsewhere. Some of those who travelled abroad eventually became influential instructors in the country's medical schools where they influenced the education of future physicians. Others became government officials responsible for ensuring the health of all citizens. Even the less renowned physicians brought back skills and ideas that they incorporated into their daily practices.
In summary, this project hopes to demonstrate that although there certainly was a current of medical nationalism in 19th-century Europe, political borders were unable to combat the transmission of knowledge by the numerous foreign students and trained practitioners travelling around the continent. Second, while the focus is primarily on the formal education and experience these men received, I also hope to be able to demonstrate the practical implications of it on some of their patients.

Employing Experts from Abroad: a Comparative Study on Foreign Engineers in Spain and in the Ottoman Empire (19th Century)

Darina Martykánová (1) (1) Universidad Autónoma de Madrid,
Meltem Akbas (2) SPAIN
University of Potsdam,
GERMANY
(2) University of Istanbul,
TURKEY

The authors of this paper, a historian of science and a general historian, have joined their forces to elaborate a long-term mise en perspective of the work of foreign engineers in Spain and the Ottoman Empire. We pay special attention to the questions of scientific-technological interchange and to the dynamics related to state-building and articulation of private sector. The two countries displayed radically different traits during the 19th century. However, they also shared certain common features that make the comparison possible and fruitful. First of all, Spain and the Ottoman Empire were independent countries with imperial past and present. Ruling elites of these countries interiorized at some point the notion of decline or "delay" in comparison to other powers. Moreover, the economies of both countries were marked by the penetration of foreign capital and by an important increase in dependence, though in different degree, during the second half of the 19th century. Parting from this background, we apply the method of synchronic and diachronic analysis, paying attention to both transnational and comparative aspects. The comparative perspective enables us to identify the characteristics of technoscientific interchange and the degree of dependence, as well as to better interpret the role foreign experts played in the production and appropriation of knowledge. A transnational perspective, which we find complementary to the comparative one, will offer a glimpse on how circulation of experts across the borders contributed to the configuration of a transnational community of experts.

The Polytechnic Comes to America. How French Approaches to Science Instruction Influenced Mid-Nineteenth Century American Higher Education

A. J. Angulo Winthrop University,
USA

What. This paper uses the case study of William Barton Rogers (1804-1882), conceptual founder of the Massachusetts Institute of Technology, to examine the intellectual crosscurrents that existed between French and American higher education during the mid-nineteenth century. The primary focus is on the pedagogical, curricular, and research orientation of Rogers's circle of scientists who were profoundly interested in the establishment of science institutions in the United States. It investigates the extent of borrowing that occurred from French systems of science and engineering education.
Why. Rogers represents a wider network of American scientists who either studied in or borrowed heavily from French polytechnic institutions. Their intended (and sometimes unintended) purpose was to bring back to the United States a unified form of science or engineering instruction that would replace the classical college and its piecemeal revision of the curriculum. MIT, founded in 1861, stands as the most obvious and most understudied example of this cross-national interplay of scientific and educational ideas.
How. Research for this paper expands on the work completed for William Barton Rogers and the Idea of MIT (Baltimore: Johns Hopkins University Press, 2009). This study is based on archival research conducted at the archives at the College of William and Mary (Williamsburg, Virginia, U.S.A.), University of Virginia (Charlottesville, Virginia, U.S.A.), MIT (Cambridge, Massachusetts, U.S.A.), and elsewhere.
Historiographical Arguments. The historiographical purpose of this paper is to highlight an overlooked scholarly gap in the literature on American higher education history. Historians of education and science have long studied the influence of British and German traditions in American higher education. British models gave Americans the undergraduate course of study; German models provided the framework for graduate work. The French have been largely omitted from this discourse. Rogers, his circle, and MIT offer fresh opportunities for cross-national comparison.

Shunning the Bird's Eye View: the Rise of General Science Courses in the Schools of Quebec and Ontario in the 1930s

Michelle Hoffman Institute for the History and Philosophy of Science and Technology,
University of Toronto,
CANADA

The early decades of the twentieth century saw a marked change in the way science was taught in high schools across much of the United States and Canada. This change, which targeted the lower grades of high schools, involved a gradual move away from a discipline-based approach (by means of separate courses in subjects like chemistry, physics, botany, and zoology) to a broad-based thematic course in general science. The general science movement was initiated in Chicago in 1903 amid concern about declining enrolments in science courses, and gradually made inroads into Canadian education. As John Rudolph ("Turning science to account," 2005) has shown, the general science program was founded on claims about the universal applicability of scientific reasoning and was fuelled, furthermore, by a technological enthusiasm that manifested itself in a proliferation of applications to machinery and engineering. This paper examines how the pedagogical ethos of general science was filtered and rearticulated by educationists in Quebec and Ontario, where demographic pressures were prompting a new outlook on the purposes and goals of secondary education, culminating in significant changes to the science curriculum in the late 1930s. Such concerns were expressed more forcefully in Ontario, where universal secondary education was gradually becoming a reality, than in Quebec, where the Church controlled the school system and where strident clerical opposition to state interference in education meant that mandatory attendance laws were not enacted until 1943. By examining educational journals (The School, The Educational Record of Quebec, L'enseignement primaire), the proceedings of national and provincial educational associations, as well as authorized textbooks, I explore the different arguments on behalf of general science that were formulated in Quebec and Ontario, and how they were framed in terms of the perceived educational needs and distinct pedagogical and scientific cultures of these two provinces.

Temperature Through Space and Time: How Science Textbooks Convey Significant Differences about Scientific Phenomena

Catherine Radtka EHESS, Paris,
FRANCE

This paper proposes to show how a cross-national comparison of science textbooks can provide results regarding the circulation of consensual forms of scientific knowledge towards lay-people.
Dedicated to children that will not necessarily become scientists, school science textbooks can be seen as a way to present within a particular political community (e.g. Nation-state) a legitimate image of science to lay-people. Even though textbooks may be used elsewhere than in the country they originate from and even if their production might be influenced by cross-national comparisons held at different levels, they can be seen as "national products" which reflect the values of national education and the various conditions and constraints that influence their content. Science textbooks thus appear as a means that unifies and proposes a consensual vision of science at a national level.
The paper proposes to draw on science (physics, chemistry or general science) textbooks dedicated to pupils aged 11-15 in three different European countries to reveal significant differences between such visions. France, Poland and England from the beginning of the 1960s and the 21st century have been selected as terms of the comparison, for the relative similarity of the roles they assign to education and textbooks, while they present at the same time interesting variations in political and social parameters. The comparison deals more specifically with the treatment of one scientific notion: temperature. It demonstrates how such a notion, presented as a basic and universal scientific notion whereas its complexity has underpinned major scientific research in the past, considerably fluctuates within the three countries considered in this work. It thus allows illustrating how textbooks participate to the construction of different, but somehow unified at a national level, scientific cultures.

Two Worlds Apart- Comparing Greek and American 19th Century Science Education

Konstantinos Tampakis National Hellenic Research Foundation, and
Faculty of Primary Education,
University of Athens,
GREECE

The history of science education has been recognized as the Cinderella of standard historiographical subjects. Historians of education seem reluctant to study science as a topic, while historians of science tend at best to ascribe to education the role of Normal Science perpetuation. Only in recent years have new approaches emerged in dealing with the historical role of education, institutional or not, in standard scientific practice.
In this paper, I will try to argue for the need to take the history of science education seriously, by comparing 19th century science education in Greece and USA. At first glance, these two social and political formations had almost nothing in common. USA was a huge but fragmented state, with abundant natural resources and clear ties with a European superpower. On the other, Greece was a devastated small country, emerging after four hundred years of Ottoman rule and struggling to modernize under heavy European influences. Despite their many differences, however, both US and Greek education drew aspirations from the same European pedagogical models.
This paper will focus on the institutions that comprised what we nowadays recognize as public science education and compare the frameworks within they operated. Specifically, the goal is to recognize the educational structures that institutions created in nineteenth century US and Greece and how natural sciences were generally incorporated into each curriculum. By drawing the analogies and marking the differences, the goal is to discuss how the study of the history of science education needs its own methodological tools, which must go beyond standard historiographies of education and science. The tentative proposal will be that the history of science education be seen as the history of discipline construction, especially in spaces not substantially contributing to the creation of paradigmatic scientific practices.

An Old Idea in Modern Concept. History of Science in Science Teaching: The Cases of Greece and Spain, a Comparison

George N. Vlahakis (1) (1) Institute for NeoHellenic Research,
Aikaterini Konstantinidou (2) National Hellenic Research Foundation,
GREECE
(2) Department of Experimental Education and Mathematics, University of Barcelona,
SPAIN

Since the second half of the twentieth century a long-lasted and sound discussion has been started considering the proper use of history of science in science teaching. Since then, a considerable literature is available on the subject, either supporting or rejecting the use of history of science for teaching science in a school class.
Nevertheless the historical research shows, that silently history of science played an importand role in the educational matters since the 18th century. The present paper discusses exactly these early attempts to introduce history of science though textbooks, historical experiments and other relevant practices and compares them with relevant actions in the contemporary schools. The case of Greece, as a country of the European periphery, now and then, has been chosen and a comparison this the analogous status in Spain is attempted, just to show that just minor differences exist on this subject between different cultural environments.
For our study we are going to use extensivelly the available primary sources like textbooks, curricula and aarchives of the state as well selected papers from the rich secondary bibliography.

The Role of Texts and Objects in Early Modern Science Education in Europe, China and Japan

Simona Valeriani London School of Economics,
Mina Ishizu UNITED KINGDOM
Ting Xu

This co-authored paper derives from a larger interdisciplinary research project 'Useful and reliable knowledge in Global Histories of Material Growth in the East and the West 1300-1800' (URKEW http://www.lse.ac.uk/collections/economicHistory/Research/URKEW/Intro%20Page.htm). This historical research employs connective as well as comparative approach in analysing the organisation and curricula established for various forms of higher education in Europe and the East. A special emphasis is placed upon higher education as an entrée into the cosmologies and cultures of elites who patronised, supported or failed to support innovation and inquiries leading to the accumulation of useful and reliable knowledge behind technological divergence between the East and the West.
The paper concerns comparison of the roles played by texts and objects in higher education in Western Europe, China and Japan in early modern period. As is well known in Europe the interest for the direct study of nature and properties of material objects grew during the sixteenth and seventeenth centuries. Although the use of these resources in practical teaching was limited, this type of sensorial teaching method increasingly gained its importance in educational theories. Texts and objects also shed a light upon the understanding of teaching traditions in contemporary Tokugawa Japan. While reading and interpretation of Confucian texts dominated the core part in the traditional curriculum in the Japanese elite schools, Western learning particularly medicine and military techniques were increasingly incorporated into practical teaching in higher education from the late eighteenth century. The paper also examines the contrasts and interactions between this new type of teaching with traditional Chinese teaching, that is, reading and interpretation of classical Confucian texts in the sixteenth and seventeenth centuries.

The Impact of Scientific Knowledge Transfer on Higher Education Systems: Comparative Case Studies of Early Modern China, India and Japan

Mina Ishizu London School of Economics,
Anjana Singh UNITED KINGDOM
Ting Xu

This paper compares the process of circulation and appropriation of western scientific knowledge between late Ming and early Qing China, early-modern India and Tokugawa Japan and its impact upon the systems of higher education in these regions.
The first part of this paper focuses on the missionary efforts of the Jesuits in China in the sixteenth and seventeenth centuries and their impact on the Chinese elites and education systems. The Jesuits' scientific knowledge system, although it had sparked intellectual dialogues with traditional Chinese learning in the Ming dynasty, became increasingly restrained by the Qing. This part compares the differences between the Ming and the Qing empires in terms of adaptation and diffusion of Western science and technology.
In the second part of the paper the contrast between China and Japan is discussed. After the initial introduction of the Jesuit scientific knowledge, the Tokugawa government's strict anti-Christian policy defined the western learning as the Dutch learning throughout its regime. The role of Dutch learning in the process of appropriation of western knowledge will be analysed from the issues pertaining to the pattern of collection and interpretation of Dutch texts and their use in higher education institutions such as private schools and then governmental research and teaching institutions.
The third part of the paper focuses on India where the experience of introduction of scientific knowledge is vastly different from China and Japan. In South Asia, while the Jesuits were active, there influence in the beginning was limited to the coastal areas, Malabar and Coromandel and only later in the imperial capital and the Indo-Gangetic plains. Yet, "New Knowledge" as it has come to be defined, were in circulation in Mughal India. The paper will look into it's reach, depth and influence, apart from responses and reactions to it.
The paper highlights the different trajectories between early modern China, India and Japan in the process of diffusion of western science and its impact on the education systems.

S03 Symposium on the History of Science and Education

Coordinated by **Pere Grapí (Universitat Autònoma de Barcelona, Spain)**
Peter Heering (Universität Flensburg, Germany)
Sylvain Laubé (University of Brest, France)
Maria Rosa Massa (Universitat Politècnica de Catalunya, Barcelona, Spain)

Chaired by **Sylvain Laubé (University of Brest, France)**
Maria Rosa Massa (Universitat Politècnica de Catalunya, Barcelona, Spain)
Peter Heering (Universität Flensburg, Germany)
Pere Grapí (Universitat Autònoma de Barcelona, Spain)

The ESHS explicitly intends to foster educational aspects of history of science, both in teaching this field and in using history of science to educate a broader audience. This is an important aspect of the aims of the society, and it is the intention of this symposium to meet this aim by developing a European basis for joint projects in this field.
This symposium stands in line with those realised at previous conferences, in 2006, a symposium was organized during the second ESHS conference in Cracow by C. Debru and J.Folta about the new prospects concerning History of Science in Education and Training in Europe.
This symposium is also related to the one on "HST and Education" (organized by C. Debru, P. Grapi, P. Heering and S. Laubé) in 2008 during the third International Conference of the European Society of History of Science (ESHS) where 17 communications showed that large activities exist already in this area at the European level.
The objective is now to establish an inventory of them and to launch a reflexion inside the European research community on the role that the training and the research in history of science and technology has to play in the development of innovative methods at primary and secondary schools (also in teacher training), at university and in education.
A round table will summarize the results et examine the conditions of the creation of a European network with a web site of resources in "History of Science and Technology for Education" with the help of the ESHS.

What Influence did the post-1848 Austrian Educational Reforms Have on Gregor Mendel Teaching?

Christiane Nivet Université Paris7 Denis Diderot,
FRANCE

In the aftermath of the 1848-revolution, natural science teaching underwent a process of reform : the university syllabus was radically affected by the change : botany, zoology and chemistry previously taught at medical faculties or philosophy institutes have been transferred to the competence of the newly established faculty of philosophy. Physics which was taught at philosophy institutes has been transferred to the secondary schools where it became obligatory.
A new emphasis was being placed on a combination of teaching and experimental work. In order to teach secondary-school teachers Doppler created the Physics Institute where students had to acquire the necessary theoretical background and the skills required to perform teaching experiments and undertake independent research. Gregor Mendel has been one of the few Doppler's "élèves".
In this communication we plan to discuss how much the aims of the reform have been achieved, and whether Mendel has been able to teach at the Brno realeschule according to the new emphasis. We also shall try to explain how he could have been teacher without teaching qualification for fourteen years.

My documentation:
Schuster P.M. Moving the stars: Christian Doppler, His life, his work and principles and the world after. Living Edition.2005
Franz Weiling, Das Wiener Universitätsstudium 1851-1853 des Entdeckers der Vererbungsregeln 3-Johann Gregor Mendel.Folia Mendeliana 21, 9-40. 1986
Christian Doppler "Statuten des physicalischen Institutes in Vienna" 1850
Vitezlav Orel, Gregor Mendel, the first geneticist. Oxford. Oxford University press.1996
Iltis, Hugo Leben, Werk und Wirkung Berlin 1924, Life of Mendel .London Allen and Unwin 2nd ed.New-York, Hafner 1965

My work about Mendel's life:
Nivet,C. Une maladie énigmatique dans la vie de Gregor Mendel.Med.Sci. (Paris) 2004; 20: 1050-3
Nivet,C. 1848: Gregor Mendel , le moine qui voulait être citoyen.Med.Sci. (Paris) 2006; 22:339-346
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
Nivet C. Was Gregor Mendel a clandestine student at Vienna University in 1851? Third ICESHS Austrian Academy of Sciences, 2008.Vienna, Austria.
Nivet C.Did G.Mendel's political involvement interfer with his scientific achievements during the period 1853-1865? XXIII International Congress of History of Science and Technology. 2009, Budapest Hungary.

Teaching Scientific Explanations and Theories from a Methodological Association of Historical-Philosophical Structure and Pedagogical Goals

Irinéa de Lourdes Batista Universidade Estadual de Londrina, Paraná, BRAZIL

The role of History and Philosophy of Science for Science and Mathematics teaching has been a theme of several studies about a correlation of these three areas, particularly with the explicit relationship between history, philosophy and cognition.
Our research is inserted in the context of the development of theoretical references for the creation of instruments to improve the learning of concepts and theories in Science and Mathematics. We believe that such creation must be in a structured, articulated, and integrated mode for achieving an analytical learning.
Our first and main report involves the identification and characterization of scientific models by historical-philosophical reconstructions, which presupposes the overcoming of that modeling – a prototheory – for obtaining a universal theory. As an exemplar of analysis and findings, we present an application to the study of Beta decay (first identification of nuclear weak interaction) addressed for undergraduate students of physics or in-service teacher education. This exemplar illustrates some pedagogical results of the application of this proposal in a discipline for undergraduate students of a physics course at State University of Londrina, Parana, Brazil. The second part of our work brings a synthesis of findings in several researches, characterized in two axis of investigation, in partnership with graduate students of our research team and on the scope of a graduate program in Science and Mathematics Education at the same university.
To the axis of Inquiry of a Historical and Philosophical Approach in the Basic Education, we present views of the follow themes: a historical-philosophical approach and Mathematics Education — a proposal of interaction between domains of knowledge, a Historical-pedagogical approach for Sciences Education in the initial series of Elementary Education, and an Inquiry on a Didactical sequence gotten after a Historical-philosophical Reconstruction to teach Trigonometric Functions in High School.
To the axis of a History and Philosophy of Science in Teacher Education, we present the themes: History of Science and Gowin's Vee diagram in teacher major education to the initial series of elementary school; a historical-philosophical study about the role of Mathematical Proof on Bachelor of Mathematics undergraduate courses, and Cognitive values, Evolution theory and Initial education of teachers.
With all these samples, this presentation aims to deal with the careful and interdisciplinary relationship that the History and Philosophy of Science can establish with and accomplish in Science and Mathematics Education, and brings a landscape of our general findings.

Not out of the Blue: the Genesis of Modern Textbook Descriptions of Historical Experiments

Peter Heering (1) (1) Institut für Physik und Chemie und ihre Didaktik,
Sebastian Kowalski (2) Universität Flensburg,
Valentina Parlow (3) (2) Institut für Physik,
Carl-von-Ossietzky Universität Oldenburg,
(3) Gymnasium Syke,
GERMANY

Recently, several papers have been published that analyse school and university textbooks with respect to certain accounts of historical experiments such as Millikan's oil drop experiment or the photoelectric effect. In doing so, the authors generally criticize the accounts in the actual textbooks as erroneous with respect to the historical experiment as well as misleading with respect to aspects of the nature of science. Even though these criticisms are well founded, it remains an open question why these accounts can be found in the textbooks. It appears to be evident that not every detail of the historical experiment can be included in the description, consequently, decisions are to be made which aspects are relevant and which are superfluous. These decisions are not simply made but the outcome of a historical process – consequently it appeared to be interesting to examine the genesis of these descriptions.
In our presentation, we are going to discuss two examples in detail and draw some more general, even though still preliminary conclusions.

The Need of Bringing Together History, Nature and Teaching of Science. A Proposal from the History of Science

Pere Grapí CEHIC,
Universitat Autònoma de Barcelona,
SPAIN

History of science has to play its role to deal with the nature of science in science teaching in the secondary education and in science teacher training. Concerning this target a question arises: what aspects of the nature of science can be considered candidates to be dealt with the history of science? The empirical model of the investigative pathways worked out by the historian of science Frederick Holmes as a result of his exhaustive researches on a number of scientific careers of prominent scientists might be reasonably suitable to answer that central question. This presentation aims to explore the teaching possibilities of this proposal.

History of Science in Science Education: the Case of Oersted's Experiment

Mariana Valente Centro de Estudos de História e Filosofia da Ciência,
Nazaré Caldeira Departamento de Física,
Universidade de Évora,
PORTUGAL

In April 1820,Oersted gave a lecture, at the University of Copenhagen, on the connections between the phenomena of electricity, galvanism and magnetism. During this lecture something happened that put him on a path towards the clarification of his ideas. In July 1820, he published his findings in a paper written in Latin which he sent to various scientists in Europe. This experiment is regarded as being at the origin of the phenomena, and of the theory of electromagnetism. What happened? Some studies in the field of the History of Science and in Science Education provide us with elements to reflect on the matter (Andrade Martins, 1986, 2003, 2007; Heering, 2000; Kipnis, 2005; Jacobsen, 2006; Friedman, 2007; Brain, 2007, Cavicchi, 2008). How is this experiment treated in secondary school textbooks? Today, in Portugal, it is presented in passing and without even naming Oersted. Time acts on ideas, in science education, in a dispersive manner: we loose a great deal of their significance and sometimes we use ideas that were previous to the experiment as if they were a consequence of the same, as we will show.
Why is it important, today, to recreate some historical experiments, in the context of science education? At a time where the discussion about the nature of science is very important, we can improve science education in this sense using eyes, hands, hearts and minds.
Experiments in science education are conducted as if they are all of the same nature. Using Oersted's experiment we can make a difference, by introducing some of his ideas about the place of experiments in knowing Nature. His 'romantic' science can prove precious in the context of science education.
The main purpose of our presentation is to show how this can be done and to answer the questions we have raised.

Historical Experiments Revisited: a Didactical Resource for Secondary School Teaching

Maria Elisa Maia University of Lisbon,
Isabel Serra PORTUGAL
Ricardo Martins

The reproduction of historical experiments is a recent trend in historical research, carried rigorously by research groups who intend to reproduce the conditions in which original experiments took place and to compare the results obtained with those referred by original papers. In these reproductions, original equipment or specially manufactured copies are used.
This idea can be used with didactic purposes, and some experiments can be adapted in order to be performed by students in classes, or demonstrated by teachers, for security reasons. The methodology is alike, but the equipment and conditions, although as similar as possible to that of the original experiment, do not need to be its exact reproduction, as this may be difficult and/or expensive.
The access to original papers is becoming easier every day, as many libraries and archives are digitalizing large amounts of documents made available in the internet.
An example of an experiment extremely relevant in the development of the physics and chemistry in the beginnings of the twentieth century is the discovery of radioactivity by Henry Becquerel in 1896. Documentation for this experiment is available in the internet and the protocol is easy to replicate in a secondary school context. This experiment opens perspectives for debates with students, not only scientific but ethic and related to technology and society.
In this communication we present a teaching module, including relevant information for teachers and an activity for students on the discovery of radioactivity, as well as suggestions for extensions of the study of the topic.

This experiment is included in a project that intends to introduce history of science in secondary schools in Portugal.

Pre-Galilean Comprehension of Nowadays Students of Trajectory Motion. Is it Possible that an Ancient Obstacle like This One be Overcome?

Marina Castells Facultat de Formació del Professorat,
Aikaterini Konstantinidou Universitat de Barcelona,
SPAIN

Pre-service students answered two problems regarding the trajectory of motion of a body, which falls down from, or is thrown from, moving vehicles. The problems are qualitative and in everyday context. Written students' answers from two different educative levels were analysed, identifying ideas and arguments. The summary of them is presented building Systemic Networks. From these networks, and considering the relationship found among several categories of them, we classify students in groups. These groups are ordered from more Physics use to less scientific use of the ideas of relativity of motion. The results show that a non-small group of students understand the velocity of a body as an absolute magnitude and give explanations similar to others found in history of science. A comparison with pre-Galilean understanding will be presented specially with G. Bruno and Kepler's interpretations. Didactical implications of these results will be commented.

Design of ICT Tools for History of Sciences and Education : a Genre of Digital Document to Model

Sylvain Laubé Equipe PaHST,
University of Brest,
FRANCE

I will present results of a research issued of the European FP7 project "Mind The Gap" concerning IBST (Inquiry Based Science Teaching), ICT tools and resources in History of Science. Elements in order to answer to the following questions will be proposed:
-The review of papers on IBST shows clearly that there are some difficulties to define what is IBST. What are the contributions of history of science and technology (HST) in order to help and define IBST? Why HST resources are an interesting answer in teacher training about IBST?
-ICT tools as data basis, website, virtual reality, etc. are used in researches in history of science and technology. In order to help to the development of ICT tools in HST for science teaching, what are the guidelines (or ICT resources) that could be proposed to science educators or teachers?
Semantic Web aims to provide a common framework that allows data online to be shared and reused for various applications and communities of practise. New research areas are explored with the help of computer science in order to model the genre of a digital document in History of Science and Technology.
As conclusion, we will show that we need ontologies [1] to describe the domain of knowledge to be able to reuse such Digital Documents in environments dedicated to research in HST but also education.

[1] http://en.wikipedia.org/wiki/Ontology_(information_science)

How could We Respond to the New Perspectives of Epistemology and Sciences History?

Arnaud Mayrargue CNRS REHSEIS, Paris,
FRANCE

The current French teaching system underlights the potential transversalism of some concepts, which are addressed in middle school as well as in high school. This is for instance the case of the energy concept, studied in a large variety of fields like physics, biology, mathematics or history. To introduce the story of this concept, we suggest to present a case study of the hot-air baloons invention during the late 18th. Firstly, this invention deals with the physics and chemistry field through the researches led by Joseph Black to define the new concept of heat, to express it in a mathematic way and to categorize it as an invariant. And from these researches about heat came out the energy concept. Then, this invention is related to history since we know how crucial these new flying objects were from a strategic perspective, especially in a tensed context between England and France after the Seven Years' War. Finally, it symbolizes quite well the circulation of ideas between scholars from different backgrounds, cultures and styles (Black in Scotland, Lavoisier in France). This perspective requires that we consider with new eyes the rôle and the place of epistemology and sciences history in teaching methods. Consequently, one of our aims will be to consider different potential methods (thematic, disciplinary and verbatim) in order to introduce epistemology and sciences history in this new framework.

More History of Chemistry, more interest in Science

Josep M. Fernández-Novell (1) (1) Department of Biochemistry and Molecular Biology,
Claudi Mans (2) University of Barcelona,
Carme Zaragoza Domènech (3) (2) Department of Chemical Engineering,
University of Barcelona,
(3) Department of Education, Government of Catalonia,
IES Can Vilumara,
SPAIN

In this study we explore the relationship between the University and the Catalan Board of Chemists "Col•legi Oficial de Químics de Catalunya" and the possibility that they could disseminate the History of Chemistry within Catalonian secondary schools. This is the first time that an organization of academic nature is proposing this idea.
After many years of working with secondary school students we have come to the conclusion that it is very important to explore science simultaneously alongside history of science.
In an effort to increase the interest in chemistry and also in science in Catalonian secondary school students, we proposed that on the 2009 science patron day (15th November) that secondary schools could work on the University and Catalan Board of Chemists' proposal. The activity proposed was about a periodic table painted in a classroom at the University of Barcelona's oldest building in 1934. This painting is and was of great historical value and has just been recently restored before the summer of 2009.
Therefore in the study in science classrooms of secondary schools, students examined, prepared and discussed the von Antropoff periodic table restoration. They compared it with a periodic table from XXI century working on Claudi Mans paper "The Periodic table from the historic building of the University of Barcelona"
More than 50 schools and 1500 students participated in this activity. After working in the von Antropoff periodic table and its restoration, students had an increased understanding of the notion of periodicity. And, finally, they related chemistry and science to the history of science, and to the history of the University of Barcelona your own history.

Visual Aids in The Nine Chapters on the Mathematical Art: Connections between Geometry and Algebra in Secondary School

Iolanda Guevara-Casanova Institut Badalona VII,
ICE de la Universitat Politècnica de Catalunya,
SPAIN

The introduction of diverse procedures to solve problems in the classroom of mathematics fosters the connection between contents and it favours the learning of the students because it does not limit them to a closed and finished vision of the problem brought up.
The use of historical texts in the classroom is a good resource to show this variety of procedures that enrich the learning and fosters a wider vision of the mathematics as a science in continuous evolution.
The Nine Chapters on the Mathematical Art (1st C a.d.), a classical text of reference of the ancient Chinese mathematics, contents more than two hundred problems that deal with subjects as diverse as the calculation with fractions, the utilization of the proportions, the extraction of roots, the resolution of right-angled triangles, the resolution of equations of 1st and 2nd degree and the resolution of equations systems.
In this communication, we present a sequence of activities implemented with pupils of secondary school, based on the problems of chapter 9 of The Nine Chapters on the Mathematical Art. From the fundamental figures, described by Liu Hui (263) and Him Chunfeng (656) in the comments of the classical text, analysed in the bilingual translation by Karine Chemla i Guo Shuchun (2005) and following the suggestions of Siu Man-Keung (2000) about their pedagogic value, the activities that are presented have been designed.
The activities are part of a more general project: The historical use of contexts in the classroom of mathematics of secondary: the concrete case of the visualization in the geometry-algebra connection.

The Influence of Euler's Calculus Treatises

João Caramalho Domingues Centro de Matemática da Universidade do Minho,
PORTUGAL

Leonhard Euler (1701-1783) was arguably the most influential mathematician of the 18th century. He is generally regarded as one of the main exponents of the analytical tendency that gained predominance during that century. For instance, he published a purely analytical version of the differential and integral calculus in a set of treatises (an Introduction in 1748, a treatise on the differential calculus in 1755, and a treatise on the integral calculus in 1768-1770) that are commonly seen as a turning point in the liberation of calculus from geometry.
But how influential were these treatises, and when?
The three treatises enjoyed reprints before 1800; but it is striking that while their original editions are spread through 22 years, these first reprints are concentrated in the 10 years from 1787 to 1797. The first translations also appeared around this period, starting in 1786. An analysis of common textbooks of the second half of the 18th century also suggests that the influence of Euler's calculus treatises grew considerably in the 1790's. In the 1760's and 1770's, only isolated passages show clear influence from Euler; while in the 1790's, important textbooks and treatises appeared that followed Euler's model in a coherent way. Pietro Paoli's Elementi d'Algebra (1794) and S.F. Lacroix's Traité du Calcul différentiel et du Calcul intégral (1797-1800) are the most obvious examples. Naturally, this was reflected in the teaching practice at new institutions such as the École polytechnique of Paris.
Possible explanations for this change include: a change in a more general cultural/philosophical framework, towards "analytical" methods; a natural time delay between the uses of concepts and methods by "research" mathematicians and by textbook authors; the great prestige of scientific analytical works such as Lagrange's Méchanique Analitique (1788).

The Origins of Technical Education in India. Study of Different Approaches

Samir Kumar Saha Mechanical Engineering Department,
Jadavpur University, Kolkata,
INDIA

In India the colonial model of technical education with the establishment of Guindy College (1794), Thomason College (1847), Poona Engineering College (1856) and Victoria Jubilee Technical Institution (1887) went in one direction. A national model was attempted to be developed in Calcutta, initially at the Indian Association for the Cultivation of Science (1876) & then at the National Council of Education, Bengal (1905-1906). National Council of Education, Bengal & then Society for Promotion of Technical Education, which later merged into BIT, initially strived for a Swadeshi model different from Guindy, VJTI or Thomason College. However, it was around 1910 & industrialisation was a distant goal. Of course, the colonial rulers did not want that also. There was the industrial policy report (1916) which devoted some pages to give a direction for Technical Education in the country. But the main concern of the British being export of raw material & building some road and rail infrastructure, there was no roadmap for growth of Technical Education in India almost till 1950's i.e. even after independence. The Sarkar Commission Report (1946) initiated the establishment of the first IIT at Kharagpur as a Technical Teaching & Research Institution.
Another attempt towards scientific progress in colonial India was the establishment of IISC in 1909, mainly with attempts of the industrialist JRD Tata. Guindy & NCE became state universities in years 1978 & 1956 respectively. Roorkee became a University and then IIT. VJTI retained its autonomous technical college structure. But IISc turned into a PG research institute.
The present paper attempts to show the differences of development of Technical Education in India – particularly the colonial & indigenous models, particularly the evolution of Jadavpur University as a premier technology teaching & research institution in India from the Swadeshi initiation of National Council of Education, Bengal in 1905.

A Historical Study of Fourier Analysis with Pedagogical and Dialectic Reflections

Ma Li Norwegian Academy of Education,
NORWAY

The Fourier transform and its generalizations are the subject of Fourier analysis which grew out of the study of Fourier series. Although the original motivation of Joseph Fourier (1768-1830) was to solve the heat equation, various properties of the transform brought about its wide applicability in physics as well as other areas. We present a historical study of Fourier series with pedagogical and dialectic reflections. It is also an example of integrating history in the teaching and learning of mathematics.

History Promotes Technical Culture thanks to Pedagogical Project: an Inter-disciplinary Team Dedicated to Virtual Reality Development, a Case Study with DCNS Indret

Jean-Louis Kerouanton (1) (1) Centre François Viète,
Florent Laroche (2) Université de Nantes,
(2) Ecole Centrale de Nantes,
FRANCE

Contemporary engineering processes require numerous competences and knowledge issue from different semantics. Our research consists to design virtually ancient technical objects. They are firstly initiated by technical contemporary product; but as we consider the history of industries, it consequently involved technical and industrial heritage. Our proposition consists in overturning the time axis of the design process generally used for developing contemporary technical products. That means that we begin at the end of object lifetime and come back to the initial need that define why the technical object had been created. First step is the digitalisation of the physical object and the capitalisation of the know-how learnt by studding the object. Next, thanks to virtual reality technologies, we can valorise this amount of knowledge. This global process is what we call Advanced Industrial Archaeology.
In this communication, the methodology will be illustrated by a case study done by our research team about the steam ship “canot”, built 1861 in Indret Imperial arsenal. The DCNS Indret originality is to dispose its own little historical archive service. All the collaboration with it and the whole studies have been done with student as pedagogical project: history, mechanic, thermal, automatism, virtual reality. This multi-field and transversal experiment called competences in history of the techniques and industrial inheritance of the Centre François Viète (epistemology, science history and technical history) as well as those of the Central School and IUT of Nantes, from the point of view of digitalization, data processing, virtual reality, mechanical and and Polytech' Nantes for thermal studies. It also calls upon competences of the UFR Histoire from the point of view of the historical and documentary study.

Early Scientific Instruments for Teaching Physics in the University of Barcelona

Santiago Vallmitjana Rico Dept. De Física Aplicada i Òptica,
Universitat de Barcelona,
SPAIN

Although the University of Barcelona was founded in 1450 there is no evidence of the existence of scientific instruments for teaching until the 19th century. According to our archives, in middle of this century it is on record that classes of Physics, Astronomy and Experimental Physics among others were taking place in the University of Barcelona.
For this reason, at that time the University acquired the first instruments for the teaching of Physics, following the recommendations made by the educational ministry, which increased notably in number until the end of the century and have continued to do so since then. Now the collection consists of about 250 instruments belonging to the sections of Kinematics, Mechanics, Statics, Dynamics, Hydrostatics, Acoustics, Optics, Static-Electricity, Electricity and Magnetism.
This study analyses the existing scientific instruments acquired in the 19th century and correlates them with a handwritten list dated 1868 found in our archives. Then a further cross-correlation is carried out with the official lists that appeared as a consequence of the educational reforms promoted by the Directorate General of Public Instruction (Dirección General de Instrucción Pública).

The Acquisition of Mathematical Knowledge through European Textbooks by the Greek Intellectual Community in the 18th Century.

Maria Terdimou Hellenic Open University,
GREECE

The subject of this paper is the transmission of European mathematical knowledge to Greece in the 18th and early 19th century, i.e. during the final decades before the Greek Revolution, mainly through mathematics textbooks. This event is illustrative of the dissemination of scientific information in the wider area of Europe.
In an age (the pre-revolutionary period), when there was an endeavour to advance Greek education and stimulate spiritual awakening, Greek scholars realised that the most important thing was not only or even mainly the production of original work, but the transmission of knowledge, in the form of translations or compilations, from Europe, where scientific and philosophical knowledge had long been developed to a high degree. And this was exactly what they did.
Of the 28 mathematics textbooks which circulated in printed form during the 18th and the first decades of the 19th century, 11 are translations of Western European works, such as those of Tacquet, Metzburg, Euler and others, while the rest are compilations, as is expressly stated in the title or preface of most. Apart from these, however, several other works which remained in manuscript form are also the result of compilation or translation efforts.

Bibnum (www.bibnum.education.fr), a Guided Digital Library for History of Science

Alexandre Moatti CERIMES, Centre de ressources et d'information pour les multimedia dans l'enseignement supérieur,
Ministère de l'education nationale,
FRANCE

The internet site Bibnum (http://bibnum.education.fr) has been opened in 2008 by CERIMES, French organism depending of both Ministry for National Education and Ministry for Research. It is a digital library, with a choice of founding scientific texts (articles, chapters of books) of the 19th and 20th centuries: these texts are commented by current scientists who underline their importance, explain the purpose of the author, and bring the text into the light of today's science. The talk will address the genesis of the project, the private-public partnership it develops and its goals. Among the latter are: 1) the valorisation of scientific heritage of the French "grandes écoles" during the 19th century (namely École polytechnique, École des ponts et chaussées,...); 2) the will to provide a lively history of science for teachers in college or university, for students at the university and 3) the will to reach out to and guide an increasingly larger public for using digital libraries.

Why is it Necessary and Important to View the Question of the Role of History of Science and Technology in the Promotion of IBST as a Historical One?

Alain Bernard Paris 12 University and EHESS, Centre Koyré
FRANCE

I will argue the three following points about the assumption that history of science (EHST) might contribute to the promotion of inquiry based science teaching (IBST) in science teaching as well as in teacher training. (1) The effort to promote EHST in science teaching is in itself a historical fact that should be studied as such and therefore calls for further historical research. (2) This history leads us to recognize that this promotion can hardly be dissociated from the simultaneous effort to promote the pupils' autonomous inquiry as a recommendable method for science teaching. In other words, the calls for taking into account history of science and new teaching methods in science teaching historically are deeply correlated: they are at the core of a long and tortuous tradition, which lead us back to antiquity. (3) This historical research is not only possible but should also be done for the purpose of enriching teacher training curricula. The reason for this is that any effort to promote both IBST and history of science in science teaching as novelties, if not revolutionary ideas in education, are deemed to fail if we do not persuade the future teachers that these promotional efforts are part of the long-term history of our teaching institutions and methods. I will therefore argue for the necessity to promote this kind of research both as an issue that is interesting per se and as a necessary component of contemporary teacher training.

History of Sciences and Teaching of Biological and Geological Sciences in the French Secondary School. What Kind of Teacher's Training and What Kind of Teaching?

Pierre Savaton IUFM, University of Caen,
Centre François Viète, University of Nantes,
FRANCE

Since 2005, the learning programmes of Biology and Geology of the pre-academics classes (pupils from 11 to 18 years) indicate that it's possible to introduce some elements of history of sciences relating to the science's concepts studing into these classes. But, it's just a possibility. Sciences teachers must follow the experimental method and not the historical one. It's through an investigative approach (démarche d'investigation) that historical elements can be used as well as experimentations or studies of current scientific documents. Usually the university training of the teachers of Biology and Geology does not include studies of history of sciences and the in-service training of teachers (of the national education) does not include training courses in history of sciences too. Thus teachers must be trained by themselves if they want to introduce elements of history of sciences into their courses of sciences. The new textbooks present some pages of historical datas, reduced to some lines of an historical source and some lines of context, even just a photography of a great scholar. There is a risk to reduce history of sciences to an illustrative and anecdotic role.
This assessment established, the communication will discuss the reasons which are opposed to a real introduction of history of sciences into secundary courses of sciences and which explain the lack of sciences history courses in teachers training.

Les Magiciens de la Lumière (Wizards of Light), a Film for Education

Pierre Lauginie GHDSO (Groupe d'Histoire et de Diffusion des sciences d'Orsay),
Faculté des sciences d'Orsay,
Université Paris-Sud,
FRANCE

"Les magiciens de la lumière" or "Wizards of Light" is a history of science film (2009, DVD format, 60 min., English subtitles) tracing the history of the speed of light up to Foucault's spinning-mirror experiment (1862). This last experiment was an item of our experimental approach of History of Science in Orsay. The film is a historical work of fiction, resulting from a collaboration between the GHDSO(1) and the SCAVO(2). It is planned for a projection in Barcelona as an optional extra activity on Wed. 17 November. The DVD will be soon supplemented by a second DVD including important "bonus", in view to make the whole set a tool for Physics education.
We focus here on such a use. Several tracks are suggested :
• role of Technology: why Fizeau's first terrestrial measurement only in 1849 ? Why did Foucault succeed in comparing the velocity of light in air and in water (1850) before Fizeau? How will this qualitative experiment be adapted for an accurate absolute measurement in air in 1862 ?
• reflections on the motives of a measurement: at first, does light has a velocity? (Römer 1676, Bradley 1728); or criterion to decide between rival theories (Foucault, 1850); or need for an accurate value for new applications (Foucault, 1862).
• at a lower level: ask children to play the scene of Galileo's trial with the lanterns; compare with Galileo's conclusions.
• at a university level: try to retrieve the implicit model of light (if any) in Römer's discussion of Jupiter's first satellite; discuss it in connection with subsequent theories.
• not to forget: watching the film like visiting a science museum (original instruments shown).
(1) Groupe d'histoire et de diffusion des sciences d'Orsay.
(2) Service de création audiovisuelle de la faculté d'Orsay.

Why, Specialy for Biology Teachers, to Use On-line Resources in History of Science for Inquiry-based Science Teaching can be Difficult?

Hervé Ferrière ERCS "PaHST",
University of Brest;
EA "CRREF",
University of Antilles-Guyane,
FRANCE

We think that history of biology helps the understanding of the scientific inquiry by the pupils, and we prepare to offer some on-line resources to them. But then, how to help the teachers to use this means ? And why they need help specially in biology ? In 1994, in the syllabus of biology in France, appears for the first time, the Charles Darwin's Theory of evolution. A few years after, it is forgotten. Teachers prefer to teach facts and mechanisms of evolution rather than the theory of evolution because students had many questions about the moral and religious values. So why this confusion in science classes ? Perhaps because students do not understand the scientific process. They do not know the nature and construction of a scientific theory. They do not understand that sciences give us only knowledges and means to understand the world. However, in study of biology, the moral values mobilized by the studied objects are often very important. Study life - its fragility, history, links with the environment - affects us directly. But these values change with time. For example, talking about the link between other animals and humans is less difficult today but it still hurts some students. Use of resources in history of science can remove these difficulties. But, if we want that history of science helps teachers to teach scientific methods and pupils to understand it, it is necessary to know the scientific concepts, the methods of investigation but also the historical transformations and implications of these moral values. So when, in France and may be in Europa, we want to offer on-line resource in history of biology, we have to discuss about this sort of problem. What on-line resources in history of biology should we given to the teachers?

An Aim for Science Education in France: the Image of the Nature of Science. How to Introduce the History of Science in Science Classes in order to Reach it?

Laurence Maurines DidaScO,
Daniel Beaufils Université Paris-Sud 11,
FRANCE

There is currently, in the French science curricula, a strong request to introduce the history of science in physics and chemistry classes at all levels of teaching. Emphasis is placed on a "cultural" dimension", which is poorly defined but essentially refers to elements of epistemological nature. But there is little or no connection between this general aim of the curricula and the learning goals specified for each thematic domain: they only concern the scientific concepts and process. Moreover, textbooks give little place to history of science, and when they do, they convey a distorted picture of the nature of science. Besides, the science curricula recommend implementing inquiry situations based on the questioning of students. In our point of view, these two aspects (history of science and investigation) reveal a general aim for science education concerning the image of the nature of science (NOS). Our main issue is to examine the possibility to communicate a more authentic image of the nature of science with history of science. If this issue has been little explored in France, this is not the case abroad, in particularly in USA and UK. First, we present the specific learning goals we derived from our epistemological and historical analyses and show how they relate to complementary characteristics of the scientific enterprise and to different spatial and temporal scales. Second, we explain the rationales that led us to elaborate documents and activities for students, to incorporate them in historical inquiry situations, and to couple some of them with experiments. Third, we give some examples and discuss the difficulties linked to teachers 'practices which could be encountered when implementing such situations in classes.

How to Read the History of Science in the Science School Textbooks: Theoretical and Methodological Considerations Inspired in Bruno Latour's Ideas about Non-humans and Networks

Diana M. Farías (1) (1) Universidad Nacional de Colombia,
Marina Castells (2) COLOMBIA
Josep Castelló (2) (2) Universitat de Barcelona,
SPAIN

We have carried out a historical research of chemistry school textbooks published in Spain in the course of twentieth century. Based on our results we point out some theoretical and methodological considerations which are important to do a reread of the way as history of science is commonly presented in school science textbooks. We propose to stress in two essential ideas of Bruno Latour's thought: 1) The role and agency of non humans in the scientific knowledge and 2) An interpretation of history in science textbooks as a complex network, where there are not clearly-defined limits between history, philosophy and sociology of science and where history can be understood as a part of a "structure", which becomes more or less stable depending on the way as their "fibers" are "interwoven" in the narrative of science textbooks.

B. Raykov and the Development of the Research Approach in the Natural Science Education in Russia

Samokish Anna Saint-Petersburg Branch,
S.I. Vavilov Institute for the History of Science and Technology,
RUSSIA

Nowadays the problem of natural science education is a topical question. The natural science educational programms are now in the course of reforming such as the whole school system. So I study the history of reserch approach in natural science education in Russia and USSR of the first third of XX century. The natural sciences in Russia both before revolution, and after were in a difficult situation. At first it was because of restriction of natural science teaching in state schools, then the Civil war was. In 20th years there were the complex programs which destroyed natural sciense as a separate school subject.

But there were teachers and even scientists who tried not only to read the school book but to form scientific outlook and to tell about with the newest scientific achievements. Among them there was also B.Raykov. He was one of the first who used a research approach (contrary to illustrative one) at school. This means a student himself does conclusions by results of the experiment or observation offered by the teacher. Even before revolution Raykov organised the laboratory at school where he worked. .

He took part in the development and headed far the long time the Society of Distribution of Natural Science Education. After the revolution he headed the departments of methods for natural science teaching at two institutes. He developed and proved his methods during that time. He made a lot for development of excursion approach in education. In 20th years he opposed the complex programs and agronomization of school biology, headed the Leningrad group of natural science teachers.

This work is based on materials of the memoirs by Raykov and his colleagues, periodicals, textbooks and methodical books of that time.

S04 Centers and Periphery in Europe: The STEP Research Project

Coordinated by **Geert Vanpaemel (K.U. Leuven, Belgium)**

Chaired by **Josep Simon (Université Paris-10, France)**
Geert Vanpaemel (K.U. Leuven, Belgium)
Manolis Patiniotis (Athens University, Greece)

In the historiography of science in Europe, the role of the various local cultures in the representation and appropriation of science cannot be denied. Centers have been defined as places where important new knowledge is being produced while peripheries only act as places for the passive reception and presentation of imported knowledge. The genesis of this distinction is often implicit: it may result from the neglect of the actual scientific life in so-called peripheral countries, or it may be produced by the strategy of ´peripheral´ scholars to attach their activities to what is considered an important center.
As a result of the work done by the international research group STEP in the last decade, European Periphery has become a historiographical standpoint. Starting from the periphery (or, better, standing on the periphery) might offer a clearer view over the intricate ideological constructs which accompany the establishment of science and technology, and at the same time, unveil the socio-political dimensions of the sciences in the European periphery.
STEP (Science and Technology in the European Periphery) is a multi-national research group focused on the study of processes and models of circulation of scientific and technological knowledge between European centres and peripheries from the sixteenth to the twentieth century. It was founded in May 1999, in Barcelona, and gathers researchers and university teachers from Belgium, Denmark, Finland, Greece, Hungary, Italy, Portugal, Russia, Spain, Sweden, Turkey, and many other countries – have recently started to include members from other continents as well. STEP organises thematic meetings held biannually. Besides the foundational meeting in Barcelona, four more meetings took place in Lisbon, Portugal (Scientific travels), Aegina, Greece (Scientific and technological textbooks), Aarhus, Denmark (Traditions and realities of national historiographies of science), Maó, Spain (Scientific and technological popularisation in the European periphery), Istanbul, Turkey (Scientific controversies in the European periphery). The 7th STEP meeting will be held in Galway, Ireland, 17-20 June 2010.
Relying on the work of the STEP group, this symposium proposes to reconsider the notion of center and periphery within the context of a history of interconnected cultures within Europe. We hope to develop a critical analysis based on comparative and historiographical studies, documenting and interpreting the local cultural settings of science, the mutual interdependence of centers and peripheries (paying attention to the varying meaning and attribution of these terms), and the construction of master narratives by actors and commentators/historians.

STEPping Forward in Historiography of Science

Manolis Patiniotis Department of Philosophy and History of Science,
Athens University,
GREECE

Center-periphery dichotomy is, undoubtedly, a difficult but also challenging issue in history of science. The aim of this paper is to communicate some historiographic reflections arising from its author's involvement in STEP research project. It focuses on three distinctive topics.
First, the question of "originality". The cornerstone of all arguments concerning center-periphery distinction is the tacit acknowledgment that there is a certain time and place where the "original" scientific ideas or practices came to light. As a result, the preeminence of center over periphery is based on the separation between the production and the distribution (or the minor contribution in the shaping) of knowledge.
The second topic discusses the intellectual character and the assumed homogeneity of such major intellectual endeavors as "Scientific Revolution" or "Newtonianism". These landmarks of science usually serve to demarcate the contexts where "real" scientific work took place, as opposed to those contexts where scientific ideas and practices comprised part of broader (and thus less scientific) intellectual undertakings.
The third topic focuses on the involvement of the scholars of the periphery in modern science. A widespread assumption among historians of science is that the scholars of the periphery, due to reasons that did not usually depend on their will or capabilities, chose to abstain from the creativity of their contemporary scientists and stress, instead, the pedagogical and ideological significance of the new scientific spirit for their societies.
These topics keep recurring in the center-periphery discussion and STEP is not immune to such considerations. However, the results of the research produced during the past ten years enables us to move away from such rigid conceptualizations. Taking periphery as a historiographic standpoint may bring forward some crucial moments of the interaction between different socio-political contexts, and the role played by the sciences in the establishment of current cultural distinctions.

One or Many? Laboratory Cultures in Europe

Geert Vanpaemel HU Brussels,
KU Leuven,
BELGIUM

Science has been presented as a universal system of knowledge, which in its modern form would inevitably lead to a homogeneous scientific culture. As such, the spread of science from the 'centres of learning' to 'peripheral' regions functioned as a strong force in connecting different local environments to a common scientific culture. This paper sets out to investigate the creation of laboratory infrastructure in various European countries. It will question the accepted view of the homogenization of scientific culture and the possibilities of maintaining a more diversified approach.
The research laboratory has become an almost iconic image of modern science. In particular during the modernization era of science (1850-1950), the construction of well equipped laboratories was a first step towards the implementation of scientific practices within a national culture. The uniformity of laboratories warranted access to the international scientific community and became a recognizable feature of modernization. Very often, the so-called 'German model', based on both the academic laboratories in German universities as well as the industrial laboratories in the German dye stuff industries, was put forward as the model to replicate. In particular in peripheral countries, adaptation of this German model was a strong rhetoric for underscoring the quality of domestic scientific culture.
Yet, the actual lay-out of laboratories was equally determined by local political circumstances, economic needs and cultural preferences. Cultural factors were also important: gender differences in work relations, appreciation of pure or applied research, preferences regarding local needs or opportunities, etc. The laboratory itself can be seen as a creator of meaning, endowing institutions with authority while taking away legitimation from existing traditions. This paper examines the variety of laboratory models in different European countries. Focusing on the experimental agricultural stations, the paper will also raise some issues related to the local geography of science.

The Dutch Cutting Edge in a Northern Periphery. The Transfer of the Fine-blade Sawmills to the Rim of the Baltic Sea in the 17th and 18th Centuries

Timo Myllyntaus University of Turku,
FINLAND

Among late 20th century Finnish historians, the Dutch fine-blade sawmill represents a technological innovation of particular fascination. The sawmill industry alone remains a hot topic in Finnish history, but the large amount of attention given to this single technological innovation by historians of two generations grants it distinction. Although its introduction boosted the Finnish sawmilling industry, many contend that nevertheless it has not perhaps been the most revolutionary innovation in the history of Finnish sawmilling.
This paper argues that the fine-blade sawmill's popularity among the historians of the 1970s and 1980s was mostly based on the story and theoretical concepts that were attached to it. Con¬sequently, the paper focuses on bringing the notions of center and periphery to Finnish historical research and constructing a distinctive peripheral identity for Finland.
Another objective is to examine case studies on the "counter-clockwise" transfer of the Dutch fine-blade to commerce centers located along the Baltic coast. Dutch and German master-builders first built a new kind of sawmills with imported fine-blade machinery in the Baltic Provinces in the mid-17th century; by the end of the century, these new sawmills were erected in Ingria and Nyen, close to present St. Petersburg, at the eastern bottom of the Gulf of Finland. Later in the early 18th century, these sawmills spread westward along the Finnish southern coast (to Viborg, Hamina, Helsinki). Refuge sawmill builders transferred the technology from Finland to Sweden, where sawmills began to modernize in the 1740s: they became equipped with several frames with fine-blades. Norway was a bit ahead of Sweden; the first 'Dutch' sawmill with multiple blades in the same frame was erected in Kristiania (Oslo) in 1714.
A significant feature was that the new fine-blade technology allowed the Baltic and Nordic sawmill industries to compete successfully in the British market, where the demand for sawn timber greatly increased after 1760.

Scientific Debates in the European 'Periphery': Disputing on the Nature of the Caloric in the Greek-speaking Space during the Early 19th Century

Sandy Sakorrafou School of Humanities,
Hellenic Open University,
GREECE

In contrary to what the so-called «centre-periphery» historiographical model suggests, the procedure of integration of the new scientific ideas is not constrained to a proper selection and transfer from the centre to the periphery countries, but it is an internal intellectual and cultural process, that of appropriation, taking place within the latter. The diffusion of the new chemical knowledge in the late 18th century Europe has been argued to be a creative procedure undertaken by groups of people of different status, with different local interests and practices. This paper explores an example of that process, the case of the Greek speaking scholars who introduced the modern chemistry in the Ottoman occupied Greek speaking regions during the Modern Greek Enlightenment (1774-1821) focusing on a scientific dispute between them on the nature of the caloric and the presence or absence of its weight. The question of the nature of heat, though not a vital one, still was critical until the early 19th century in Europe. The Greek speaking scholars felt legitimately entitled to participate in this discussion. The debate initiated by Dimitrios Schinas in the pre-revolutionary scientific journal Hermes the Scholar in 1811. The disputants, among them the eminent scholar Veniamin Lesvios (1759/62-1824), being aware of their lack in experimental equipment, unable to replicate any experiment for or against the question under study, would seek for a qualitative explanation. They would proceed to the creation of a distinctive discourse according to the local scholastic-Aristotelian and neo-Aristotelian tradition; following the form of philosophical argumentation the emphasis was given to the logical character of their arguments, the usage of analogical reasoning and the definiteness in language.

Centres and Periphery in Europe: The Case of Gregor Mendel´s Discovery

Jiri Sekerak MENDELIANUM Musei Moraviae, Brno,
CZECH REP.

Periphery of time: Mendel´s elucidation of hereditary processes based on his experimental model with plant hybrids in 1865 was a solely standing achievement. The biologists were working within the mainstream of science influenced by Charles Darwin who brought the up to then hereditary research into the context of heredity of acquired characters. Mendel was solving a question that was not considered as problematic in the nineteen-sixties.
Periphery of specialization: Mendel worked in the Brno Agriculture Society intended for practical exploitation of knowledge in the improvement of sheep and plants to contribute to the industrialization of the Habsburg Austrian Moravia following the British progressive model. Next to sheep and fodder plants the Brno improvers aimed at the hybridization of ornamental plants in order to achieve new colour varieties. The results of those hybridizing experiments captivated Mendel´s attention and gave him impetus for realization of his pea trial even though he was a physicist by university training.
Periphery of place: Brno was a suburb of Vienna in Mendel´s days focusing its attention at founding a university and technically oriented school of higher learning. Open scientific societies implemented the experimental method and cultivated science as a mighty instrument in achieving societal welfare. Many an Austrian dissident scientist found a refugee in Brno that attracted motivated people to engage in the starting industry, business, banking and education.
Periphery of style: Mendel did the artificial pollination alone. As a son of a peasant he did most of the „dirty" gardening work alone. Not using white gloves in performing artificial pollination Mendel was a man at the fringe of the academic style.
From the periphery to the centre: The shift took 35 years. In 1900 Mendel´s discovery became the fundament of a new science – genetics making revolution in the study of life systems.

Chemical Industry and Technology in the Czech Lands in the First Half of the 20th Century (Cross-National Comparison)

Ivana Lorencova Department of the History of Science and Technology,
National Technical Museum, Prague,
CZECH REP.

In in the first half of the 20th century chemical industry, technology, engineering and science had undergone an quick development. It was a period of unbelievable technical and scientific progress and the period of the circulation of "brains". But it was also the century of many political and social turns, gives us many occasions to think about what was the driving force of the development of new technologies, why the production of some goods was increased, whereas some products weren't produced anymore. Economic and political situation of the society was often the motive power of development of the science and technologies, which on the contrary retroactively affected the society. In the context of all-European development, even the chemical industry was developing, chemical technologies were gradually taking over new scientific theories and technical solutions and their development was dependent on the progress in chemistry, physics, medicine, biology etc. The quality of life in the 1st half of the 20th century was radically changed by the emergence of transport, better distribution of electricity, by introduction of the batch production and last but not least, by both World Wars. The introduction of new manufacturing processes desperately needed some special education of future scientific experts. At the end of the 19th and the beginning of the 20th century, many specialized research institutions were founded, mostly in Germany and in the USA. Chemical companies started to organize and financially support their own research centers. In the Czech Lands many foreign specialists, technicians, engineers and university teachers brought new modern ideas, experience, instruments and techniques.

The Modernity of Mathematics in Spain through the Doctorate in the Period 1900-1936

Luis Español González Universidad de La Rioja, Logroño,
Mª Ángeles Martínez García SPAIN

Located on the periphery of European mathematics, Spain reached the twentieth century with a weak mathematical research both in quantity and quality. To be a doctor in mathematics wasn't necessary to have done an original research, it was enough to have some degree of erudition without requirement of modern mathematics in relation to the mathematical vanguard of Europe. The 1900 legislative reform intended to improve university education and the relationship centre-periphery in the context of European science. But some gaps remained in force, for example only the University of Madrid was authorized to provide doctoral studies, and this fact did not change throughout the period that we consider in this paper. Moreover, only a very small number of professors, somewhat higher since 1915, participated in a PhD. The studied period finishes in 1936, the beginning of the Spanish Civil War.
In this communication we consider the doctoral thesis defended in Spain between 1900 and 1936. The first ones correspond to studies with the format of the previous century, and since 1905 these works follow the guidelines of the reform of 1900. Until 1915 there was a predominance of geometry, mainly synthetic projective geometry. There was a change in 1915, when the "Mathematical Laboratory and Seminar" was founded, which was a research site independent of the Faculty of Science. Since then, the quality of the thesis increased, originality was demanded and more current subjects were appearing in Spanish research. The aim of our work is to establish a classification of doctoral thesis in the period that permits to identify both the reception of mathematical theories as the focus of mathematical creation that influenced in the Spanish development.

S05 Circulation of Ideas, Techniques, and the Scientific Personae - the Role Networks did Play, from the Gender Perspective

Coordinated by **Annette B. Vogt (Women's Commission of the DHST/IUHPS)**
Annette Lykknes (Women's Commission of the DHST/IUHPS)
Maria Rentetzi (Women's Commission of the DHST/IUHPS)
Chaired by **Maria Rentetzi (National Technical University of Athens, Greece)**
Ida H. Stamhuis (VU University Amsterdam, Netherlands)

In the last two decades in the history of science some progress was made towards a deeper understanding of the role of women scientists in different disciplines (in sciences, technology, medicin and in the humanities). The ESHS conference in Barcelona offers the possibility to bring together various results as well as experiences in the research on women scientists and gender research. The aim of the session will be to discuss the different forms of circulation of knowledge and the role networks played in these processes from the gender perspective. It is indubitable that networks play an important role in the development of science. Exchange of knowledge and expertise between scientists of several countries and universities stand on the top of their agenda. Parallel to this runs the importance of belonging to the "right" networks for the development of one's own scientific career. Historically participation in professional organisations and other scientific networks have been long ago recognized as the most essential part in the advancement of science. However, given the marginal position of women in science it is interesting to explore the role of gender in networking in science.
Papers from different approaches and different perspectives are welcome:
1. Investigations into the circulation of ideas, theories, methods, and the role women scientists played in this context.
2. Studies about the circulation of objects, instruments, artefacts as well as the circulation of texts, i.e. manuscripts, letters, printed books, and translations, and the role women scientists played in this context.
3. Investigations on the circulation of scientific personae and the role networks played

Exchange of Scientific Information among the Sanitary Professionals Participating in the International Sanitary Conferences in the 19th Century

Francesc Bujosa (1) (1) Grup d'Investigació d'Història de la Salut,
Gloria Gallego (1) Institut Universitari de Ciències de la Salut,
Pere Sales (1) Universitat de les Illes Balears (GIHS-IUNICS-UIB),
Joana Maria Pujades (1,2) (2) Centre d'Estudis Demogràfics,
Universitat Autònoma de Barcelona (CED- UAB),
SPAIN

The archive and the library of the Spanish physician Pere Felip Monlau (1808-1871) are located in the Balear Library in Palma of Majorca. This archive contains all the correspondence exchanged between Monlau, Spanish delegate in the three first International Sanitary Conferences, and the others delegates of the countries represented in the Conferences.
The archive has letters of Guglielmo Menis (1793-18??) a delegate from Austria, François Melier (1798-1866) from France, A. Costi from Greece, José Maria Grande (18??-1858) from Portugal, Mühling from Prussia, C. O. R. Rosenberger (1806-1866) and Eugene Pelikan (1824-1884) from Russia, Angelo Bo (1801-1874) from Sardinia, Pietro Betti (1784-1864) from Toscana, Giuseppe Carbonaro (1800-1858) from Two Sicilies, Bartoletti from Turkey, John Sutherland (1808-1891) from United Kingdom and Agostino Cappello (1784-1858) from the Vatican State.
The aim of the paper is to analyze the information related to the fight against epidemics, mainly cholera, contained in these letters in order to evaluate its influence in the conclusions of the International Sanitary Conferences.

Naturalistic Observations in Apulia during the 19th Century. Vincenzo de Romita and Enrico Hillyer Giglioli

Peter Zeller Department of Human Science, Landscape, Cultural Heritage, Literary Civilisation and Education (DISCUM),
Faculty of Education Sciences,
University of Foggia,
ITALY

After the 1861, year of the Unity of Italy, a new and different circulation of goods and then of naturalistic finds and scientific instruments among the different areas of the country begins. The south, far from Europe, poor of material and intellectual resources goes on finding its reference centre in Naples. In Naples there is the University and so people go to Naples to study and to teach.
In Naples there has been for some years the Zoological Station with the Aquarium, made by Anthon Dora (1872). But something happens also in the far province of Bari (Apulia) where a young scholar, Vincenzo de Romita, manages to create, with personal sacrifice, two collections: a naturalistic one and another of Neolithic finds (For more information: The anti-historical remains of the Province of Bari, 1876).
He goes down into the caves, catches snakes, walks tens of miles looking for carved flint stones. But, most of all, he weaves an important net of exchanges with the most important scholar of his time. In particular, he is friend of Enrico Hillyer Giglioli who studied at the London School of Mines, where he knew Darwin and Huxley and who was back from an adventurous travel around the world with the Magenta corvette. Twelve letters found in the La Specola Museum of Florence witness a decade of exchanges.
Finally, Giglioli entrusts him the responsibility of writing the observations on the Apulia avifauna for the making of the First Report of the Results on the Ornithological Inquiry in Italy (1890). The de Romita's collection; which soon reaches some notoriety, is the basis of a series of publications: the Apulia avifauna (1883), the Addition to the Apulia Ornithology (1890), The new Additions to Apulia Ornithology (1900) and the Materials for the Fauna of Bari (1900). This last one will be presented during the universal Exposition of Paris in 1900 inside the volume The Land of Bari from the historical, economical and naturalist point of view realized by the Province of Bari.

Erna Lesky, General and Diplomat.
Networking as a Power Tool for Career- and Science-Management in History of Science

Felicitas Seebacher Faculty of Humanities – Department of History,
Alpen-Adria-University of Klagenfurt,
AUSTRIA

On the 3rd of October, 1960, the physician Erna Lesky became the manager of the Institute for the History of Medicine at the University of Vienna, housed in the 'Josephinum', the former Military Medical Academy. She had built up her career together with her husband, Albin Lesky, professor of old philology. In 1956, Lesky habilitated in the history of medicine, on the same day as her competitor Marlene Jantsch, who worked for Leopold Schönbauer. Schönbauer had been provisional head of the Institute for the History of Medicine from 1944 to 1960 and Jantsch was his personal assistant. Throughout this time, Jantsch remained "the woman behind". Referring to Lisa Fischer, men constructed the reality in science. If women succeeded in developing a self-image, contrary to the male external definition, they had to suppress it in order to maintain the patriarchal system. Lesky broke with the traditional role model and perceptions of women in medicine. Michael Hubenstorf deals with the conflict in the essay "Success and Tragedy of an Historian of Medicine". Fortunately, Lesky integrated well into a scientific community of male order, as her correspondence with male historians of medicine shows. The diplomatically built up networks and an enormous determination for performance stamped her objective and subjective career success. Lesky understood how to demonstrate authority and power and to win allies. On the occasion of the six-hundred-year celebration of the University of Vienna in 1965, she invited colleagues to her "reconquered Josephinum" with its precious collections and libraries. In 1966, Lesky was the first woman who received a chair at the medical faculty. In international comparison, this was very late.
The aim of this paper is to show how Lesky was able to act in a social sphere, formed by men in historical tradition and at the same time, successfully breaking up ingrained structures at the medical faculty. With the classification of Lesky in a contemporary historical category, new aspects will be highlighted in her work for the history of the Viennese Medical School.

"How Russian Intellectual Women could contribute to Agriculture?" Circulation of Ideas in Education and Career Development of Women Agronomists, late 19th – early 20th Century

Olga Yu. Elina S.I. Vavilov Institute for the History of Science and Technology,
Russian Academy of Sciences, Moscow,
RUSSIA

In the second part of the 19th century Russia, compared to the other European countries and the USA, faced rather disturbing situation regarding women high education and career opportunities. Universities as well agricultural institutes were still prohibited for women; few specialized institutes prepared mostly 'educated housewifes', and only later opened up for future physicians and teachers. There were a few women enthusiasts who managed to receive special permission from both Ministry of Agriculture and Ministry of Education to enter Moscow Agricultural institute. Pioneers of the movement Mariya S. Bevad and Anna K. Kosto-Sudakovich became first Russian women agronomic scientists.
In the end of the 19th century the great hope for Russian women with passion for agricultural science became the establishment of an Association (Society) for the Advancement of Women's Agricultural Education (AAWAE). The AAWAE was set up in 1889 by men of liberal views, led by professor of agricultural science Ivan A. Stebut. This association became the first in Russia in the field of agriculture to give women full membership (in the other associations women could only attend public lectures and entertainments). One of the most active female members was Nadezhda P. Dolgova, who lectured extensively on the development of women's agricultural education. She traveled around Europe, met her women colleagues to get information on the subject, and wrote a lot of articles and books on agricultural education abroad. As a result of the AAWAE activity, High Agricultural Courses for Women were set up in St. Petersburg (1904), Moscow (1908), and in other cities. In 1910s about 400 women graduated from these institutions every year to become agronomists and agricultural scientists.
The presented paper examines for the first time the circulation of ideas and the formation of networks in the field of women agricultural education and career opportunities in Russia.

International Networks for Supporting Scientific Careers of Women in Spain, in the First Third of the 20th Century

Isabel Delgado Echeverría Grupo Genciana,
Carmen Magallón Portolés Universidad de Zaragoza,
SPAIN

In the early twentieth century, mobility for scientific training was not easy. And less for Spanish women, who only gained access to university on an equal basis as men, in 1910. Besides the JAE who played a key role by awarding scholarships for Spaniards to travel overseas, some networks of international solidarity for women were important.
Through trajectories of Spanish women scientists who went abroad and of some foreigners women who worked in Spain, particularly in Physics, Chemistry and Biology, it is highlighted, first, the welcoming attitude of the Spanish republican institutions, and secondly, benefits from the existence of international women's organizations engaged in promoting scientific training for women.
Between 1907 and 1936, at least 30 women enjoyed the opportunity to broaden their studies or research abroad. Two came to Spain from other countries, while 28 Spaniards received scholarships to the United States (12), Germany (8), France (6), England (4), Switzerland (3), Belgium (3) and Austria (1) , Denmark (1) and Italy (1).
This support was crucial for the inclusion of Spanish women in the emerging scientific community in Spain, unfortunately miscarried by the wars in Spain and Europe.

Gender in Portugal Scientific Congresses (1930-1940)

Maria Margaret Lopes CEHFCi – History and Philosophy of Science Research Unit,
Universidade de Évora,
PORTUGAL

National and International Scientific Congresses constitute especial 'loci' to understand the circulation of scientific knowledge but have not received the full attention they deserve as an independent topic of investigation, in Portugal, particularly from the gender perspective. Since the beginning of last century, scientific congresses of different disciplines relied on the participation of women scientists and not just with the presence of wives or other women accompanying male scientists.
This paper is part of an International Congresses of Science in Portugal (1880-1950) project that analyzes gender among Portuguese scientists consolidating their international networks and articulated them with national initiatives. Considering this gender dimension in international congresses in Portugal, such as 3rd International Congress of History of Science (1934), 12th International Zoological Congress (1935) or 16th International Geographical Congress (1949), this paper focus on the role of Portuguese women scientist in the 1st National Congress of Natural Sciences (1941), which incorporated symbolically, politically and scientifically the Portuguese Colonial Empire in Africa. This 1st Congress is a privileged forum of gender analysis that shows that the scientific, social and political dimension of scientific practices cannot be dissociated. Their lists of participants, referees, main speakers, scientific and political authorities and official programs, areas of concentration of scientific sessions and communications effectively presented contribute to map the presence and scientific interests of Portuguese women scientists.
This paper argues that although the scientific trajectory of some Portuguese women scientist are well known, such as Branca Edmée Marques (1899-1986), who studied with Marie Curie and André Debierne and inserted herself in the "right" network for the development of her scientific career, other Portuguese women were advancing specific agendas and promoting their disciplines in the local political and scientific contexts.

Women, Ecoles Normales Supérieures and Networks: Two Case Studies

Anne-Sophie Godfroy Research Unit "Sciences Technique Education Formation",
Ecole Normale Supérieure de Cachan / INRP
FRANCE

As an example of the interest of an in-depth study of the role played by the Ecoles Normales Supérieures (ENS) regarding women in academic life, we present two exploratory case studies. Simone Weil: Belonging and Being Included — or not On one hand, she could be considered as well integrated in the French academic system: "normalienne" and "agrégée". On the other hand, philosophy remains one of the most masculine discipline, career perspectives were rather different: teacher in secondary education for women, doctor and professor at the university for men (see Nicole Mosconi). Through the correspondence and the works, networks she belonged to will be identified and commented. Paradoxically, she appears better included in the mathematicians' networks through her brother André than in the philosophers' networks. We will observe how it has influenced her research. Women Scientists and the issue of single-sex education at ENS: A very high proportion of active women full professors are "normaliennes" (alumnae of one of the ENS). As ENS were single-sex between 1940 and 1985 (except ENS de Cachan), they recruited each year the same number of men and women in all disciplines through separate competitive examinations. Even if the future of women students was mostly secondary school teacher, many of them became researchers and professors. Through selected interviews, we will explore how they were supported by the fact they were ENS alumnae, what networks supported them, what networks they created themselves, assuming that they benefited of better opportunities than other women academics, if we consider the high proportion of "normaliennes" among top women academics. In 1985, ENS became co-ed, the proportion of women recruited in natural sciences and mathematics dropped. From existing numbers, we will try to figure out how it is affecting the proportion of women professors.

Guest Scientists - the Personae Who Circulated Ideas, Theories and Methods - and the Role Women Scientists Played in this Context

Annette B. Vogt Max Planck Institute for the History of Science, Berlin,
GERMANY

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. Some progress has also been made towards a deeper understanding of the role of various laboratory practices and instrument making. More investigations are neccessary about the circulation of ideas, theories and methods, the exchange of knowledge and translations in the practice of science, and the role women scientists played in this context. 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 guest scientists.
First, the paper describes (summarize) the situation of women scientists, and the status of guest scientists especially, in the institutes of the Kaiser Wilhelm Society. Second, the paper analyze a sample of in total 54 women scientists who were in various institutes of the Kaiser Wilhelm Society as guest scientist. Third, the paper compares the different conditions for these guest scientists, the institute's practices and their achievement to the circulation of ideas, theoris and methods. Furthermore, based on the analysis of the women guest scientists in the Kaiser Wilhelm Institutes, the paper discuss the role of gender in networking in science.

Smallpox Eradication: a Network of Learned Women in the Academy of Sciences of Lisboa

José Alberto Silva CIUHCT - Interuniversitary Centre for the History of Science and Technology,
University of Lisbon,
PORTUGAL

Inoculation and vaccination were the first effective measures introduced against smallpox during eighteenth-century Europe. The adoption of inoculation for smallpox spread at a different pace, and not without opposition, in different European regions and countries. Trial inoculations were made on condemned people and charity children and, at the same time, some royal houses – afflicted by the disease - had their heirs inoculated too.
Royal patronage was important to the adoption of inoculation in Portugal. However, at the beginning of the 19th century smallpox continued to be an unsolved problem of public health. Jennerian vaccination was adopted since 1799 and pursued by surgeons, physicians and others in a private and non systematic way.
In 1812, with the Court settled in Brazil since 1807 following the Napoleonic Invasions, it fell on the Academy of Sciences of Lisbon (ACL) to promote a systematic program of vaccination against smallpox. The ACL founded an Institution for Vaccination organized through a network of vaccinators covering all the Portuguese territory. Some learned women participated in the creation of that network. Those women, Ana Tamagnini, Maria Vanzeller and Luisa da Mota were previously engaged in the private practice of vaccination in the province and were made fellows of the Academy due to their decisive contribution.
In this paper, an account is offered of the vaccination program of the Royal Academy of Lisbon and the contributions given by learned women to that program. Methods and reports, the acquisition of the vaccine, financial support, network of vaccinators and the polemics aroused in journals will be considered.

Laboratories at the Medicine Faculty of Coimbra University in the 19th Century

Maria Burguete Faculty of Medicine,
University of Coimbra,
PORTUGAL

The beginning of natural sciences came to predominate in medicine with the emergence of natural scientific thinking in the first half of the 19th century. Philosophical approaches became less relevant. Research concentrated on the biological, physiological and chemical foundations of life. Therefore, the creation of the Laboratories of Experimental Physiology, Histology, Toxicology and Pathological Anatomy was the result of the reorganization of the Medicine Faculty at Coimbra University in 1866-1872, according to the following paradigm replacement: The superficial look of disease was replaced by the study of the inner body, trying to understand the symptoms, giving rise to a new paradigm of medicine practice – Evidence-Based-Medicine. However, in spite of the good conditions of space and light provided by the Colégio de Jesus in Coimbra for the Laboratory of Physiology and Histology, an important "ingredient" was missing: the experimental instruments to design experimental works to provide a good teaching and research model for the Coimbra Faculty of Medicine. This problem was solved within one year with the scientific trips made by professor Costa Simões in 1865 while establishing contacts and assisting to practical lectures and courses with the most influent personalities of the world of medicine of the 19th century such as the physiologist Emil Du Bois-Reymond (1818-1896), the pathologist Rudolf Virchow (1821-1902) and the inventor of the ophthalmoscope and physiologist Hermann von Helmholtz (1821-1894) from the famous "Berlin School" of medicine in the 1840's, today the Humboldt University. The whole collection of scientific instruments from the Laboratory of Experimental Histology consisted of twelve microscopes including the special Smith, Beck & Beck as well as many other scientific instruments used for the performance of experimental works of histology and physiology using the Medical School of Berlin University (Berlin School) founded at 1810 as a target model for teaching and research works.

S06 Knowledge and Technology in the Mediterranean Basin

Coordinated by Àngel Calvo (Universitat de Barcelona, Spain)
Chaired by Àngel Calvo (Universitat de Barcelona, Spain)

In its strict borders, the area included between the north limit of the olive grove and the north limit of the palm grove, or in the historical borders, which expand the limits far beyond the coasts (F. Braudel, Mediterranean and the Mediterranean world in the age of Philip II, vol. 1), Mediterranean has been a crossroads of the big communication and commercial routes from the Ancient Times and a privileged space for the circulation of men, knowledge and technology.
Mediterranean has been cradle of the big urban civilizations of the Minoan traders, of the commercial civilizations of the Phoenicians, of the Greek and Roman cultures and territory of expansion of the Muslim contribution to science, mathematics, astronomy, medicine and philosophy (Lipiński, E., Phoenicia and the East Mediterranean in the first millennium B.C.; Glick, Th., Medieval science, technology, and medicine: an encyclopedia, 2005; Lindberg, D. C., Science in the Middle Ages, 1980; King, A. D., Islamic Mathematical Astronomy, 1986).
Agrarian economies and pottery technology, an important part of the Neolithic 'package, expanded across the Mediterranean by several waves of colonists who established there coastal farming enclaves, well before the spread of metalworking (Zeder, M.A., "Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact", Proceedings of the National Academy of Sciences, 2008; Thorpe, I. J., The origins of agriculture in Europe, p. 22; Jones, A., Prehistoric Europe: Theory and Practice, 2008; Cunliffe, B., The Oxford illustrated history of prehistoric Europe, 2001, p. 244).
Mediterranean was the cradle of the galley (Glete, Jan, Warfare at sea, 1500-1650: maritime conflicts and the transformation of Europe, 2000), the Greek trireme, first appeared in the seventh century B.C. (Morrison, John S. et al., The Trireme: Battleship of the Ancient World, 2000) and lighthouse technology in the 3rd century BC on the island of Pharos in Alexandria, Egypt. The development of nautical technology in the area, with the caravel, the nao merchant ship and the Spanish galleon (Konstam, A. and Bryan, T., Spanish Galleon 1530-1690, 2004) supported the expansion of Mediterranean culture.
Economic and social ties throughout the basin have persisted even through such upheavals as the Muslim ascendancy during the early Middle Ages (Alan H. Hartley), when they received the naval techniques from Byzance until securing the control of the sea: Cultures in conflict (Lewis, B., Christians, Muslims, and Jews in the age of Discovery, 1996, p. 125)
Mediterranean was vital for the traffic of the great European trade with the India before the discovery of the route for the end of Good Hope (Merchants' magazine and commercial review, volume 15, p. 26). The area assisted to the diaspora of Jews expelled by the Catholic Kings in search of lands and new places for business (Alisa Meyuhas Ginio).
Mediterranean was an important center for the diffusion of techniques and uses of silk, cotton and wool (Lewis, B., The Arabs in history; Arbel, B., Trading nations: Jews and Venetians in the early-modern eastern Mediterranean, 20); paper manufacturing (Needham, J. et al., Science and civilisation in China, 6, 1996, p. 476; Glick, Th. F., From Muslim fortress to Christian castle: social and cultural change in ..., 1995); glass-working, sugar, hydraulic technology and water management (Glick, Th. F., From Muslim fortress to Christian castle: social and cultural change in ..., 1995; Galloway, J. H., "The Mediterranean Sugar Industry", Geographical Review, 67, 2 (Apr., 1977), pp. 177-194), as well as innovation in organization, such as the dense consular network built by the Crown of Aragon, the laws gathered by its jurists and the public institutions aimed at monitoring and organizing the trade -the Llotges de Mar, public buildings of the merchants (Rovira i Virgili, A., Història de Catalunya, 1978, p. 499; Ringrose, D. R., Spain, Europe, and the "Spanish miracle", 1700-1900; Bisson, Th., Medieval crown of Aragon: a short history, pp. 99, 174 and 194).
With the role played by the Mediterranean in the diffusion of knowledge and techniques in mind, the Symposium proposed here tries to attract the attention on last the three hundred years, that coincide with the increasing globalisation of the world-wide economy (Pamuk, S. and Williamson, Jeffrey G., The Mediterranean response to globalization before 1950, 2000; Merger, M., Transferts de technologies en Méditerranée, 2006).

High Technologies of Telecommunications for Non-Core Countries. The Spanish Case

Angel Calvo University of Barcelona,
SPAIN

The paper aims at examining some relevant episodes in the development of the Second Industrial Revolution, exploring both the most important issues of the day, such as the role of the multinationals in technology transfer, and more recent debates on the creation of infrastructures for the acquisition of technology.
The research draws above all on primary sources predominantly from the business world: the Archives of Alcatel-Spain (Madrid), Telefónica (Madrid), Ericsson (Madrid), Esteve Terradas (Barcelona) and from state institutions such as the Presidency of the Government (La Moncloa) and the INI (the National Industry Institute) in Madrid. Documentation from the Historical Archive of the Spanish Patent and Trademark Office in Madrid has been also analysed in order to evaluate the Spain's capacity for innovation and the mechanisms of technology transfer.

The Ram-Tortoise of Hegetor of Byzantium in the Treatise "On Machines" by Atheneaus Mechanicus. Some Remarks on its Reconstruction

Maurizio Gatto Max Plank Institut for the History of Science, Berlin, GERMANY

About the life of Hegetor of Byzantium we know very little. It is common opinion that he was a war-machine engineer, active in the III century BC. who probably worked for Demetrius Poliorcetes (king of Macedon in 294–288 BC). His name occurs just in three ancient works: 1) in the treatise Περὶ μηχανημάτων (on machines) by Athenaus Mechanicus, 2) in the X book of the de Architectura by Vitruvius and 3) in the Παραγγέλματα πολιορκητικά (manual on siegecraft) by Anonymus Byzantinus of the X century A.D. Although none of these three texts spend a word upon the man, all of them relate a description of the invention which made him famous: a huge ram-tortoise, known just as “Hegetor’s machine”. Given its unusual size, it’s hard to believe that such a machine had really been constructed and used during the sieges. As far as we know, it has to be considered just a project that never materialized, which however doesn't make it less interesting for us. Between the three above mentioned sources, Athenaeus’ description seems to be the most detailed and therefore probably also the most reliable. Because of the general difficulty and obscurity of his language, the interpretation of Hegetor’s machine has given rise to a variety of conflicting interpretations. On the base of a new critical edition of Athenaeus’ work, which I recently published, it’s possible to provide a more authentic reconstruction, quite different from the past ones. The four most evident differences deal with a) the number of columns lying on the platform perimeter and supporting the roof, b) the number, the location and the function of the central pilasters supporting the ram-holding frame, c) the function of the leather cover around the chains holding the ram, d) the shape of the ram itself. With Athenaeus’ greek text in hand and with the help of some pictures, I’ll try to motivate the reasons for these new interpretations.

Nicolò Sagri’s Il Chartiggiatore (1570): Practical Knowledge from a Sixteenth-century Ragusan Manuscript on Shipbuilding and Seamanship

Lilia Campana Nautical Archaeology Program,
Dept. of Anthropology,
Texas A&M University,
USA

The discovery of the autographed manuscript Il Chartiggiatore (1570), written by the Ragusan mariner Nicolò Sagri (1538-1571), in the James Ford Bell Library at University of Minnesota, provides us with unprecedented information on sixteenth- century Mediterranean and Dalmatian seamanship and shipbuilding. Dedicated to Sagri’s young nephew Francesco, who was at that time beginning his career as a merchant onboard his father’s galleon, Il Chartiggiatore is conceived as a vademecum for a future patronus navis. In explaining the textual material, Sagri, a merchant and a ship owner himself, makes use of visual strategies such as geometric diagrams, technical drawings and arithmetical calculations. This paper discusses Sagri’s role as a leading authority on shipbuilding practice in the Late Renaissance, and discloses significant aspects of his life and career. It examines the content of Il Chartiggiatore providing a fascinating insight into the unique historical and technical context in which the manuscript was written.

Paul Deshayes and the Study of Portuguese Tertiary Molluscs

Jose Manuel Brandão LNEG / Centro de Estudos de História e Filosofia da Ciência, PORTUGAL

When the Portuguese Geological Survey (Commission) starts its activities, according to the royal decree from August 1857, it was temporarily installed in the house of one of its member’s directors, lacking, however, the necessary logistics to pursue its main goal: the collection and study of the relevant geognostic facts to the preparation of the geological map of the Kingdom. It was a great need to acquire professional literature, field and laboratory equipments, and comparison collections of fossils, rocks and minerals, appropriate to the work in progress.
Carlos Ribeiro (1813-1882), one of two directors from the Commission members, embarked on a tour that took him, to several European countries (1858), in intention to acquire the ways of work that were necessary, while also establishing a network of relationships with corporations and other European scientific institutions, that could ensure, the long term, both the exchange and circulation of knowledge, as well as the internationalization of Portuguese Geosciences. On this trip, Ribeiro had the chance to deprive with some notable geologists as Beaumont, Valenciennes and Michelin in France, Hornes from the Imperial Kabinett in Vienna, or Barrande in Praha.
Among this network of contacts, developed and consolidated in subsequent years by the actions of his fellow contributors Nery Delgado and Paul Choffat, bore fruit, especially in this pioneering period, the collaboration with the Frenchman Gérard Paul Deshayes (1796-1875), reputed conchyologist, to whom Ribeiro introduced himself "only with a business card and a common interest: the tertiary fossils”. Deshayes's experience with the fossils of the Paris basin, and his "magnificent" collections, consulted by Ribeiro during the stay in the city of lights, would come to reveal decisive in the study of fossils from the Portuguese Tertiary, secured the unpretentious and enthusiastic cooperation of the Parisian scholar.

Alentejo (Portugal) and the Scientific Expertise in Fortification in Modern Period: the Circulation of Masters and Ideas

Antónia Fialho Conde Departamento de História/CIDEHUS,
Universidade de Évora,
PORTUGAL

The question of mobility in architecture or engineering is an ancient process that grows with the rise of the professional group. The History testifies several forms of this mobility (migration, emigration, mission, availability) and with a direct relationship to the importance of the professional status or the power of political and economic institutions (public, private, military and civilian, secular and religious). During the modern period, master architects, engineers and experts in a wide range of other fields travelled all over Europe disseminating their ideas, and in Portugal specialists of other nationalities had a significant influence. The advent of gunpowder and greater sophistication in construction techniques meant that the art of fortification came to be regarded as constituting military engineering. A large number of architects and engineers working in Portugal from the 16th century followed a geometrical pattern featuring angular bulwarks and regular shapes, and they were important figures in the training of Portuguese architects and engineers and in Portuguese military architecture, which ended up be exerting an influence abroad. Around a hundred engineers from abroad worked in Portugal following the Iberian Union, taking part in operations during the Restoration War (1641-1668) to reinforce the land frontier, specially in Alentejo, because the topography of the region made it vulnerable to attack by land, accounting for the high concentration of fortresses; coastal fortifications were only reinforced/constructed much later, although some plans were produced during this period. John IV, in 1640, set up the Council of War and the Frontier Commission, whose well-defined role was to inspect fortifications and deal with all questions in this area. The translation of treaties, the national bookish production in the field, the wealth of mapping and imagery produced, are also testimony of the vitality and interest aroused by the fortifications in Portugal.

Technocratic Ideals in Motion. Ideology and Engineering in Catalonia before the II World War

Jaume Valentines Álvarez Centre of Research for the History of Technology (CRHT),
Polytechnic University of Catalonia (UPC),
SPAIN

This paper focuses on the rise and partial fall of the Catalan civil engineers and their heterogeneous technological ideals during the II Spanish Republic (1931-1939). The international exhibition of Barcelona, the international economical crisis and the birth of an autonomous government in Catalonia prompted civil engineers to actively participate in economics and politics.

The study of the Catalan engineering ideals and projects will take account of the local analysis on Technocracy which have recently appeared (e.g., France, Greece, USA), in order to complete the international panorama and to understand the continous articulation between the national and international issues as "sides of the same coin". Like machines or technical skills, local engineering thought cannot be explained by linear diffusion or "spontaneous generation"; then, it will be necessary to explore specific (socioeconomic, psycological, cultural) contexts.

The paper also studies the relations between engineers and other professional organizations (e.g., physicians, military engineers) and social groups (e.g., workers, entrepreneurs), their role in the scientific organization of industries and states, and the meaning of the fascist victory in the social development of their cosmovision.

The Role of the Academy of Natural Sciences and Arts of Barcelona in the Circulation of Science and Technology in the Late Eighteenth-Early Nineteenth Century

Carles Puig-Pla Research Center of Technological History,
Universitat Politècnica de Catalunya,
SPAIN

The Academy of Natural Sciences and Arts of Barcelona is a unique case in the scientific landscape of eighteenth century Spain. This was the only, non-military, Spanish scientific society established as an Academy and dedicated to physical, mathematical and natural sciences in that century. Its nine sections included Algebra and Geometry; Statics, Hydrostatics and Meteorology; Electricity, Magnetism; Optics; Pneumatics and Acoustics; Natural History; Botany; Chemistry and Agriculture. Throughout the first decades of its existence (1764-1824), scholars of this institution acted as catalysts for the movement of European scientific ideas. Its members were interested in learning about and assimilating the advances of modern science and its application its own country's socioeconomic context. This is shown in the reports submitted in the academic sessions. They were not only interested in getting and discussing scientific books of European authors (Muschenbroek, Gravesande, Nollet...) but also initiated relationships with leading scientists (Proust, Biot, Méchain, Chaptal...) and foreign scientific societies. The Academy provided a network of correspondent scholars residing in various cities within and outside the Iberian Peninsula (Madrid, Valencia, Granada, Rome, Munich, Havana, Florence, Versailles, Beziers ...) some of them foreigners. Other scholars to broaden their scientific background travelled to cities like Paris, London, Edinburgh, The Hague, Amsterdam, Marseille, Montpellier, Toulouse, and so on. They contacted major booksellers and subscribed to scientific journals. Academics and skilled artisans collaborated together to build machines and scientific instruments from the drawings of foreign books. Academy members also translated scientific works, especially French, which were used to teach subjects such as mechanics, chemistry or experimental physics. They were also the promoters of technical and scientific schools established by the Board of Commerce of Barcelona. Some of them were responsible for drafting a technical publication for the spread of foreign technical advances "Memorias de Agricultura y Artes".

Technology Transfer and Industrial Espionage in the Eighteenth Century

Juan Helguera Quijada Dpto. Fundamentos e Historia e Instituciones Económicas,
Universidad de Valladolid,
SPAIN

About 1750 the Spanish industry was not yet fully recovered from the crisis of the seventeenth century. Convinced that this situation was mainly due to technical delays, some enlightened rulers undertook an ambitious policy for technology transfer, and the industrial espionage was one of main instruments. But the attempts to introduce new techniques in Spain, often were failed because of the disappointing results of their practical application. In short, the Spanish case study shows once again that the historical processes of technology transfer present a great complexity, and that backward countries have encountered many and varied difficulties to acquire "useful and reliable knowledge" abroad.

Augustin Betancourt and the Mining Technologies: from Almaden to Saint-Pétersbourg (1783-1824)

Irina Gouzevitch (1) (1) Centre Maurice Halbwachs,
Dmitri Gouzevitch (2) (2) Centre d'études des mondes russe, caucasien et est-européen,
EHESS, Paris,
FRANCE

This text will deal with one of the aspects of Betancourt's multi-sided activity as engineer, administrator and organizer of research: his works in the field of mining. In spite of the fact that his 3 Memoirs on the Almaden mercury mines are now famous, we consider this theme as weekly studied for the simple reason that Almaden was but a starting point for a series of other much less known though very interesting works in Spain, as well as in England and, later, in Russia. In this paper, the authors would like to synthesize the results of their recent and inedited researches establishing the inherent links between al these works and bringing so a new light to the role played by this engineer as a European-scale mediator of technological change.

Textile Technological Transfer from a non Innovative Country: Spain during the 20th Century

Montserrat Llonch Casanovas Department of Economics and Economic History,
Esteve Deu Baigual Universitat Autònoma de Barcelona,
SPAIN

During the first third of the XXth Century, a latecomer country created some of the most important textile technological innovations of this century. Moreover, these inventions were the base of the Textile Machine-Making Industry of multinational companies: Casablancas High Draft Co.Ltd. and Weefautomaten Picanol N.V.
The focus of this paper is to understand how entrepreneurship of the innovators was set in a difficult socioeconomic context. The main hypothesis tested is that, to be successful, transfer of technology needed to be articulated outside this context, which meant abroad from Spain. Methodologically, two of the most relevant and significant inventors are analysed (Ferran Casablancas and Picañol brothers), which reveal to be exceptional cases in joining invention, innovation and successful business.

Bell's Travels to Paris and the Introduction of his Telephone in France (1877-78)

Jesús Sánchez Miñana Universidad Politécnica de Madrid,
SPAIN

In mid-August 1877 Alexander Graham Bell started what he had planned as a short stay in Great Britain but finally lasted until the end of October of the following year. Despite general scientific recognition and continuous engagements to present his invention, at the beginning of this period he was eager to work personally on the more commercial aspects of its introduction in Europe but, increasingly disenchanted with the difficulties encountered by his patents, he ended up leaving business completely in the hands of the concessionaries.
To the author's knowledge the French case has received little attention. Based, among other sources, on family letters made available on the internet by the Library of Congress, this communication will show that Bell travelled at least three times to Paris from London, each trip corresponding to a different state of his affairs and attitude towards them. This research will also serve to pinpoint three initial phases in the history of the telephone in France: the heralding work of Alfred Niaudet and the Maison Bréguet; their efforts, together with the concessionaire, Cornelius Roosevelt, to fight the imitators and develop more powerful transmitters; and finally the appearance of Bell's friend Frederic Allen Gower which would eventually lead to the formation of the first telephone company.

Franco's Dams: a Case of Technological Regress. The Technological Backtracked Facts in Historical Perspective

Santiago López García Salamanca University, SPAIN

What happened to the Spanish economy when had not access to the foreigner technology?
This paper offers an analysis about the phenomenon of technological regress. The analysis is employed to examine a specific historical example about the construction of dams after the Spanish Civil War. The Spanish society had a transient shock to productivity (grave import restrictions of technology and capital goods) and population (losses of human capital) that induced the neglect of some techniques rendered temporarily unprofitable, which were therefore not transmitted to the next generation. Productivity remained constrained by the smaller stock of knowledge and technology had thereby regressed.
The effect of this double shock was that the society lost the capacity of exploitation of its economic opportunities. The manufacture of the machines and tools necessary for the consistent exploitation of the opportunities resulted impossible. The firms responded using old technology. After decades a process of economic liberalization and huge transfer technology was required for the economy to reach its previous level of technological sophistication. The case study analyse two companies of the electrical oligopoly that constructed and exploited the dams of the East and West of Spain. Our principal source is its archives.

The Electricity in Spain, its Introduction and Industrial Development

Joan Carles Alayo Manubens Centre de Recerca per a la Història de la Tècnica, SPAIN

After the Spanish scientific society was perceived the great importance of the electricity, its introduction into the country was slowly. Spain been absent of proper technology was a field for the expansion of the French, English, American and German technology. The result was the creation of several utilities in the country to exploit the power electrical industry with an abroad technological base.
During the first years of the twentieth century industrial initiatives emerged in Spain, nevertheless the weight of the European and American technology was basic to extend its dominance to the whole peninsula.
The work will emphasize the introduction of the electricity in the main Spanish cities and the technology adopted by the utilities that were created.

S07 The Transmission of Mathematical Sciences among the Mediterranean Cultures

Coordinated by **Konstantinos Nikolantonakis (University of Western Macedonia, Greece)**

Chaired by **Konstantinos Nikolantonakis (University of Western Macedonia, Greece)**

Historians of mathematical sciences have frequently stressed the significance of the transmission of the Greek and especially Hellenistic heritage into Arabic for the history of scientific thought. They have not waited until now to appreciate the importance of this phenomenon for Arabic, Hellenistic and Latin mathematical sciences. The emergence of Arabic science itself is incomprehensible unless one refers to the reception of its Greek heritage; nor can one hope to reach a full understanding of the achievements of Greek science itself without the substantial part that was survived only in Arabic, as for example, Apollonios and Diophantos. The same holds for the history of the relationship between Greek and Latin science whose understanding requires the examination of Greek texts translated into Arabic and then into Latin. We should not forget, also, the relations between Egyptian and Greek mathematical sciences.
In the context of the proposed symposium we are going to examine, how mathematical sciences discover themselves as the result of the Mediterranean which was the area of exchanges among all civilizations of the ancient and modern world (Egyptian, Greek and Hellenistic, Arabic, Latin). By this frame historians of mathematical sciences will be more capable to illuminate the struggle between modernism and tradition.

Francesco Maurolico and the Transmission of the Elements in the Renaissance

Veronica Gavagna Dipartimento di Matematica e Informatica,
Università di Salerno,
ITALIA

The first printed edition of the Elements, based on the medieval recensio of Campanus of Novara, appeared in Venice in 1482; some years later, in 1505, Bartolomeo Zamberti published a new (and quite different) translation based on a Greek code. The contemporaneous availability of two Latin editions -- we could say two 'editiones principes' -- of the Elements, both unsatisfactory for different reasons, gave rise to different reactions among the European mathematicians: some of them embraced the cause of Campanus, some others the cause of Zamberti, and others rejected both Campanus and Zamberti redactions. In the last case, the absence of an established, shared and trustworthy Euclidean text, let some mathematicians write 'their' Elements. In this paper I describe the main features of the transmission of the Elements in the early Renaissance Europe and I focus my attention on the figure of the mathematician Francesco Maurolico (1494-1575). Maurolico (http://www.dm.unipi.it/pages/maurolic/intro.htm) was very unsatisfied with the available editions of Campanus and Zamberti and in a letter dated 1532 he announced an original publication programme about Euclid's Elements, founded on the following essential points: 'emaculare', or to correct the available editions by mathematical mistakes, 'reddere faciliorem', or to make easier, if possible, the Euclidean proofs; 'coaptare' or to choose every time the best logical architecture, the best proof, the best language between the two editions. In other words, he composed a new text coming from the joining of the two Renaissance traditions with many additions of his own. The Elements “ex traditione Francisci Maurolyci” – which are going to appear in the volume 'Elementa geometriae' of the 'Edizione Nazionale dell’opera matematica di Francesco Maurolico' – were only partially published in XVIth century, nevertheless it’s possible to detect some influence in Clavio’s fundamental recensio of the Elements (1574) and in Borelli’s 'Euclides restitutus' (1658).

Playfair's Geometry in Arabic

Gregg De Young Mathematics Department,
The American University in Cairo,
EGYPT

Cornelius Van Alan Van Dyck (1818-1895) is best known for his role in producing one of the first modern translations of the Bible into Arabic. Less well-known are his efforts to produce science textbooks in Arabic. Trained as a physician, Van Dyck came to Syria under the auspices of the American Board of Commissioners for Foreign Missions as a medical missionary. Recognizing the importance of education, Van Dyck focused his efforts on organizing schools. The lack of adequate textbooks, especially in the sciences, moved Van Dyck to translate or write several elementary treatises on mathematics, chemistry, and physiology in Arabic.
In this paper we examine briefly his Arabic translation of John Playfair’s pedagogical geometry treatise (Beirut, 1856). Bearing the descriptive title "Elements of Geometry: Containing the First Six Books of Euclid, with a Supplement on the Quadrature of the Circle, and the Geometry of Solids: to which are added Elements of Plane and Spherical Trigonometry," Playfair’s treatise went through several editions and reprintings during the first half of the 19th century. Playfair’s version of Euclid’s geometry was probably attractive to Van Dyck for use in his translation because the text was originally composed for use in schools. Playfair’s treatise is interesting historically because he replaced Euclid’s parallel lines postulate with an axiom that now bears his name and because Playfair introduced algebraic notation into books II and V in order to facilitate understanding of the argument. Van Dyck’s translation represents the earliest introduction of such innovations into the printed literature of geometry in Arabic. The translation had a wide circulation in its day, extending beyond the borders of Ottoman Syria. Copies may be found as far away as India.

Studies on the Problem of Minimum and Maximum in Conic Sections's Traditions. Apollonios of Perga and Serenus of Antinoeia

Konstantinos Nikolantonakis University of Western Macedonia, GREECE

The treatise of Apollonios of Perga Conics has put its sign on the development of mathematical sciences in the Arabic world since the 9th century and Apollonios is the most referenced and studied mathematician after Euclid. The Arabic translation of the 7 books of the Conics has been done in Baghdad in the 9th century, after the demand of Banu Musa from Hilal ibn Hilal al-Himsi and has been controlled by Thabit Ibn Qurra. This translation has inaugurated a tradition, and has influenced the interest on solid problems –especially the trisection of an angle and the construction of a regular heptagone-the application of the conics on problems from other fields like the optics (burning mirrors and lenses), geometric resolution of the 3rd degree equations (works of Al-Khayyam and Sharaf al-Din al-Tusi) or even the theory of astrolabes, sun clocks or the perfect compass. All these applications will lead to the reinvention of new properties on these curves – focus properties, study of asymptotes, local and harmonic properties. In the 5th book of the Conics which survived only in Arabic, Apollonios studies, the problem of minimum and maximum. The treatise Section of a Cone of Serenos of Antinoeia (4th century A.C.) deals with the areas of triangular sections of right or scalene cones made by planes passing through the vertex and either through the axis or not through the axis, showing when the area of a certain triangle of a particular class is a maximum, under what conditions two triangles of a class may be equal in area.
In the context of this paper we are going to present a comparative study of these two treatises and show the influence of the work of Apollonios to the approach of Serenus.

Astronomy in Late Byzantine Era: the Debate Between the Different Traditions

Gianna Katsiampoura National Hellenic Research Foundation, GREECE

In the Late Byzantine era (late 13th-15th c.), specially in Constantinople, we meet a non negligible number of scholars writing about astronomy, following the Ptolemaic tradition. The debate about this mathematical science was very popular among the scholars, the main topic being the renewal of the existing astronomical data. During the same period, in Mongolian Persia, near the Byzantine border, astronomy was florishing at the Observatory of Maraga and at Tabriz, where the scholars followed the Islamic tradition, while in Provence the Jewish community of Caraites founded a new astronomical school, based on Hebrew tradition.
The basic principles of Persian and Jewish traditions were transferred in Constantinople and three groups of astronomy scholars were appeared. First, those who followed the Ptolemaic astronomy and believed that the solution of the problems was the study and interpretation of the ancient Greek corpus; second, the scholars who introduced the principles of Persian astronomy, and, third, the scholars who introduced the Carait astronomical tables.
In this paper, we will present, first, the transmission of ideas from the periphery of the Empire to the capital, secondly, the three schools and their representative figures and thirdly, various phases of the debate among these schools. We will interpret the main arguments in this conflict and the ideology behind them, and also we will present the effects of this exchange of ideas.

S08 The Travels of Scientists in Europe since the 16th Century

Coordinated by **Ana Simões (Universidade de Lisboa, Portugal)**
Eberhart Knobloch (Technische Universität, Berlin, Germany)
Robert Fox (Museum for the History of Science, Oxford, UK)
Suzanne Débarbat (Observatoire de Paris, France)

Chaired by **Eberhart Knobloch (Technische Universität, Berlin, Germany)**
Ana Simões (Universidade de Lisboa, Portugal)
Robert Fox (Museum for the History of Science, Oxford, UK)
Suzanne Débarbat (Observatoire de Paris, France)

Since the sixteenth century, in different contexts and different periodes, European scientists have been notable travellers. Their travels have been undertaken with diverse motives, ranging from curiosity and pleasure to the systematic gathering of scientific information. Some 'scientific travellers' have sought to advance in their discipline. Others have wanted to extend their competence into new areas of study, to collaborate with their peers in other countries, or to foster the exchange of information. Other motives again have included the desire to undertake explorations in field of research poorly developed in their own countries, 'spying' in the quest for industrial knowledge, and the reinforcement of correspondence networks. The purpose of this session would be to advance our understanding of the voyages that have drawn upon and enriched European science since the sixteenth century and to assess their consequences for science in the early modern periods.

Discovering Azores's Nature

Conceição Tavares CIUHCT - Centro Interuniversitário de História das Ciências e da Tecnologia, PORTUGAL

Since the end of the 15th century, the geographical position of the Azores islands turned them into an obligatory stop for all return journeys to the old continent. Winds and sea currents molded specific maritime trajectories, and accounted for the visit of the first group of naturalists eager to explore them. The first written accounts of the fauna and flora of the islands were due to Francis Masson and J.C. Albers and they heralded a succession of explorations aimed at the collection and systematization of their findings.
In September 1836, Charles Darwin stopped for a few days in the Azores but his attention was not caught by any facts of special relevance. After 4 years on the HMS Beagle, Darwin was probably musing over the different characteristics of islander and continental species observed during his wanderings. Following the publication of the Origin of Species (1859) a new vague of travelers arrived at the Azores. Their evolutionist agenda included again collection and classification, but was now guided by the drive to look for explanations for the biological colonization of the Azorean islands and their endemic species. Members of this group included Frederick du Cane Goodman, the Challenger travelers, and the naturalists who participated in the oceanographic expeditions of Prince of Monaco.
This talk aims at the characterization of these successive types of travels, their different naturalistic practices and objectives. It also aims at understanding how social and scientific relations were molded between traveler naturalists and local naturalists in the on-going process of construction of the natural knowledge on the Azores.

Travels of Professor Frantisek Lexa and Jaroslav Petrbok in Europe and Mediterranean

Adela Junova Mackova The National Museum Archives,
Faculty of Art, Charles University, Prague,
CZECH REP.

In my lecture I would like to introduce travels of the first Czechoslovak Egyptologist, professor Fr. Lexa, to Egypt in 1931 and 1956 that led to the foundation of the Institute of Egyptology in Prague as well as his summer journeys to Bulgaria. Jaroslav Petrbok, secondary school teacher and scientist of the National museum in Prague, undertook several travels to south Europe and the Near East due to his scientific research in Paleontology. He also organized summer travels for secondary school teachers.

Global Science from a Dutch Perspective: Dutch Participation in 19th-Century Humboldtian Networks

Azadeh Achbari Free University of Amsterdam,
THE NETHERLANDS

My subject concerns the sizeable Dutch participation in global Humboldtian scientific networks from the early nineteenth century onwards. In my paper, I will discuss the Dutch tidological, geomagnetic and meteorological initiatives during the eighteen-thirties and forties as part of the broader Humboldtian research networks.
Dutch representatives of Humboldtian research included Gerard Moll, contributing to the study of tides by William Whewell in Britain; Richard van Rees, cooperating with Adolphe Quetelet in Belgium in meteorological research; Willem Wenckebach, participating in geomagnetic projects by Friedrich Gauss and Wilhelm Weber in Germany.
All three scientists travelled to different centers in Europe at a certain point in their career to visit their foreign colleagues. The aims of their visit were manifold. What they had in common was that these Dutch investigators often acted as nodes connecting local and national networks to the international networks.
This paper explores the ways the Dutch established contact with their foreign colleagues, their initiative to travel and the purposes of their visits. It also addresses the scientists' concerns to engage in scientific networks by investigating their personal motives, ambitions, and accomplishments in their fields of research.

The Rituals of Chemistry: the Conferences of the International Union of Pure and Applied Chemistry in the 1920s

Danielle M. E. Fauque Faculté des sciences,
Université Paris-Sud 11,
FRANCE

From 1920 to 1930, the annual conference of the International Union of Pure and Applied Chemistry (IUPAC) was held in a different European city, with the exception of 1926, when it took place in Washington. On each occasion, chemists from across the world met for several days to discuss the organization and standardization of tables of data, nomenclature, methods of analysis, documentation and other major issues in their discipline.
After 1930, economic difficulties and political divergences changed the character of the conferences. But the IUPAC gatherings of the 1920s, with their excursions, visits to industrial sites and receptions with representatives of the political and diplomatic worlds (especially important in the new political order of post-war Europe), provided an effective forum for the promotion of personal contacts and exchanges on both the theoretical and the applied aspects of chemistry. Beneath the appearances of conviviality and cooperation, however, national rivalries persisted. In this paper, I consider the effects of these rivalries but also, and more importantly, the positive contributions of the conferences both to the advancement of chemistry, and to the structuring of the international chemical community.

Why Europe? Alexander von Humboldt in Italy, 1805

Marie-Noëlle Bourguet Université Denis Diderot-Paris7 (Laboratoire ICT), AND
Centre Alexandre Koyré,
FRANCE

"My grand tour shall be one round the whole world", told Joseph Banks in 1768, as if his decision to embark with James Cook opened a new era in scientific travel, which substituted discovery voyages to the south seas and to unknown continents for the traditional tour of Europe.
It was not so for Alexander von Humboldt. A few months after completing his American four-year expedition — for which he was to be celebrated as "a second Columbus"—, the naturalist began travelling again, this time to Italy. Accompanied by the French chemist Louis JosephGay-Lussac and the German mineralogist Leopold von Buch, Humboldt travelled throughout the peninsula from April to October 1805, carried out meteorological and geomagnetic measurements along the way, went to Naples to observe Vesuvius at the time of a violent earthquake and eruption. In Roma, besides visiting the city museums or monuments, and meting Italian or foreign scientists and artists, Humboldt spent time at the Vatican library where he studied some precious Mexican "paintings" together with their comments by exiled ex-Jesuit scholars....
Humboldt's tour of Italy has, thus, to be understood as part of a global scientific endeavour. This trip, I argue, throws new light on the scientific travel disciplinary and cognitive practices around 1800. Beyond its singularity, it helps to delineate the role that European travel played in the making of a decentered and all-encompassing science, articulating the local and the global, the present and the past, the New World and the Old.

Creating an International Community in Nutrition Physiology: The European Tours of Francis Gano Benedict

Elizabeth Neswald Brock University,
CANADA

In 1907 the American nutritional physiologist Francis Gano Benedict undertook the first of what was to become a series of extended tours of European physiology laboratories under the auspices of the Carnegie Institution of Washington D.C. By 1932, when the last of these tours took place, Benedict had visited Europe seven times, and his assistant, Walter Miles, had taken the trip once. These regular four-month tours took Benedict through Britain and Western Europe, to Scandinavia, Russia and Eastern Europe. He visited both the most prestigious laboratories and institutions and less well-known rural agricultural experiment stations, sanatoria and hospitals in his search for the latest and most interesting approaches to metabolism research.
This paper will investigate the motivation, results and changing mandate of Benedict's foreign laboratory visits. It will show how these travels played a crucial role in the standardization of methods, techniques and instrumentation in nutrition physiology, laid the foundation for an extensive programme of international exchange and training, and, after the First World War, enabled Benedict to stylize himself as a "scientific diplomat" able to reestablish communication between international researchers in the aftermath of national animosities.

Expeditions in Russia on Earth Magnetism during the First Half of the 19th Century

Karin Reich University of Hamburg,
GERMANY

The idea to investigate earthmagnetism in Russia goes back to Leibniz. During the 18th century several expeditions in Russia took place, where also earthmagnetic observations had been made. In the first half of the 19th century, however, earthmagnetism got political support and therefore became an important discipline within astronomy and physics. Russia had a specialty, there were two lines running through the country where the magnetic declination was zero. Several expeditions were organised in order to get more and better data, especially the year 1829 was of great importance (Alexander von Humboldt, Adolph Theodor Kupffer, Christopher Hansteen, Georg Adoplph Erman, Friedrich Parrot, Emil Lenz), but also later several expeditions on earthmagnetism took place (F. Parrot, Georg Bunge, Georg Fuss, Aleksej Savel'ev). But, also lots of observatories were founded, where new and better data could be achieved. New journals came up, where these observations were coordinated. In no other country earthmagnetism got more support than in Russia. It was a special highlight, when in 1849 the new "Central Institute for physics" was founded in St. Petersburg, whose first director was Kupffer. This institute had no parallel in the world.

European Travels of Scientists from the National Museum in Prague (1818-1948)

Libor Jun The National Museum Archives, Prague,
CZECH REP.

In my lecture I would like to introduce travels of scientists round Europe. They travelled for various reasons, for example they took part in the international conferences, did lecturing at European Universities. They undertook several expeditions to collect products of nature. The travels produced several results - new experiences for taking care for the valuable collections and enlarging of these collections of new specimen of animals, plants and so on. Plenty of photographs and some documentary films from these expeditions are preserved in the National Museum Archives.

Alexander von Humboldt's Travels to Paris 1830-1848

Ulrich Päßler Alexander-von-Humboldt-Forschungsstelle,
Berlin-Brandenburgische Akademie der Wissenschaften,
GERMANY

Alexander von Humboldt spent almost one third of his life in Paris. He resided in the French capital during the years 1798 and 1804/1805, as well as from 1807 to 1827. Furthermore, after having returned to his hometown Berlin, he paid eight extended visits to Paris between 1830 and 1848.
The proposed paper examines the various purposes of these continuous travels between two European centres of scientific research. During a period, in which the natural sciences were becoming increasingly institutionalised and structured within national frameworks, Humboldt upheld a cosmopolitan tradition of communication through his travels as well as through his extensive correspondence. Friendships and personal exchange were vital to Humboldt's method of work. His stays in Paris enabled him to establish or renew contacts with Parisian researchers in the sciences and humanities. Humboldt presented work by Prussian researchers to a French scientific public at the Paris Academy of Sciences. By transferring knowledge from Prussia to France, he not only helped younger scientists to establish an international reputation, but also sought to counter general French indifference towards German science in the first third of the 19th century.
In this spirit, Humboldt successfully encouraged Prussian scientists to spend time in the Parisian scientific community themselves – in a period in which Britain was replacing France as the main destination of German scientific travellers.
To provide a fuller picture of Humboldt's travels to Paris, the proposed paper will finally address the question of how Humboldt was perceived by the scientific community and the general public in his host city – given that besides pursuing scientific aims, Humboldt was also performing diplomatic missions in the service of the King of Prussia.

European Voyages around Lapland Expedition (1736-1737)

Monique Gros Institut d'astrophysique de Paris (CNRS) and
Universite Pierre et Marie Curie -UPMC,
FRANCE

The proposal focuses on the previous travels in different parts of Europe of the participating members of the concerned mission. This scientific travel was organized by the French Académie Royale des sciences, jointly with a similar mission to Peru, and was proposed in order to obtain a definite response to the Newton's theory of gravitation after measurements made in France from the north to the south of the kingdom. Before their misison to Lapland, several participants visited England, Basel to be informed about the gravitation theory and implications. A new small english instrument was added to the equipement used in the measures in Lapland. Following this mission, further international cooperation and research settlement resulted for participants of the Lapland expedition, including other scientific travels in Europe.

Invisible Travellers and Virtual Tracks: Knowledge Construction in Colóquios dos Simples e Drogas de India... of Garcia de Orta (Goa, 1563)

Teresa Nobre de Carvalho Centre for the History of Science and Technology CIUHCT,
University of Lisbon,
PORTUGAL

In 1563 it was published in Goa the first modern book about the Asian natural world. Its author, Garcia de Orta (c.1500-1568), was a Portuguese physician who had lived in Asia for more than thirty years. The Colloquies on the simples contains an accurate description of some of the most important Oriental plants, drugs and spices. The information published by Orta was not only the result of his erudite readings and medical practices, but also of the experience of several field actors.
In fact, Orta was at the centre of a complex network of political elites, administrative officers, apothecaries, merchants, adventurers and other credible informants. These men were particularly able to answer to specific inquiries about the Asian natural resources. Even if their written reports had a limited circulation, they were available to Orta. Some of these informants were clearly referred by Orta in his Colloquies on the Simples..., others were only recently identified.
In this talk, I intend to follow the invisible tracks of some of the informants of Garcia de Orta. These virtual travels will show the different roles played by each field actor in the emerging of a new botanical knowledge about the Asian Portuguese Empire.

16th Century Professors of Mathematics at the University of Helmstedt: A German and European Scientific Network

Pietro Daniel Omodeo Max Planck Institute for the History of Science, Berlin
GERMANY

This paper addresses the 16th century international scientific network of the professors of mathematics appointed at the University of Helmstedt. It presents part of the results of a research project accomplished at the Herzog August Library of Wolfenbüttel (Germany) in 2010.
The Protestant University of Helmstedt had two chairs of mathematics as was prescribed by Melanchthon's University Reform. Since its foundation (1576), it was strictly connected to Wittenberg and other Protestant universities. Most of its 16th century professors of mathematics came from the University of Rostock. They were supported by Heinrich Brucaeus, a Flemish Professor of mathematics and medicine who had studied in Gent and Bologna, taught in Rome, and worked as a physician in Belgium and Portugal and, apart from that, was well acquainted, among others, with the Danish astronomer Brahe. Brucaus helped his countryman Cornelius Martini to become part of the Philosophical Faculty of the University of Helmstedt and introduced Magnus Pegel (Professor of lower mathematics 1575-81), Franciscus Parcovius (lower mathematics 1586-90), and the Scotsman Duncan Liddel (lower mathematics 1591-93, superior mathematics 1593-1600). Other academics were: Erhard Hofmann (Professor of superior mathematics 1576-93), who came from the University of Jena, and Simon Menz (Professor of inferior mathematics 1593-1606), a Melanchthonian humanist from Wittenberg. Remarkably, the latter was involved, together with the Scott Magister John Johnston, in a cosmological dispute against theses of the Italian philosopher Giordano Bruno, who participated in the cultural life of Helmstedt University around 1588-1590.
The biographies and works of the Helmstedt mathematicians show a late-Renaissance scientific network over a North-European area (German Lutheran Universities-Breslau-Denmark-Flanders-Scotland). I would also like to highlight the importance of this network for the circulation of scientific theories (especially in connection with post-Copernican astronomy).

An Alchemist's Grand Tour: Oswald Croll's Travels throughout Europe

Gloria Gallaire Fabienne Université Paris Diderot,
FRANCE

The early modern period is known as a time when naturalists and physicians travelled all over Europe to exchange ideas and techniques. Another category of observers of Nature also spent much time travelling: alchemists. We will focus on the extensive voyages of Oswald Croll (c.1560-1608), a German physician and alchemist who followed in the steps of Paracelsus not only in his theoretical works, but also in his relentless journeys through "France, Spain, Italy, Switzerland, Hungary, Bohemia and Poland". He visited the most famous scholars of the time to learn from them and exchange techniques, thus extending his epistolary network and bringing back alchemical recipes together with curious observations and precious specimens.

Sir James Hall, a Man of Science in the French Revolution

Elizabeth Denton Université Montpellier 2,
FRANCE

Sir James Hall's French travel diaries constitutes a unique insight to the French Revolution, as seen by a Scottish chemist and geologist, who describes the French political scene with a constant concern for accuracy and scientific neutrality. The whole text is obviously very similar to Sir James' experiment diaries, although the topics are very different: from politics to architecture, or chemistry and geology to linguistics and agronomy, the diaries are very good source of information on what France looked like in 1791, both in Paris and in the provinces.

The Amateur's Open Laboratory: The Président de Virly's Travels, 1777-1786

Patrice Bret IRSEM & Centre Alexandre Koyré-CRHST,
FRANCE

From 1777 to 1786, Grossart de Virly (1754-1805) – an amateur chemist, rather than a true scientist – was more often travelling than occupied with his regular jobs in French higher Courts. He left no recollection about his "running after great men" (Watt), but information can be picked up from the correspondences between leading European scientists and in their printed works. Was travelling a means for an amateur to conquer a position within the Republic of Letters?
Son of a rich family, Virly got both a good education and a helpful social network and was appointed as a scientific companion to Baron de Tott, in his inspection tour of French commercial sites in Egypt and the Ottoman Empire (1777-1778). Become a President of the Chambre des Comptes at Dijon in 1780, he was lead to natural history by Guyton de Morveau, whose courses of chemistry he attended at the local Academy. There he was eventually elected as a member after translating a few German and English texts. Then, Virly travelled through Europe (1781-1784) : he spent six months in Sweden, working in Bergman's laboratory with J.J. d'Elhuyar, then went to Russia, Poland, Hungary, Austria, Italy and Geneva. Back in Dijon, he helped Guyton de Morveau in his second aerial travel, running the experiments and checking the instruments (June 1784). Lastly, he kept travelling along the British Isles for eighteen months (1785-1786). Thus, the President de Virly probably met all the major chemists in Europe.
All these travels in that open laboratory were not only opportunities for observations and experimentation, but also for transferring theoretical and practical knowledge, and bridging the scientists he visited, bringing them mineral specimens or exchanging information. While participating in meetings of foreign learned societies and experimenting new methods abroad, Virly was also improving his linguistic competence, so as to translate Wilcke from Swedish and help Mme Lavoisier in her translation of Kirwan's Essay on Phlogiston.

The Ottoman Ambassadors' Discovery of Parisian Scientific Cabinets: A Case Study on the 'Take away' of Bion's Eclipse Calculator to Istanbul

Feza Günergun Department of History of Science, Faculty of Letters,
Istanbul University,
TURKEY

Scholars who flourished in Turkey until the opening of 'European-modelled' educational institutions in the 18th century, were generally affiliated with the colleges (madrasa) of medieval Islamic literature and sciences. The madrasa scholars or graduates would travel to scientific centers in Cairo, Damascus Baghdad, Tabriz, and as far east as Herat and Samarkand to improve and enrich their knowledge. These travels were more frequent in the 15th and 16th centuries, and continued to be practiced up to the end of the 18th century.
Madrasa scholars were content with the knowledge integrated in the medieval scientific literature, and refrained from traveling to Europe, which they saw in a culturally, religiously and linguistically altogether different realm. Some 18th century high-ranking Ottoman bureaucrats and dignitaries, however, were influential in conveying scientific knowledge to the Ottoman Empire through their mission in European capitals. One of them was Said Effendi, the Turkish ambassador in Paris between 1741-42.
Said Effendi, deeply interested in scientific and technical novelties, visited – as had his father Mehmed Chelebi, also Ottoman Ambassador to France, before himself – the scientific cabinets of Paris. His visit to Nicolas Bion's workshop would lead him to acquire a number of scientific instruments including one predicting solar and lunar eclipses designed by De La Hire, and crafted by Nicolas Bion. Back to Turkey, the ambassador would commission the translation into Ottoman Turkish a prospectus accounting for its use. The translator Sıdkı Effendi, in his additional notes to the translation, enabled the native Muslim reader to calculate the predicted eclipse dates in the Islamic calendar. The present paper aims to emphasize the role of Ottomans traveling in European capitals in the transmission of scientific knowledge to the Empire. It will also point out to the efforts to adopt the imported knowledge to local traditions, and that besides textual translations, instruments did play a role in the transmission of knowledge from the center of Europe towards its periphery.

Voyages along Meridian Lines in Europe

Suzanne Débarbat Observatoire de Paris
FRANCE

After the creation of the Paris Observatory meridian line, in 1667, Picard made measurements along it from Amiens to La Ferté-Alais. After his death ((1682), Cassini enlarged it in 1683 up to Bourges, later (1700-01), with Cassini II, up to the Pyrénées. The end came only in 1718 from the northern to the southern borders. After measurements in Lapland (1736-37), a new campaign is performed in France by Lacaille around 1740. This may explain why this pecular meridian was chosen in 1791 to give birth to "une mesure révolutionnaire: le mètre", which definitive length was fixed, after new measurements (1792-98), in 1799. Other voyages along a meridian line occured in Europ (1800-20) in Lapland, Spain, Great Britain and in Central Europe (1816-55) with the longest meridian arc ever measured. Despite these new measurements, the length of the "mètre" has never been changed leading 50 years ago to adopt its modern realization for the "Système international d'unités", the SI, in 1960.

Contribution of Japanese Printed Drawings of Aquatic Animals Brought to Europe by Holland Merchants in the 18th and 19th Centuries for Biological Development

Yuko Takigawa Lab. of Biological and Chemical Oceanography,
Faculty of Agriculture,
Kagawa University,
JAPAN

During Japan's isolation from the west, Linnaeus established the scientific classification using binominal nomenclature, that was promptly accepted as a universal system by Western scientists. Therefore, concerning fish, except for some specimens and materials brought back to Europe by voyage naturalists, there were only a few Japanese ichthyological resources available in Europe. Those materials included drawings called “Poisson du Japan” associated with Isaac Titsingh, and a book titled "Umi no sachi" (Boon of the seas), which were brought to Holland by the Dutch East India Company, the sole western trader with Japan. They are now stored in the Muséum National d’Histoire Naturelle, Paris.
"Umi no sachi" is a haiku anthology book of wood engravings in color, published in 1762, Edo Period, Japan. It mainly contains illustrations of fish and marine invertebrates, in and around Japan, whose characteristics are described to some extent with accuracy. Admitting to the limitation of the illustrations, which often lack accuracy in the number of the fin rays or spines, European biologists in the early 19th century did however utilize the book as a reliable source material for their scientific works. Cuvier and Valenciennes often cited it as “the Japanese printed copy” in their work, "Histoire Naturelle des Poissons" (1828-1849). Moreover, in the plates for "Histoire naturelle générale et particulière des Céphalopodes Acétabulifères" (1834-1848), Férussac and d'Orbigny exactly copied and reproduced the drawings of squids and octopuses from the book.
Based on my research on "Umi no sachi" in the Bibliothèque Centrale du Muséum National d'Histoire Naturelle, Paris, I would like to evaluate its academic value in the progress of science. The role of the book is also reviewed as media, which contributed to the biological classification in the 19th century by providing ideas and description of aquatic animals living in the unknown country.

S09 Within Europe and beyond Europe: the Jesuits as Circulators of Science

Coordinated by **Catherine Jami (REHSEIS-SPHERE, CNRS / Université de Paris-Diderot, France)**

Chaired by **Catherine Jami (REHSEIS-SPHERE, CNRS / Université de Paris-Diderot, France)**

Over past decades, historians of science have brought to light the role of the Society of Jesus in the sciences during the early modern period. However, it has often been assumed that as communities centred on academies emerged during the seventeenth century, the Jesuits receded from the front of the scientific scene to more marginal positions. Nonetheless, there is ample evidence that the Jesuits continued to play a major role in the circulation of scientific and technical knowledge within as well as beyond Catholic Europe up to the dissolution of the order in 1773. This role relates in great part to the two main tasks that the Society of Jesus set itself from the onset, namely education and mission. The combination of these two tasks may well characterise the particularity of the Jesuits' position. However, they also edited journals, made instruments and observations, and wrote and translated scientific treatises. The networks within which they worked spanned most of the world then known to Europeans; the circulation to which they contributed connected not only various geographical and cultural areas of this world, but also different social groups in particular areas, and, last but not least, different scholarly disciplines. The case studies presented in this symposium focus on the Jesuits as creators and carriers of knowledge, but also on the routes of circulation and on the various media and material objects that they circulated: printed books and instruments, which contributed to the standardisation of knowledge and practice, as well as data and artefacts collected in one location and implemented or centralised in others, which contributed to the construction of knowledge, and sometimes to redefining its standards.

The Jesuit Missions and Chinese Materia Medica during the 18th Century

Carlos Hugo Sierra Keele University,
UNITED KINGDOM
University of the Barque Country,
SPAIN

The main purpose in this paper is to explore the exchange of medical knowledge and the specific way of understanding certain nuclear principles of Chinese medicine by Jesuit physicians during the XVIII century. Unlike other fields of western science, as mathematics or astronomy, the historical transmission of western medical practice was limited, insofar as the Jesuits did not view medicine as a vehicle for missionizing. However, is very important to pay attention to this process of scientific encounter with China, insofar as allows to analyze not only the strategies of introducing western medical knowledge, but also the way from which is conceived the conceptual system associated with Chinese medicine. On the one hand, the Jesuits physicians are aware of medical knowledge as a essential instrument in order to access to some elitist circles with political influence. In this respect, a small number of Jesuits served as physicians and surgeons at court, although they left few records. On other hand, the French and Portuguese Jesuits in Beijing and Macao made a lot of efforts to collect Chinese medical texts and herbals and these bibliographical collections allowed a comparative study between the two medical traditions, by emphasizing the epistemological supremacy in western medical advances. Thus, the Jesuits understood the evidence of Chinese theory concerning blood, air and circulation in tension with a lingering Galenism or Chinese moxibustion as cautery. At the same time, the Jesuits studied Chinese diagnostic and therapeutic skills by means of the confrontation with the western anatomical paradigm (J. Bouvet, D. Parennin).

The Jesuit Le Chéron d'Incarville and his Catalogue of «Objects d'Histoire Naturelle» in Use in China

Manuel S. Pinto Universidade de Aveiro,
PORTUGAL

'Catalogue alphabétique des plantes et autres objets d'histoire naturelle en usage en Chine, observées par le Père d'Incarville', written by the Jesuit (1706-1757) in Pekin around 1755, was sent as a manuscript to Russia and published in 1812 and 1813 in the Mémoires de la Société Impériale des Naturalistes de Moscou. It has some 660 entries relating to plants, animals and minerals, the number of plant names being roughly the double of the other two together. Each name is followed by its Romanized form in Chinese and by a short description of what the «objet» was for (medicine, food, etc.) and where it was found. The number of medicinal plants predominates. Latin names are presented for many plants given by a member of the Société des Naturalistes, not by d'Incarville who neverthless was a professional botanist. Also odd is that he mentions many objects that he did not observe in China. The catalogue is an important piece of work because it makes known or better known in Europe: a) several aspects of China's traditional medicine and resources, so promoting the international circulation of scientific and technical knowledge; b) the role played by d'Incarville in exchanging botanical material between China and Europe, allowing for the cultivation of exotic plants in both regions; c) various products and goods imported into China, as well as many native goods available in the Chinese markets, so giving notice of their international and national circulation and economic value; d) certain aspects of the Chinese day-to-day life and character, so allowing for the circulation of some knowledge about the Chinese society; e) the names in Chinese of the objects, so contributing for an international vocabulary in the field of natural sciences; f) the role of the Jesuits of the French mission to China in the 18th century in this field.

The First Protestant Missionaries as European Naturalists in India. Competitors of Jesuits in the 18th Century

Brigitte Hoppe Geschichte der Naturwissenschaften,
Ludwig-Maximilians-Universitaet Muenchen,
GERMANY

At the beginning of the 18th century (1706) the first protestant missionaries were sent to South India with help of a contract between the "Waisenhaus"-foundation in Halle (Saale) and the King of Denmark. At their first missionary station at Tranquebar (East coast of South India) they had different contacts with Jesuits, the religious competitors but also supporters of activities with the same aim. Priests of both groups, trained at European universities, and in particular the protestant missionaries supported by missionary physicians, sometimes, were scholars in many fields. By means of studies of the Tamil language they published grammatical textbooks, translations of Christian religious texts, and comparative textbooks on linguistic and scientific subjects as well.
In one field the first protestant missionaries in India surpassed the Jesuits: Some of them became specialists in natural history and made extensive collections of Indian natural objects, which activities remained nearly unnoticed by the history of science until our days. The 18th century missionaries in India remained in correspondence with eminent European naturalists, who highly estimated the natural objects of the overseas regions, sending recent European publications on natural history to India, in order to support the self-training of the scholars in the far country. In the counter-move these sent their collections and observations to European partners who became sponsors for the missionary work. The historian states many ways of knowledge exchange between Europe and India from the 18th to 19th centuries and find traces of the spread of natural history collections and manuscripts through whole Europe. Moreover, the collections and messages of the missionaries were published by European naturalists immediately. In this way, these activities furthered much the development of European natural history from the 18th to the 19th centuries, during decades before Indian countries became members of the British empire.

"In parte physicae theoretica Newtonum eiusque commentatores secutus sum" – Leopold Gottlieb Biwald's Physica Generalis as a Compendium Propagating Newtonian Physics in Europe

Cornelia Faustmann University of Vienna,
AUSTRIA

Leopold Gottlieb Biwald's physics textbook in two volumes, Physica Generalis and Physica Particularis (Graz 1767/1768), was very important in the 18th century. Widespread in whole Europe and officially designated for use at the universities and lyceums throughout the Habsburg monarchy by an imperial decree of 1779, it played an important role as a very up-to-date compendium propagating Newtonian physics. In his textbook Biwald, Jesuit and Professor in Graz (Austria) for decades, does not only refer to elements of Newton's theory itself but also to several Newton-commentaries and uses various Newtonian textbooks. Biwald's principal sources on the subject are compendia written by 'sGravesande, Keill, Maclaurin, Mako, Musschenbroek, Pemberton, and Scherffer. In my lecture I will analyze the Physica Generalis into which the most important elements of Newton's theory found their way as an example of the propagation of Newtonian physics in Europe. Attention will be given to the following questions: Which sources are the most important for Biwald: Newton's Principia, Newton-commentaries or textbooks? Does Biwald focus on Jesuit sources when explaining Newtonian physics? Which is the geographical and cultural background of the authors of the Newtonian sources of the Physica Generalis? What does this aspect tell us about the (international) scientific (Jesuit) network in the 18th century and which new facets concerning the form of dissemination of the Newtonian theory in Europe result from that? In which aspects is Biwald's textbook outstanding in comparison to its Newtonian sources, what are the author's own specific achievements? Hence, how can the success of the Physica Generalis be judged in the pan-European context?

Mathemathics in the Jesuit Schools in Spain in the 17th and 18th Centuries

Agustín Udías Universidad Complutense de Madrid,
SPAIN

Jesuits established a networks of colleges in Spain which reached 126 in the 18th century. According to the Ratio Studiorum mathematics should be included in the philosophy programs of all Jesuit schools. In contrast to other European countries, Spanish Jesuits showed a certain resistance to fulfill this requirement. Explicit mention of professors of mathematics are only recorded for the colleges of Madrid, Barcelona, Cadiz, Calatayud and Valencia. The longest list is that of the Colegio Imperial of Madrid from 1627 to 1767, but of the 23 professors only 13 were Spaniards. In the other colleges with the exception of Cadiz teaching mathematics began in middle of the 18th century. Teaching was centered in geometry during the first years and later in algebra with the introduction of differential and integral calculus in the last years before the expulsion of Jesuits from Spain in 1767. The professors of the Colegio Imperial, where two chairs of mathematics were established in 1625, left a number of published books and unpublished manuscripts. Among the Spaniards excelled José Zaragoza and Tomás Cerdá who proposed the publication of a series of mathematical textbooks. Some foreign professors were della Faille, Richard, Petrei, Wendlingen and Rieger. Mathematics were given a special importance in the Seminarios de Nobles of Madrid, Barcelona and Calatayud founded in middle of the 18th century. The contents of the teachings can be followed from the Conclusiones Mathematicas, published programs of mathematical dissertations by students of the Seminario de Nobles and the Colegio Imperial of Madrid between 1704 and 1762. In them we can find when modern mathematics was introduced as well as the acceptance of the Copernican system and the Newtonian physics.

Maximilian Hell's Ephemerides and the Dissemination of Astronomical Knowledge in and from the Habsburg Monarchy (1757-1792)

László Kontler Central European University, Budapest,
HUNGARY

Maximilian Hell (1720-1792) was one of the foremost Jesuit scholars active in Central Europe in the mid-eighteenth century. He is chiefly remembered internationally on account of his role in the 1768-1769 Venus transit observations and his calculation of the solar parallax. This paper, part of an incipient project aiming to understand Hell's contributions in all their diverse contexts, focuses on the remarkable journal Ephemerides Astromicae ad Meridianum Vindobonensem, which he edited (actually, for the most part, wrote himself) over a period of three and a half decades in his capacity as imperial and royal astronomer in Vienna. The Society of Jesus was suppressed roughly at the middle of this period. What, if any, difference did this make in terms of the leverage behind Hell's editorial work, both as regards patronage and intellectual ambience? What stakes did the Habsburg court have in sponsoring his activities? How did this affect the production, the collection, and the uses of the knowledge reported in the journal? Was there an echo to the Ephemerides beyond the boundaries of the Habsburg Monarchy, where can it be located on the map of contemporary astronomical learning? Tentative answers to these and similar questions are hoped to contribute to the rise of a more contextualized approach to processes of the circulation of knowledge in Central Europe in the Enlightenment.

Hallerstein and Gruber's Scientific Heritage

Stanislav Joze Juznic Research and Development Department
Fara, Municipality of Kostel
SLOVENIA
Oklahoma University
USA

Augustin Hallerstein's (1703-1774) role in the Beijing Jesuits' electrical and vacuum research was not that clear as his publications in astronomic, cartographic, Aurora Borealis or China demographic research. The same goes for Hallerstein's younger Slovenian compatriot Gabriel Gruber's (1740-1805) Jesuits in Russia who brought the western education, technology and science to Petersburg. The Jesuits were not always useful in all aspects, but they were also not evil or mean all the time. They tried to sell their superior scientific and technological know-how to their hosts as the keys unlocking hosts' hart and most of all their souls. The Jesuits especially favored the souls of their high society hosts including the Russian or Chinese Emperor because the Jesuits hoped to repeat the Roman Emperor Constantine's example. General Gruber eventually nearly won Emperor Paul's soul for Jesus, but the Chinese Jesuits were never that close. Hallerstein happened to be one of the first to figure out that all tools will never be enough to conquer the Emperor's soul for Christianity, and therefore somewhat disappointed Hallerstein devoted most of his strength to the science on both opposite ends of Euro-Asia with numerous European Publications. The science Hallerstein offered to the Chinese was not always up-to-date, also because the Lisbon-Canton ship connection returned his mail only once in two years, which is far the from modern internet capabilities. Hallerstein was extremely proud of his observatory and didn't hide it from the visitors. Even the military oriented experiments, which would be today considered as top-secret, were freely published in European scientific journals before French Revolution, and there was no reason for the Jesuits to hide the European knowledge from the Chinese. With the Chinese Jesuits still on board, the Chinese technological gap would not broaden so deep as it did after Hallerstein's death.

Circulating Optical Instruments in the Service of God (1600-1700)

Koen Vermeir REHSEIS-SPHERE, CNRS, Paris,
FRANCE

The circulation of knowledge is accomplished by material means. Books and other written sources are often seen as privileged material bearers of knowledge, but other material objects are also suited for the distribution of practical as well as theoretical knowledge claims. In this paper, I will show how Jesuit authors were perceived to disseminate metaphysical and theological views by 'embodying' them in optical instruments. (I will understand this process of 'embodiment' in terms of the integration of scientific instruments, often accompanied by written inscriptions, in specific religious practices). Jesuits did not only promote their missionary work by preaching and by circulating theological volumes; they also did this by circulating material scientific objects through their vast missionary networks. In this paper, I will focus specifically on how the Jesuits' use of optical instruments was commented on by contemporaries (e.g. in Johann Christoph Wagners, Das mächtige Kayser-Reich Sina, 1685). In the confrontation between the different parties in a religious controversy, otherwise tacit aspects of religious and technical practices become more explicit. This will give us a better understanding of the Jesuits' use of scientific instruments and their reception in a global context.

A. Hallerstein: A Scientific Link between Europe, China and Korea

Mitja Saje Department of Asian and African Studies, Faculty of Arts,
University of Ljubljana,
SLOVENIA

The Jesuit missionary Ferdinand Augustin Haller von Hallerstein, Chinese name Liu Songling, hold a remarquable position in Beijing acting as the head of The Imperial Board of Astronomy from 1746 until his death in 1774. According to his achievements he could well be placed among the most celebrated Jesuits working in Qing dynasty China like Adam Shall von Bell (1591 – 1666), Ferdinand Verbiest (1623 – 1688), or Ignatius Kögler (1680 – 1746). Except from his regular work Hallerstein even succeeded to carry out several scientific accomplishments, which were not directly linked to his official tasks. He discovered a new comet that appeared in the year 1748 (C 1748 H1) and reported it to the Royal Society in London. To the same institution he provided some herbs' samples and a description of musk deer. Then he calculated the geographical length of Beijing from the orbits of Jupiter's satellites on the basis of time difference between Beijing and Sankt Petersburg. In the scientific circles of the time he became quite known because of his experiments with inductive electricity. He calculated the total population of China for the year 1760 when the total of 19 provinces was 196,837.977, and for the year 1761 when its total was 198,214.533. He was actually the first to make such precise calculation. In the field of geography he made the map of Mulan region in Manchuria, and took part in preparations for the Big Atlas of China, which the Jesuits published in 1761. In his scientific work he maintained contacts with the Academies in London, Paris and Saint Petersburg, and published his works in different European countries as well as in China. In fact Hallerstein did more scientific work and had greater variety of scientific results then most if not all of his predecessors in The Imperial Board of Astronomy, but because of changed historic circumstances in China, his scientific achievements were only praised in Europe and almost completely forgotten in China.
Apart from cultural links between Europe and China, Hallerstein also played a role in cultural and scientific exchange with Korea. In his letter to his brother Weichard he writes that Koreans come to Beijing each year and that immediately after arrival they come to the house of the Jesuits. They often pose well-founded questions about astronomy, always in written form, because they don't know how to speak Chinese, so they communicate in writing and the missionaries answer them through a servant. There is also one document about the visit of the Korean emissary to the South church where Hallerstein received him and answered his questions concerning the new calculations of the calendar. Then Hallerstein showed him a manuscript of the new report for the Emperor. The Koran emissary put more questions concerning astronomic instruments and about the bearing compass. Then Hallerstein showed him about a meter long bronze telescope with two lenses. The emissary admired the instrument and after looking at the sun asked how come that the three dark sunspots were not visible. Hallerstein explained that sometimes there were up to eight sunspots but their number was not constant. Asked about other instruments Hallerstein answered that all the big instruments were at the observatory and unfortunately those were not accessible to the visitors.

"Neither do men inhabit the moon nor do souls migrate there": What Place for Jesuit Selenography in the Network of Seventeenth-Century Cartographic Knowledge?

Thomás A. S. Haddad School of Arts, Sciences and Humanities,
University of Sao Paulo,
BRAZIL

After the fast incorporation of the telescope into astronomical research practices in the first decades of the 17th century, lunar cartography (or selenography) flourished, with an important highlight being the two moon maps produced by Jesuits Giovanni Battista Riccioli and Francesco Maria Grimaldi in Bologna in the late 1640s (published in the former's "Almagestum Novum" of 1651), which established a lunar cartographical language and toponymic system that were to become standard in the field. In this paper we examine these along with other four moon maps published between 1614 and 1665 by other Jesuit scholars working in Rome (A. Kircher), Ingolstadt (C. Scheiner) and Portugal (C. Borri). We investigate the kind of knowledge mobilized in the production of such maps, its sources, and the intended audiences, drawing a comparison between those Jesuits' selenographical practices and instances of the much better-known terrestrial cartography of the time. As for the latter, a great deal of work has been devoted to the understanding of the circulation of cartographic knowledge (meaning precisely the sources of cartographic information, the map-making practices and the maps themselves) and the establishment of networks of so-called cartographic power, i.e., the sort of power claims or exercises conveyed by maps and by the ability to make, access or use them. By its global reach, the Society of Jesus has been identified as an important collective actor in this enterprise, but when it comes to moon maps, it is a harder task to identify in a historically meaningful way the precise nature of the "power" being claimed or exercised. Indeed, as our conclusions point out, the categories that have become standard in the history of terrestrial cartography may be unfit to the description of celestial cartography in general, including selenography.

The Jesuit Honoré Fabri and the Theory of Projectiles

Michael Elazar Max Planck Institute for the History of Science, Berlin, GERMANY

The Jesuit Honoré Fabri (1608-1688) was a senior representative of Jesuit scientists during the period between Galileo's death (1642) and Newton's Principia mathematica (1687). As I have shown in a paper published in 2008,∗ Fabri managed to integrate into his impetus-based physics (and general Aristotelian framework) the principle of Linear Conservation of Motion, generally (and inaccurately) referred to as "inertia". Furthermore, Fabri also accepted Galileo's law of falling bodies, as long as perceptible times and spaces are concerned; he indeed formulated a different rule for "infinitesimal" moments, but he took pains to (successfully) show that for measurable spatial or temporal units his own law converged to Galileo's rule, i.e. the "odd numbers law". However, while thus accepting two key concepts of classical (or Pre-Classical) physics, Fabri flatly rejected Galileo's analysis of projectiles and dismissed the Pisan's parabola as the solution for the projectile's trajectory; instead, Fabri employed an Aristotelian-flavored principle – that nothing exists "in vain" (frustra) – and developed a different curve, which albeit being totally erroneous was closer to the trajectory actually observed than Galileo's parabola. My lecture will thus explore this unique case of scientific-theory dissemination, in which a member of the Society of Jesus reveals himself as keen on assimilating important "New Science" insights, but in his own terms: preserving an Aristotelian (or Neo-Aristotelian) spirit that demands theory to stay as close to observed facts, and cannot accept a mathematical abstraction which does not correspond to observed projectiles (i.e. the parabola, which as we know today is different from observed projectiles because of air resistance).

* Michael Elazar, "Honoré Fabri and the Trojan Horse of Inertia", Science in Context 21(1), 1-38 (2008).

Archaeology of a Theological Controversy: the Jesuit Scientific Mission in China Seen from Europe and Mexico

Antonella Romano European University Institute, Florence, ITALY

The constitution of a broad set of knowledge related to China is generally attributed to the extensive work of information undergone by the Jesuits since the last decade of the 16th c. It is well known that they have carried out such an activity within the context of their missionary apostolate and advertised it as a successful tool in order to evangelise China.
The aim of this paper is to discuss the problems raised by the missionary context for scientific activities. This will be done through the introduction of Mexico in the analytical framework. On one side, I aim at analysing the part taken by Mexico, as a concurrent channel, in the process of providing Europe with information about China; on the other side, I intend to investigate about the critical assessments made by Mexico's observers about the scientific activity of the Jesuits in China. In offering different definitions of the work of evangelisation, they opened the path toward the crucial debate which developed in Europe about accommodation.

Tychonic in Europe, Tychonic Worldwide: Cristoforo Borri and the Diffusion of Tychonism in Early Modern Iran

Luís Miguel Carolino Centro InterUniversitário de História das Ciências e da Tecnologia, Museu de Ciência, Universidade de Lisboa, PORTUGAL

After the publication of Giuseppe Biancani's Sphaera Mundi, in 1620, Jesuits became committed defenders of the cosmology of Tycho Brahe. The defense of Tychonic planetary-system had a profound effect on the kind of European cosmological knowledge that early-modern Jesuits diffused worldwide. From the Jesuit colleges of Brazil to the East Asian missions, Tycho Brahe was taught, explained and communicated by Jesuit missionaries. Nevertheless, during the seventeenth-century, Tychonic cosmology underwent its own inner development and a number of Jesuit missionaries and/or teachers in non-European colleges played an important role in that process. Cristoforo Borri (1583-1632), whose Collecta astronomica ex doctrina (Lisbon, 1631) played a part in the history of Tychonism and Jesuit preference for Tychonism, is a case in point. After a five-year's experience of missionary work in Cochinchina, in his way home to Europe, in Goa, Borri wrote a treatise which was translated into Persian by the Italian orientalist Pietro della Valle (1586-1652), who later sent it to the Persian astronomer Zain al-Din of Lar. This treatise, entitled Risalah-i Padri Khristafarus Burris Isavi dar tufiq-i jadid dunya (Compendium of a treatise of father Cristoforo Borri on the new model of the universe) is acknowledged to be one of the first western astronomy works to reach Iran. This paper focuses on this treatise and its aim is twofold: first, it analyses Borri's cosmological development of Tycho Brahe's astronomical system (as it appears in Risalah); second, it aims at discussing the impact of Borri's Tychonic conception upon the Safavid Iran.

The Jesuits and the Circulation of Books in the Sciences from Europe to China (17th-18th Cent.)

Noël Golvers Fac. Letteren (Sinol.) - F. Verbiest Instituut and
Faculteit Letteren,
Katholieke Universiteit Leuven,
BELGIUM

The aim of this paper is, to reconstruct the Western book collections of the Jesuits in China in the sciences, especially mathematics but also medicine and botany, as a contribution to understand their scientific activities, and to identify the sources of their Chinese publications in the field.
In a first part, I look for the sources of information on new publications the SJ in China had access to (a.o. a dense network of correspondence, and a 'portefeuille' of mainly learned periodicals). A strong 'souci d'actualité' as the ultimate motive of their demands was periodically frustrated by the problematic supply, through different routes, which resulted in a mostly irregular but sometimes unexpectedly efficient communication of recent titles, after a time span of which I try to 'measure' the average length. I also take into consideration (in short) the procedures of acquisition, and identify the main book agents, advisors and donors in Europe.
In the second part, I present te main SJ libraries in China, and some personal collections (a.o. true "Gelehrtenbibliotheke" [J.-F. Foucquet], side by side with episcopal libraries [a.o. A. De Gouvea]), showing the different place books of science had in them.
After a classification of the individual titles, according to sub-domains, I focus on some particular 'highlights', old and recent ones (from Arsitotle to Linné etc.), describe the language shift (from Latin to the vernaculars), and identify the different (major and minor) centers of research (SJ colleges, official and more informal academies, observatories, etc.) and scientific book production in France, the German Kulturgebiet, England, Holland, Russia, Italy, present in China.
In all this, I will try to understand the circulation of these books not only from the European background, but also in direct connection with the presence and scientific activities of particular Jesuit scholars in China.

The French Jesuits and the Padroado. Itineraries of Knowledge between Europe and China in the Late Seventeenth Century

Catherine Jami CNRS (SPHERE-REHSEIS), Paris,
FRANCE

The Jesuit mission to China is one of the best-documented cases of the Society's involvement in the circulation of knowledge beyond Europe in the early modern period. During its first century, the mission was under the sole patronage (Padroado) of the Portuguese crown. The first breach of this monopoly took the form of a state-sponsored scientific expedition, set up under the auspices of the French Académie royale des sciences in 1685. The five French Jesuits who arrived in China in 1688 claimed that they not only worked for "French science", but also represented it in China. Although they and their successors were never the only informants of European savants concerning China, they by and large dominated the China-related editorial scene in eighteenth-century Europe.
However, because of the intricacy of the various patronage networks within which the China Jesuits worked, it is impossible to divide their multifaceted activity according to nationality, institution or location. To illustrate this point, this paper follows the itineraries of several Jesuits who worked at the Beijing court during the last two decades of the seventeenth century. It focuses on the one hand on some "Portuguese": Tomas Pereira (1646-1708), Antoine Thomas (1644-1709) and Claudio Fillipo Grimaldi (1638-1712); and on the other hand on three French Jesuits: Jean de Fontaney (1643-1710), Jean-François Gerbillon (1654-1707) and Joachim Bouvet (1656-1730). Whether they collaborated or competed, their paths crossed and sometimes joined, mostly in the service of the emperor, but also in Europe or on the way to China. An analysis of such intersections in their itineraries provides interesting insights into their respective information networks, but also into the shaping of the knowledge they contributed to circulating as well as into the very process of this circulation.

'The Limits of Control'. Jesuit Drugs under the Patronage of the Kangxi Emperor (r. 1662-1722)

Beatriz Puente-Ballesteros Postdoctoral Research Fellow,
Faculty of Arts, Department of Sinology,
Katholieke Universiteit Leuven,
BELGIUM

In my previous research based in Chinese archival documents I demonstrated the role played by Jesuit medicine, i.e. Jesuit physicians and Jesuit drugs, at the court and how it was patronized and monopolized by the Kangxi emperor (r. 1662-1722), the first of the three great rulers of the Qing dynasty (1644-1911). Now, moving a step further, I will try to answer the question about the limits of control of the emperor's patronage of Jesuit medicine. In my lecture I will not offer a direct answer to this question, but instead will raise different hypotheses based on archival documents and printed sources. In a first step I will describe the network of power created by the Kangxi emperor, as it is reflected in the so-called medical palace memorials (Chinese and Manchu documents), in order to arrive at a more comprehensive evaluation of the medical involvement of the Jesuits, as practicing physicians, suppliers of foreign drugs and as patients, all of them under the apparently strict monopoly of the Kangxi emperor. Secondly I will rely on a number of Jesuit testimonies that show the different routes along which Jesuit drugs travelled beyond the court in Peking itself. As is revealed by archival documents, this not only reflects the geographical distribution of the Jesuits in China, but also represents the different settings and purposes of these drugs brought by them to China. On one hand they were part of the missions' pharmacies and thus the Jesuits took them for personal use in case of emergency. On the other hand they were given as gifts to Chinese or Manchu noblemen, beyond the emperor himself, as a means to build networks and obtain support. No doubt, the use of "miraculous" drugs was also seen as helpful device in winning new converts. Thus, the aim of this paper is to create a more complete image of the different functions of Jesuit drugs in China, beyond the Kangxi emperor's quasi monopoly, and to offer a first insight into their routes of circulation.

S10 Cartesian Physics (as Experimental Philosophy) and its University Reception

Coordinated by **Mihnea Dobre (University of Bucharest, Romania)**
Chaired by **Mihnea Dobre (University of Bucharest, Romania)**

Our symposium is dedicated to one of the most important attempts in seventeenth-century natural philosophy to reform the received Scholastic knowledge and replace it with a completely new physics, which was built upon a new philosophical framework; namely Descartes's system of philosophy. While Descartes's emphasis on metaphysics and his search for a certain foundation of knowledge had been thoroughly discussed in the scholarly literature, the empirical element of his physics has been largely neglected. However, a closer look at Descartes's followers from the seventeenth century shows us a different picture, in which Cartesians living in his immediate posterity have tried to find solutions to various natural philosophical problems not only by starting from metaphysics, but – and our symposium will examine some of the most important attempts in this direction – by investigating nature through experiments and observations.
Thus, the theme of our proposal is the reception of Descartes's approach to experimentation, with a focus on how his followers succeeded in their attempts to promote and disseminate a Cartesian physics. For this, we are going to investigate the circulation of Cartesian ideas within the institutional settings of the seventeenth-century universities and other contextual aspects of this reception. The symposium will open with Delphine Bellis's contribution on Descartes's communication about experimental results in his correspondence; the early reception of Cartesianism in the Netherlands will be discussed by Theo Verbeek; the dissemination of Cartesian ideas in England through Samuel Clarke's very popular English translation of Jacques Rohault's 'Traité de Physique' will be the topic of Mihnea Dobre's paper; and the session will conclude with a paper examining Buchard de Volder's creation and use of the Leiden Physics Theatre, providing insight into a particular brand of pre-Newtonian Dutch Cartesianism, which integrated the ideas of Descartes with experimentalism, a paper presented by Tammy Nyden.

Experience and Experiment: What Can We Learn about Descartes' Natural Philosophy from his Correspondence?

Delphine Bellis Utrecht University
THE NETHERLANDS

Descartes' physics has often been seen as a mere theoretical work or, even worse, as an imaginary production, far from being in touch with experimental reality. This picture of a novelist-physicist, lost in his speculative reflexions, was developed as early as the 17th century by Christiaan Huygens or later on by Voltaire. Nevertheless, if we pay more attention to Descartes' own words on the topic, we may draw a quite different insight of his natural philosophy. The role of experience is theorized in several of his works. Experience there appears to be a way to choose between several explanations of physical phenomena, all being coherent with physical principles and equally possible from a theoretical point of view. But, usefull as they might be to understand the role experience can play from a theoretical point of view in Descartes' physics, these texts do not always make fully explicit what precise role experience played in the concrete making of Cartesian natural philosophy, nor what Descartes considers to be a valid experiment. To have a more accurate view on this, we must turn to Descartes' correspondence. There we discover him discussing of several experimental devices or fully realized experiments, some of them being notably performed by others. Apart from the well-known role Mersenne played in scientific communication all over Europe and from his support to experimental philosophy, Descartes' correspondence can give us a new insight on what the philosopher considers to be important in experience by comparison with what the experimenters do and with what they find relevant for natural philosophy. In these epistolary exchanges, this is not only the way scholars communicate on experimental results which is to be seen, but also several divergent aspects of the status of experience in natural philosophy in the first half of the seventeenth century.

The Empirical Element in Descartes' Physics and its Reception by Spinoza

Epaminondas Vampoulis Department of Philosophy,
University of Patras,
GREECE

While studying the role of the empirical element in Cartesian physics one must take into account one of the special features of this theory, namely its connection to metaphysics. Cartesian physics adopts an epistemologically realistic worldview that is based on the doctrine of the truthfulness of clear and distinct ideas. But the application of this doctrine on physical matters is closely related to the demonstration of the existence of material objects and thus implies an allusion to experience. That is the reason why in his Principles of Philosophy Descartes opens the presentation of his physical theory in the second Part of the book with an account of what our senses tell us concerning the existence of the things of the external world. The same Part of this book concludes with an allusion to the contrast between the seven impact rules and sensory experience that seems to contradict them. Thus, Descartes' theory concerning the principles of material objects although claiming to be a mathematical theory, seems to allow experience to play a crucial role.
In his first published book Spinoza gives a more geometrico transcription of the first two Parts of Descartes' Principles of Philosophy. Spinoza follows a rigid deductive method that leads in a deterministic way from the first principles to their consequences. Thus, Spinoza insists in the second Part of his book on causal relations and not on facts of an empirical origin. His exposition of Cartesian physics relies strongly on a purely intellectual grasp of the nature of corporeal substance that our senses cannot reveal. But things become more complicated once we realize that Spinoza's text contains some elements that are not of a purely rational origin and that cannot be easily translated into a purely mathematical language.

Experiment in Cartesian Courses. The Case of Professor Buchard de Volder

Tammy Nyden Grinnell College,
USA

In 1675, the University of Leiden became the first university to offer courses in experimental physics and to create a facility dedicated solely for that purpose. Burchard de Volder (1643-1709) initiated this curricular development. His pedagogy soon became famous and emulated throughout The Netherlands. One might expect English universities to have been the first to teach experimental physics given the traditions of Bacon and Newton exemplified by the Royal Society. However, de Volder taught in the Leiden Physics Theatre twelve years before the publication of Newton's Principia and thirty years before William Whiston and Roger Cotes first taught experimental physics at Cambridge. While the location and early date of his innovation is striking, even more so is the fact that de Volder was a Cartesian rationalist and remained so throughout his career. The traditional narrative of the early modern period, which divides philosophies into Continental rationalism and British empiricism, would lead us to believe that de Volder would eschew experiment and observation, much less introduce their use in the physics classroom. However, when we examine de Volder's innovation within its national and institutional context, we come to see that de Volder's Cartesian empiricism is not unique, but representative of a certain form of pre-Newtonain Dutch Cartesianism, as well as of a pedagogical tradition of teaching through observation at Leiden.

Rohault's "Traité de Physique" and its Newtonian Reception

Mihnea Dobre University of Bucharest,
ROMANIA

Jacques Rohault (1618-1672) was one of the most important Cartesians in the seventeenth-century France. He became famous in the 1660s, when he hosted some very popular public conferences. Unlike his contemporary Cartesian fellows, Rohault was well concerned with the problem of experiment and he designed a number of instruments, which were used in his observations. How does his view on experiment fit into the general Cartesian framework of metaphysically grounded natural philosophy is display best by the use of his own version of an air-pump for the rejection of void. The results of his experimental research were printed in the "Traité de physique" (1671), which was quickly translated into Latin and published in Geneva, Amsterdam, London, and Louvain among other places.
In this paper, I shall refer mainly to the various editions of Rohault's textbook published in London (both in Latin and English), which went through numerous prints from the end of the seventeenth century onwards, up to the 1730s. Of a particular interest with these editions (both in the early Latin, but especially in the English ones) is the fact that they were accompanied by the annotations of the celebrated Newtonian, Samuel Clarke, making this way a textbook on physics that combines the views of Descartes and Newton. While Descartes's influence upon Newton's philosophy has been discussed by various scholars, the relation between Cartesianism and Newtonianism is still a topic in need of further exploration for the historians of science. Clarke's various editions of Rohault's "Traité" will provide a good example of the diffusion of Cartesianism at the end of the seventeenth century, making an interesting case study for the dialogue between two competing paradigms of the "scientific revolution" and ultimately for the transformation of natural philosophy into physics.

S11 Some Aspects of the Circulation of Symbolic Language

Coordinated by **Mª Rosa Massa-Esteve (Universitat Politècnica de Catalunya, Spain)**
Chaired by **Mª Rosa Massa-Esteve (Universitat Politècnica de Catalunya, Spain)**

The circulation of ideas plays a central role in the understanding of their evolution. In this symposium we will focus on some aspects of the circulation of symbolic language in the algebraization of mathematics that took place over almost three centuries, from the mid 15th to the mid 18th century. Indeed, one of the key points in this process of algebraization of mathematics was the establishment of a symbolic language as a formal language, so that the new language of symbols and techniques could be used in operations to obtain new results.
The circulation aspects of symbolic language to be analyzed can be related with the different writing of symbolic language in the printed books or in the manuscripts that circulated at that time. We can also consider the problem of printing determinate symbols by some editors. A second aspect to be considered is the sources used by scientists or the sources they mentioned as having been used by them. For instance, pages with exactly the same symbolic language can be found in works by different authors. Another aspect that we have to consider is the connection between the transmission and the reception of symbolic language, and its appropriation by other scientists. Other aspects are related with the role of the correspondence between the scientists or the influence of the institutional organizations in the dissemination of symbolic language.
All these studies can provide new insights, new ideas and new research in the domain of the development of symbolic language.

Purpose and Function of Symbolism in Abbaco Algebra

Albrecht Heeffer Center for Logic and Philosophy of Science,
Ghent University,
BELGIUM

While algebra developed into a symbolic practice from the sixteenth century onwards, we find already symbols or abbreviations for the powers of the unknown and operations on polynomials in manuscripts from the abbaco tradition (1300-1500) and early cossic tradition (1450-1600). In this paper we discuss the purpose and function of these 'symbols' and their relation or difference with the symbolism in printed books from Pacioli's Summa (1494) onwards. We first provide an overview of some competing systems of symbolism and formal representation schemes in published and unpublished abbaco manuscripts. Then we discuss an interesting family of unpublished manuscripts from the first half of the fifteenth century in which an explicit reference is made to rhetorical (per scritura) and symbolic (figuratamente) solution methods (BNCF Magl. Cl. XI. 119, Mediceo-Laurenziana Ash. 343, Ash. 608, British Library Add. 10363, Add. 8784). These findings lead us to the conclusion that the practice of symbolic scratchpad calculations was much more common than what can be testified from extant manuscripts. Symbolic calculations were used for solving algebraic problem but not considered appropriate for inclusion into a treatise and were thus reformulated into a rigid rhetorical format. Also, professionals scribes, who copied abbaco treatises, did not always understood the symbolism of the maestri d'abbaco and omitted or mutilated the original scratchpad calculations. We find further evidence for this thesis in the transmission of manuscript to print. Regiomontanus used scratchpad calculations in his correspondence with Bianchini and his draft manuscript (Moscou MS. 541) of the Triangulis omnimodis (1533). The symbolic versions of his algebraic solutions were left out of the printed edition. We will also show examples of how Pacioli's symbolism in his Perugia manuscript (1478) was simplified, possibly for typographical reasons, in his Summa.

Can we Know if Printers Played a Role in the Elaboration of Algebraic Symbolism in the 16th Century?

François Loget Centre d'études supérieures de la Renaissance (Tours),
Université de Limoges,
FRANCE

What we may call "symbolic revolution" is not only a technical matter. It is also connected with the so-called "printing revolution". As an effect of the massive diffusion of printed books, the learned culture gradually changes and written culture takes a major place. The development of symbolic writing is part of this new culture.
My aim is to study the evolution of symbolic language in connection with the history of the book. In this paper I will focus mainly on the relationships between printers and authors of French algebraic treatises.
In the 16th century, the symbolic language varies from one treatise to the other. In France, some of the first treatises to be printed are based on the cossist notation (e.g. Peletier's Algebre), but the use of letters in place of cossist symbols occurs in La Ramée's Algebra and in Gosselin's treatise. And as one knows, Viète uses only capital letters in his Isagoge.
Most of the French algebraists of the period have a great concern regarding the language of algebra. However it is hard to know whether the symbolism they used is their own or if it was choosen due to technical constraints.
Some of them had close connections with printers: Peletier lived in Vascosan's house for a time and later worked with J. de Tournes in Lyon; La Ramée had most of his books printed in Paris by Wechel and seemed to take great care of the way his books were handcrafted. This leads us to raise the questions whether the printers played a role in the elaboration of symbolic language or not; and whether the relationships between authors and printers were a factor of the circulation of symbolic language.

The Circulation of Algebraic Symbolism Related to the First Algebraic Works in the Iberian Peninsula

Fàtima Romero Vallhonesta Universitat Politècnica de Catalunya,
SPAIN

In the 16th century mathematics underwent in Europe deep changes whose diffusion was favoured by the invention of printing in the previous century, that changed completely the way of transmitting the culture. One of the main changes was the progressive development of algebra from practical arithmetics, in which the symbolism played a relevant role.
In this paper we will analyse the circulation of symbolic language in the algebraic works of the second half of 16th century from other countries to Iberian Peninsula and also this circulation in the Iberian Peninsula itself. We will give some examples to show that in some cases the use of specific symbols was due to the constrictions of the typography as Juan Pérez de Moya (ca. 1513-ca.1597) stated in his Arithmetica practica y speculativa (1562).
We also will analyse when symbolic language is used only as a simplification to contribute to a better understanding of the rhetoric reasoning and when it is used as a part of the symbolic reasoning, thus stepping forward from the operations with numbers to the operations with new objects of algebra. These analyse will contribute to the better understanding of the process of algebraization of mathematics in the Iberian Peninsula.

The Circulation of Symbolic Language in the Seventeenth Century

Mª Rosa Massa Esteve Centre de Recerca per a la Història de la Tècnica,
Departament de Matemàtica Aplicada I,
Universitat Politècnica de Catalunya,
SPAIN

This research on the symbolic language is framed within the context of a more extensive research concerning the transformations of mathematics and natural philosophy and their relationship between the fifteenth century and the seventeenth century.
The publication in 1591 of In artem analyticen isagoge by François Viète (1540–1603) constituted an important step forward in the development of a symbolic language. As his work came to prominence at the beginning of the 17th century, other authors also began to consider the utility of symbolic language and algebraic procedures for solving all kinds of problems. Thus, symbolic language and its use in different forms became more widely disseminated, though this fact did not imply that it was generally accepted.
In this paper, after presenting some examples of different reactions to the acceptance of symbolic language and algebraic procedures, such as those of Cavalieri, Barrow and Hobbes, I would like to analyze some examples of the connection between the transmission and reception of symbolic language and its appropriation by other scientists such as Hérigone and Mengoli or Mengoli and Leibniz. These analyses can provide new ideas for a better understanding of the algebraization of mathematics.

Mathematics and Instrumentalization as "Linguistic" Tools for the Widespread Circulation of Science and Technology

Nathalie Huyghues des Etages Independent Researcher,
FRANCE

It is often said that mathematics is a language, a position reflected by sentences like “the sense of a physical expression in the common language”, or when we hear that this or that concept can give rise to a mathematical "translation". I will address this issue by asking whether the process of “mathematization” and its resultant instrumentalization offers a powerful tool for the widespread dissemination of science. This line of inquiry will then lead me to some more general observations about the meaning of mathematization .
The concept of mathematics as a language of the sciences is also part of an epistemological debate concerning disciplinary claims for the definition of a specific but nonetheless scientific disciplinary culture. Since Newton's Mechanics initiated the mathematization of physics, later extended to other natural sciences, the common vision of science is more or less dominated by the idea that a science can reach a threshold of scientificness only when a certain degree of mathematization is achieved. One argument against mathematization is that it engages a physicalist ontology and that this ontology leads one to ignore specificity thus offering no more than an abusive reductionism. To the latter claim may be opposed the idea that mathematics is a language and that the difference between qualitative and quantitative properties therefore lies not in the properties inherent in the objects but in the property of the language.
I will address this question not at the ontological level but rather by showing how “mathematization”can be viewed by comparison to natural language as the elaboration of a standardized language (from a linguistic point of view) which has favored the circulation of science and technology on a large scale. This, in turn, will lead me to some observations about the meaning of mathematization as a process toward better communication.

S12 The Development of New Scientific Ideas in Portugal and Other Peripheral Countries: Scientists, Laboratories, Instruments and Texts in the Nineteenth and Twentieth Centuries

Coordinated by **Isabel Serra (Universidade de Lisboa, Portugal)**
Elisa Maia (Universidade de Lisboa, Portugal)
Francisca Viegas (Universidade de Lisboa, Portugal)
Chaired by **Nuno Marques Peiriço (Universidade de Lisboa, Portugal)**
Elisa Maia (Universidade de Lisboa, Portugal)
Francisca Viegas (Universidade de Lisboa, Portugal)

In nineteenth century science has undergone an extraordinary development from which resulted many applications. University teaching followed that development in different ways in the several European countries. In peripheral countries, as Portugal, some professors played a central role in that development, bringing in new ideas, new instruments, and new techniques and producing scientific and didactic texts in native languages. In this process, the creation and equipment of laboratories was fundamental to assure the modernization of the University and the development of scientific research.
In this symposium we intend to sketch an overview of this process with particular focus in the so called peripheral countries, by the study of scientists, as well as laboratories, instruments and texts that were relevant for the implementation of new ideas and practices in teaching and research during the nineteenth and twentieth centuries.
We would like to emphasize that in Portugal, as probably in other countries, some University Professors had a main role in the process of transfer of scientific knowledge.

Kurt Jacobsohn and Manuel Valadares. Two Unusual Teachers and Researchers of the Polytechnic School/Faculty of Sciences

Nuno Marques Peiriço University of Lisbon,
PORTUGAL

In 1929 Kurt Jacobsohn (1904-1991), at 25 years old, leaves the Kaiser Wilhem Institute für Biochemie to work at the Institute Rocha Cabral in Lisbon where he developed his research activity as enzymologist and in the study of metabolic reactions and, mainly those related with Krebs Cycle. In 1935 Kurt Jacobsohn got Portuguese nationality and was invited to held the position of Professor of Organic Chemistry and Medical Chemistry at the University of Lisbon, position that he kept for forty years. At the University, Kurt Jacobsohn developed efforts to create the course of Biochemistry what happened only after his jubilation with the coordination of Professor Ruy Pinto, one of his former students.
In the same year, 1929 with the same age, Manuel Valadares (1904-1982) leaves Lisbon to do his PhD at the Curie Laboratory in Paris with Marie Curie. In 1934 he returns to Portugal to teach Medical Physics at the University of Lisbon. His career as professor in Portugal was drastically interrupted in 1947, for political reasons.
These researchers, although in very different areas, carried out and coordinated research of international standard, what was unusual in Portugal by that time. Having brought from abroad updated scientific knowledge, they both introduced new ideas in the teaching in the medical course, Jacobsohn in biochemistry and Valadares in the field of the applications of the radiations.
In spite of the difficulties due to the scientific stagnation of the country in this period each one succeeded in bringing together researchers and assistants. Some of them later developed their own scientific careers, in scientific research and university teaching.

The Role of Theodor Gerdorf, Friedrich Krantz and Émile Deyrolle in the Collections of Mining, Metallurgy, Mineralogy and Paleontology from the Institute of Engineering of Porto (ISEP), Portugal

P. Costa (1,2) (1) ISEP, Politécnico do Porto,
H.I. Chaminé (1,3) (2) Museu do ISEP,
P.M. Callapez (4) (3) Museu de Mineralogia e Geologia, ISEP;
Centro GeoBioTec, UA,
(4) Museu Mineralógico e Geológico,
Univ. Coimbra, FCTUC;
Centro Geofisica, UC,
PORTUGAL

After a period of political turbulence that marked the first half of the nineteenth-century in Portugal, began in 1851 a new stage of constitutional monarchy. With the first government of Regeneration was created a new ministry for infrastructural and industrial development, the so-called Ministério das Obras Públicas Comércio e Indústria, under leadership of António Maria de Fontes Pereira de Melo (1819 -1887). The purposes of this effort were a reduction of the socio-economic delay of Portugal when compared with other West European countries, by modernizing the administration to achieve long-term economic and social development. That resulted in a significant increase of railways and roads, together with the construction of the first telegraph lines, and the establishment of an industrial education system in 1852. Industrial education had a strong practical emphasis in its curriculum courses highlighted by numerous cabinets and laboratories, at the time known as auxiliary offices of education. During several years were purchased scientific instruments to supply these cabinets and experimental laboratories. The equipments exhibited in the Museum of ISEP belonged to the ancient Cabinet of Mineralogy and Cabinet of Art Mines and Metallurgy, and had been made by the European manufacturers Friedrich Krantz, Theodor Gerdorf, and Émile Deyrolle. Currently, they still are the House Krantz, probably one of the older and larger rock, mineral and fossil traders, and the House Émile Deyrolle, related specially to paleontology. At that time these were considered the benchmarks with regard to the educational material, available on almost prestigious scientific institutions in Europe. The international and universal exhibitions were also an excellent way of spreading of the scientific and technological advances. In short, the acquisition of this type of collection indicates the scientific knowledge at the time, which allowed a country like Portugal to develop the industrial education and experimental training for graduates.

Scientific Life of Marieta da Silveira, Professor of the Faculty of Sciences of the University of Lisbon

Francisca Viegas Universidade de Lisboa,
PORTUGAL

Marieta da Silveira (1917-2004) was born in the one of the Azores islands, and come to Lisbon where she graduated in physics and chemistry of the Faculty of Sciences.
She started research in the field of nuclear science in the Center for Studies in Physics where she studied the absorption of the Uranium X radiation. The hypothesis of the existence of natural radioactivity by spontaneous emission of neutrons was one of her results, published in Portugaliae Physica. She obtained her PhD in 1945 and she continued working in the Centre until 1947, when the senior researchers were expelled from the University for political reasons. The same political reasons led to a situation where she herself, although not expelled, was also segregated. Some years later she started working with geologists studying radioactive minerals doing research work where Portuguese uranium minerals, including those originated in the Portuguese colonies, are analysed. This work was more ambitious than the previous articles published on the first half of the century on the same theme – their authors were aware they were doing scientific research.
Marieta da Siveira's research work was of great quality and some of her publications are mentioned in international documents of history of science(BEYER, R. T., Foundations of Nuclear Physics, New York, Dover Publications Inc., 1949). Besides these research activities she was also an outstanding teacher.

Jacob Bjerknes and the Weather Forecast in Portugal

A. J. Leonardo Center for Computational Physics and
D. R. Martins Department of Physics,
C. Fiolhais University of Coimbra,
PORTUGAL

In 1922, due to the initiative of António de Carvalho Brandão, the Meteorological Service of the Navy was founded in Portugal. This was the beginning of synoptic meteorology in the country. Brandão became not only the first director of that Meteorological Service but also one of the most known Portuguese meteorologists.
Four years later, in an international meteorology meeting held in Zurich, Brandão announced the deliberation of the Portuguese government to install a wireless telegraphy station at Azores to provide meteorological services. In 1927, Colonel Émile Delcambre, head of the French meteorological services, and Jacob Bjerknes, the famous Norwegian meteorologist, came to Portugal to meet with the Portuguese authorities to discuss details concerning the Azores international station. Bjerknes came earlier, on 8th May, to study the local weather and to get acquainted with the Portuguese meteorology. In the last day of his visit, 23rd May, accompanied by Carvalho Brandão, they visited the University of Coimbra, where Bjerknes delivered a conference, later published in O Instituto, the journal of the Coimbra's academic society. He then referred to the important role of Portugal might play in the European weather forecast and described a project of establishing several stations in Northern Atlantic to collect transmissions coming from all ocean liners, and communicate this information to the International Meteorological Organization, founded in 1873.
The international meteorological station of Azores started to operate in 1929. The inauguration was internationally announced at the meteorological congress held in Copenhagen in the same year. In 1934, the Meteorological Service of the Navy was receiving daily reports from four meteorological observatories (one being located in the city of Horta, Azores) and 30 stations. From these stations, 18 had an international character, i.e., their data was relayed abroad from Lisbon.

We present an episode of the history of meteorology, between the two world wars in which Portugal played a relevant role in the establishment of weather forecast services in Europe.

Making Science Cooler: Carré's Apparatus

Maria do Carmo Elvas (1) (1) MCUL, University of Lisbon,
Isabel Marília Peres (2) (2) CICTSUL and CCMM, University of Lisbon,
Sara Carvalho (2) PORTUGAL

The need of refrigeration in the laboratory is not a new idea, and this paper intends to make a tour through its history in the 19th century, where one of first attempts to make things cooler was created by the Carré brothers. The aim is to explore the types of Carré Apparatus, the techniques used in it and study their evolution and improvement. This work will focus mostly in the instrument's collection of the Museum of Science of the University of Lisbon, which own several exemplars of the Carré Apparatus and improved versions of it, including one that belonged to Portuguese Royalty. Our approach tries to put back these objects in their real place in the 19th century lab work, corroborating equipment with archival sources by establishing links between equipment and photographs, reports, curricula, chemistry compendia, textbooks written by the professors, where certain experimental settings are described and depicted, invoices and other administration papers, e.g. the 1854 inventory, among other archival and bibliographical sources. The 19th century 'Laboratorio Chimico' of the Polytechnic School (1837-1911), integrated in the Museum of Science of the University of Lisbon suffered a restoration and a musealization work (2000-2006) as well as a part of the museum's heritage, where a Ferdinand Carré's apparatus is included . This historical space and the pertaining collection allows us to go back to the nineteen century scientific practice at the Lisbon Polytechnic School and breathe the its atmosphere in a golden period.
Isabel Marília Peres and Sara Carvalho are members of the project "Cientistas, Laboratórios e Instrumentação Científica de Física e Química na Escola Politécnica/ Faculdade de Ciências de Lisboa" (PTDC/HCT/81550/2006) funded by FCT, Portugal.

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Regulations of the Mineral Chemistry Laboratory of the Politechnic School of Lisbon in 1889

Maria Luisa Cordeiro Rolo Laborinho dos Santos Alves Universidade de Lisboa,
PORTUGAL

Built "with the thought of filling the lack, in Lisbon, of (...) an establishment where at least the rudiments of natural sciences could be taught", the Polytechnic School of Lisbon appears as a space where science teaching reveals specific characteristics, and laboratory practice, in spite of several difficulties, is progressively introduced as an important factor in the teaching and learning process.
The works carried out in the laboratory of 6th course – General Chemistry and Notions of its main Applications to Arts – that transformed the old laboratory in the magnificent Mineral Chemistry Laboratory, constituted a landmark in the evolution of the experimental teaching in our country.
The Director of the Laboratory, Professor José Júlio Bettencout Rodrigues wrote very detailed regulations for the work in this laboratory, that we will analyze in this communication. In his "Projecto sumário de Regulamento dos Trabalhos e Serviços do Laboratório de Chimica Mineral da Escola Polytechnica de Lisboa" in 1889/1890 he specifies the rules related to the management of the laboratory, like the opening hours in different days of the year timetable, as well as some elementary safety rules. He also details the process of assessment of students. These regulations for the practical work in the laboratory are very complete, as compared to those of other laboratories at that time. They reflect not only concerns for the good management of the laboratory, but also pedagogical concerns related to the teaching and learning of good practice of the students and are an important conquest in science education in Portugal. The laboratorial practice is gradually an important agent in the process of teaching learning, that deserves be remembered.

"Laboratory Hands" once more and the Polytechnic School of Lisbon, 1837 - 1911

Sandra Lopes CICTSUL - Centro Interdisciplinar de Ciência, Tecnologia e Sociedade,
Isabel Cruz Universidade de Lisboa,
PORTUGAL

In two previous papers presented at the 6th International Conference on History of Chemistry, held in 2007 at Leuven, and 7th International Conference on History of Chemistry, held in 2009 at Sopron (Hungary) we brought up some facts regarding the personality identification of the chemistry preparers in some teaching institutions in Portugal, namely in the Polytechnic School of Lisbon. In those papers we also endeavoured to distinguish aspects of the professional evolution of the mentioned individuals.
In spite of being basically employed to assist the lecturer and relieve him of the so called minor preparatory tasks necessary for the practical classes and investigation, the laboratory hand would, when needed, alternate between a mere laboratory assistant helper to practically an assistant lecturer. Yet, it is clear that there was a barrier that prevented lecturer and hand – each with a totally independent professional situation – from being mistaken one for the other.
New significant data provided by the intensive research done in Polytechnic School archive documentation as well as in other exterior sources, related to the current CICTSUL project, "Scientists, laboratories and scientific instrumentation in the Polytechnic School of Lisbon" (later to become Faculty of Sciences), lead us to the necessity of delving deep into this issue. Therefore, the present work proposal approaches again the question of that specific professional area – the laboratory hand - and his role in the development of Chemistry teaching in Portugal, using the Polytechnic School of Lisbon as a case study. The objective is to outline with more accuracy the general points of evolution within the perspective of their work with the Chemistry lecturer, professor or investigator, and thus provide a better understanding of the historic process of Chemistry and its development in the educational institutions of the XIX century.

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The Photographic Self-Recording of Natural Phenomena in the Nineteenth Century

Isabel Marília Peres (1) (1) CCMM, Centro de Ciências Moleculares e Materiais,
Maria Estela Jardim (2) (2) Faculty of Sciences,
Fernanda Madalena Costa (1) University of Lisbon,
PORTUGAL

From the time of its discovery, Photography participated in the production of evidence in many scientific fields. In the second half of the nineteenth century the quality of the photographic images as well as the discovery of easier and reliable photographic techniques, transformed photography in a precious tool for scientists; they were now able to register in an indirect way atmospheric and magnetic phenomena.
Throughout Europe, Meteorological and Astronomical Observatories had started to be equipped with photographic self-recording instruments in order to be able to register in a continuous way the temperature, pressure or atmospheric electricity variations. One of these Institutions was the Kew Observatory considered one of the best in Europe.
By the end of the nineteenth century, the Infante D. Luiz Observatory of Lisbon, the Meteorological and Magnetic Observatory of the University of Coimbra, as well as the Meteorological and Magnetic Station of Oporto, owned photographic self-recording instruments for meteorological and magnetic purposes: barographs, psychrographs, electrographs and some magnetographs (declination, bifilar and of balance).
Portuguese scientists established privileged scientific contacts namely with the Director of the Kew Observatory, Balfour Stewart (1828 – 1887) and with William Thomson (Lord Kelvin) (1824 - 1907), among others.
Around 1870 the international network of meteorological observatories focused on the relations between magnetic and solar activity. At the Lisbon Observatory nearly 400 solar photographs were taken using a photoheliograph and a chrono-goniometer designed by Brito Capello (1831 – 1891).
In this report we will present our research on the instruments, photographic processes and the photographic data as well as on the contributions of Portuguese scientists in this field focusing on the international cooperation between Portugal and other European countries.

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Pombal's Reform of the University of Coimbra (1772) and the Institutionalisation of Astronomy in Portugal in 18th Century

Fernando José Bandeira de Figueiredo CMUC-FCTUC,
University of Coimbra,
PORTUGAL

The establishment of scientific education at the University of Coimbra was one of the most important features of the Pombal's Reform of the University (1772). One of the best examples is the creation of the Mathematics and of the Astronomical Observatory of University of Coimbra (OAUC). The foundation of the OAUC was fundamental in the institutionalization of astronomical science in Portugal, during a period when astronomy supported by the great theoretical advances of the celestial mechanics and applied mathematics could finally provide some important solutions to the most prominent scientific problems. Questions about navigation, geodesy, determination of comets' orbits and measures of time, were part of the program and practice of any european astronomical observatory. Such questions were also central in the conception and planning of OAUC the first university based astronomical observatory, although with aspects of a National Observatory. Jose Monteiro da Rocha (1734-1819) was the central personality in the conception, planning and construction of OAUC (1799), as well as in its instrument's provision and posterior scientific activity. His teaching activity, first at chair of Physics-Mathematics (1772) and later at Astronomy (1783), as well as the first Director of the OAUC (1795), would shape pedagogic and scientifically the Faculty's life and practice (and also the University itself), as well as all of the activity of the Observatory. He was the individual behind the applied mathematical and astronomical methods that allowed the OAUC to establish and publish its most important and significant scientific production: the Astronomical Ephemeris (1804). In this communication we describe the challenges performed by Pombal's Reform in the teaching of Astronomy and the contributions of José Monteiro da Rocha to the foundation of the OAUC and we illustrate some of his most outstanding astronomical and mathematical research, that was fundamental to advance of the national portuguese science during the 19th century.

The Birth of Electrochemistry in Spain: Characters, Laboratories and Sites

Ángel Toca Department of Chemical Engineering and Inorganic Chemistry,
ETSIIT, University of Cantabria,
SPAIN

In the last years of nineteenth century there was a growing interest for electrochemical industries in Spain, mainly by arriving of German and French enterprises and the promotion of this kind of industry by Spanish investment companies and banks. Productions like chlorine, caustic soda, bleach (sodium hypochlorite) calcium carbide and cyanamide, etc, were only a few examples.
With the reform of the education system that took place in the first decade of the twentieth century, Electrochemistry was introduced in Schools of Industry, new institution that promoted technical knowledge of low level with which Spanish pupils would de able of substitute foreign foremen in industry. Electrochemistry was not introduced in Science Faculties until the third decade of the century.
The industrial, applied and academically aspects of Electrochemistry were promoted by different professions: chemists, telegraphists, industrial engineers and agronomist. Most of them taught Electrochemistry in Schools of Industry and faculties of Science, and published different books focused in applications and theoretical knowledge of the discipline. At the same time there were laboratories that used Electrochemistry for different purposes: academically and industrial research, technical and analytical applications, etc.
This communication will try to show all this aspects of the birth of Electrochemistry in Spain and how chemists made use of their theoretical and applied knowledge to hold some of the new sites that appeared (industrial laboratories, educational ones, chairs in faculties and schools, etc) during these years.

The Influence of European Science on Brazilian Racial Thought about Miscegenation during the 19th Century

Juanma Sánchez Arteaga Instituto de Biologia,
Universidade Federal de Bahia,
BRAZIL

The main goal of this presentation will be to show how some anthropological concepts coming from Europe and the United States influenced the development of scientific debates about "racial degeneration" in Brazil during the 19th century. During that period, foreign -and, mostly, European- presence in the Brazilian scientific milieu was so significant that Europeans would even take a complete control over some of the best national scientific institutions. Sistematically, Emperor D. Pedro II looked for European or American experts in order to lead and organise many of the first scientific institutions of Brazil, such as the National Museum, the Museu Paulista, the Imperial Observatory, the Geological Commission of the Empire, the School of Mines of Ouro Preto, the Agronomic Institute of Campinas.... This clear dominance of foreigners in the Brazilian scientific institutions was noticeable at all scientific levels, however, the influence of foreign scientific doctrines and theories was particularly sensitive when the discussion pointed to the natural status of the different "human races". Throughout the nineteenth century, whenever Brazilian scientists approached the study of "races" and "racial miscegenation", they did so looking for previous scientific models produced in Europe or the United States. It would be impossible to understand the development of different forms of Brazilian scientific racism during this period -as manifested, for instance, in such relevant authors like Nina Rodrigues, Ladislau Netto, João B. Lacerda, etc.- without taking into account the enormous influence of some European or North-American authorities such as Carl Friedrich von Martius , Armand Quatrefages, Auguste Saint-Hilaire, Paul Broca, Morton, Louis Agassiz, Cesare Lombrosso, etc. Then, Brazilian Doctors, anthropologists, and natural scientists would re-adapt those foreign scientific proposals, often marking them with an original Brazilian character, as in the paradigmatic example of Raimundo Nina Rodrigues' Anthropological school.

Physics in Portugal in the Transition to the Republic (1910). The Role of the Polytechnic School / Faculty of Sciences of the University of Lisbon

Isabel Serra University of Lisbon,
PORTUGAL

During the nineteenth century, physics had been brought to a high degree of development and, at the end of that century, a new domain was born – microphysics. The rapid advances in physics accentuated the peripheral position of Portuguese scientific research, and science in general. Whereas in some European countries science was undergoing a great development, the update of scientific knowledge was not a priority in Portuguese society at the time, even in the universities.
The republican revolution that occurred in Portugal in 1910 led to some changes in thinking about priorities in education and science. In 1911, the diploma which created the Universities of Lisbon and of Oporto clearly put forward scientific research as a goal. However, in spite of the existence of the new Universities and the new legislation, the institutionalization of research came much later. Scientific activity was developed mainly on applied fields in an individual way. The first group working in fundamental physics began its activity in the University of Lisbon only in the thirties.
Meanwhile, from the end of the nineteenth century, some Professors tried to update and transmit their knowledge about the new physics. Standing out among them was the Professor of physics of the Polytechnic School/Faculty of Sciences, João de Almeida Lima (1859-1930). In this communication, the work of Almeida Lima and the others Professors of the Polytechnic School/Faculty of Sciences, as well as the subjects they studied, will be described in order to explain their role in spreading the new scientific ideas of the end of the nineteenth century and the beginning of the twentieth century.

S13 Scandinavian Science Denationalized

Coordinated by **Vidar Enebakk (University of Oslo, Norway)**
Henrik Kragh Sørensen (University of Aarhus, Denmark)
Chaired by **Henrik Kragh Sørensen (University of Aarhus, Denmark)**
Vidar Enebakk (University of Oslo, Norway)

At the end of Napoleonic wars the political situation in Scandinavia was completely changed. In accordance with the treaty of Kiel in 1814 Norway was separated from Denmark only to enter a union with Sweden until 1905. Meanwhile, the war against Prussia in 1864 caused Denmark's cession of Schleswig and Holstein, with the northern part of Schleswig being reunited with Denmark after a referendum in 1920. Such changing configurations resulted in a variety of nationalism and patriotism, but also a more transnational Scandinavianism throughout the nineteenth and twentieth century.
In this process, mathematics, science and technology served many different functions, and the circulation of people, ideas and artefacts took on new forms. In this symposium, we are primarily interested in the notion of science as an agent of denationalisation as it was developed and put to use in different ways in the Scandinavian region during the nineteenth and twentieth century. While peripheral to Europe, the Scandinavian countries shared a common linguistic and cultural background that enabled a Scandinavian stepping stone for the denationalisation of science in the various countries. Furthermore, the shared features of Scandinavian society enable comparisons of the scientific organization and research within the Scandinavian region. However, the provincial practices in Scandinavia must be understood in relation to broader European and international changes and circulations. To what extent was the international or denationalizing aspect of mathematics, science and technology mobilized to promote national goals and aspirations? How could the internationalism of science bring honour, prestige and esteem to the Scandinavian nations? Were the activities in these countries promoted as part of a universal undertaking or rather as a specifically Scandinavian supplement? And what, if anything, could only Scandinavians provide to the international circulation of mathematics, science and technology?

The Construction and Circulation of Christopher Hansteen's Magnetometer

Vidar Enebakk University of Oslo,
NORWAY

In 1819 Christopher Hansteen, a Norwegian mathematician, astronomer and director at the observatory in Christiania, published "Untersuchungen über den Magnetismus der Erde". Here he presented his geomagnetic observations and research summed up as a modified version of Edmond Halley's four pole theory. The book was accompanied by a beautiful magnetic atlas, and Hansteen later produced what is usually considered the first world map of magnetic intensity.
To measure the intensity of the earth's magnetic forces, Hansteen had constructed a new magnetometer, a small and portable oscillation instrument which was multiplied and modified by his instrument maker in Christiania, Henrik Clausen. The instrument was essential on Hansteen expedition to Siberia from 1828 to 1830 where he was trying to locate the second magnetic pole in the northern hemisphere. However, it was also used by various other researchers and explorers during the 1820s to make standardized observations and measurements. For instance, Paul Ermann in Berlin and François Arago in Paris both made systematic observations and reported back to Hansteen in Christiania, as did Hans Christian Örsted on his journey to Germany, France and the United Kingdom in 1822-23. Hansteen's approach to the study of geomagnetism even influenced Edward Sabine and the formation of the "Magnetic Crusade" in the 1830s.
I will explore the construction, circulation and calibration of Christopher Hansteen's magnetometer during this process of international scientific collaboration.

New Sciences in a New Nation State

Ernst Bjerke Forum for University History,
University of Oslo,
NORWAY

During the years 1825-1827 a group of young scientists and science students from the newly founded Universitas regia Fridericiana, in the newly founded Norwegian nation state, travelled extensively together on the European continent. Some years earlier this group, among them the mathematician Niels Henrik Abel, the geologist B.M. Keilhau and the zoologist Chr. Boeck, had formed a scientific society, connected with the only Norwegian scientific journal. This milieu placed itself at the very forefront of the institutionalization and professionalization of the natural sciences in Norway. They rejected the utilitarian natural history of their Enlightenment predecessors, and committed themselves to new analytical sciences, as they were developing internationally.
At their young university, in their young nation state, these young scientists looked outward to find their scientific ideals. Travelling on government grants, they criss-crossed the continent, furthering their own education, qualifying themselves for positions after their return. They were looking to bring home the latest developments in scientific thought and practice, so as to lift the standard of Norwegian science. In order for Norwegian science to contribute to the developing nation state, it first had to meet international standards and become internationally recognized. At the same time these young scientists were part of an established network of Norwegian and Danish natural scientists, collecting data for established practitioners such as Christopher Hansteen and H. C. Ørsted.
Drawing on travel journals, the extensive correspondence between the travellers themselves and their benefactors (official and private), this paper intends to shed light on the practices of scientific travel in the early nineteenth century, as well as the professionalization and institutionalization of the natural sciences in a newly formed nation state. How were new scientific ideals and practices imported to Norway, and how did young Norwegian scientists attempt to position themselves within the international networks of science?

Scandinavian Science De-internationalized? The Challenges of the Learned Societies in the Post –Napoleonic Era

Magne Njåstad Department of History and classical studies,
Norwegian University og Sciencen and technology,
NORWAY

The learned societies of the 17th and 18th centuries formed an international network for exchange of scientific ideas and results through correspondence and circulation of publications. The era of the French revolution and the Napoleonic wars dealt a blow to this network. In the post-Napoleonic era, the learned societies had to find their place in a new order of scientific knowledge, where the universities were to play a more important part.
This paper will deal with how one such society, The Royal Norwegian Society of Sciences and Letters, met these challenges in the period ca. 1810-1870. The society, which had been founded in 1760 in the city of Trondheim, had participated in the international exchange of scientific knowledge through the network of learned societies, but by the turn of the century, it found itself in a peripheral position, both due to the lack of active members, but also hastened on by the troubled political situation. The society met this challenge by reinventing itself as a locally based organization, aiming to play an important role on the national stage, and with pretences to uphold its international network.
The first two goals were successfully achieved, but the society struggled to place itself in a meaningful international context. Most successfully, this was done in the exchange of publications and the maintenance of the best scientific library in Norway, and partly it was done by trying to engage the personal networks of the leading members abroad. By the second half of the century, it was obvious that these strategies had to be based in a scientific environment of a more professional nature, such as a university or a research-based museum. The latter course was chosen by the society around 1870.

Scientific Travels among Geologists

Anne Kristine Børresen Norwegian University of Science and Technology,
NORWAY

In the summer of 1882 a young Norwegian geologist, Johan Herman Lie Vogt (1858–1932), went abroad to increase his scientific capital (i.e. learn more geology, work in famous professors laboratories, visit interesting geological deposits) and also expand his cultural capital (by visiting and learning more about European cities and continental life). He originally planned to stay abroad for one year, but when the first year of travelling in Sweden came to an end, he decided to expand his journey for another year, and yet another one.
For Vogt, the three years of travel proved critical for his career. He arrived back in Norway as a mature scientist with a name that was noted in foreign disciplinary circles, which in turn enabled him to begin gaining entry into the national natural-science elite. In this respect he repeated the pattern of several generations of Norwegian academics.
Years of travel had been an important element in the development of a scientific culture and education in Norway from the University was founded in 1811 and even before that, when German mining engineers came to Norway to educate Norwegian recruits. Many of them went subsequently to Sweden and the German states to learn more about the mining industry.
My presentation will focus on the travelling practices among Norwegian geologists in the second half of the nineteenth century. Where did they go? Why was travel so important and what consequences did this have - on research, scholarly practices, new organizational forms at the University and modes of teaching among the new generation of professors in geology?

Mathematics Denationalized: Scandinavian Mathematical Congresses, 1909-1925

Henrik Kragh Sørensen Department of Science Studies,
Laura E. Turner University of Aarhus,
DENMARK

Reacting directly to the changed political landscape in Scandinavia after the dissolution of the union between Norway and Sweden in 1905, the prominent Swedish mathematician Gösta Mittag-Leffler extended “a brotherly hand” for Scandinavian colleagues to meet for a congress in Stockholm in 1909. Since the last decades of the nineteenth century, mathematicians had benefitted from the modernization of transport in meeting regularly every four years for the International Congresses of Mathematicians. But Mittag-Leffler had the vision of bringing together Scandinavian mathematicians – united by culture, language and politics – for a denationalized, yet regional effort in furthering mathematics and mathematical research in particular.
During Mittag-Leffler’s lifetime, the first congresses were organized approximately every 2-3 years: 1909 in Stockholm, 1911 in Copenhagen, 1913 in Kristiania (Oslo), 1916 in Stockholm, 1922 in Helsingfors (Helsinki) and 1925 in Copenhagen. After the series got underway, Mittag-Leffler had the ambition of internationalizing the congresses even further when he invited the International Congress of Mathematicians to Stockholm for 1916. However, due to World War I, the international congress had to be abandoned and Mittag-Leffler had to settle for a more regional event. After the war, efforts were again made to bring together the Scandinavian mathematicians, now more explicitly including the Finnish community where national identity was conflicting with the international and universal nature of mathematics more strongly than anywhere. In 1925, some of the participants even argued for a role on the international scene for Scandinavian mathematics, claiming that when united the Scandinavian mathematical communities were comparable to any of civilized nation in diversity and depth.
In our presentation, we will briefly outline the motives behind the inception of the Scandinavian Congresses of Mathematics in 1909 before we go into deeper discussions of their role between national, regional and international communities and between mathematics in a nationalized and a denationalized framing.
This presentation is based on an English-language joint paper to be submitted in 2010.

Chemical Engineering versus Industrial Chemistry at the Norwegian Institute of Technology, 1930s-1950s

Thomas Brandt Norwegian University of Science and Technology (NTNU),
Trondheim,
NORWAY

In 1924 Henry Ingeberg, a chemical engineer, had returned to Trondheim from America. There he had been impressed with chemical engineering education and its focus on large scale experiments and training in the use of instruments. Chemical engineering was a rather new scientific discipline, described by Fred Aftalion (1991) as "a hybrid science requiring both the chemist's and the engineer's knowledge." Ingeberg saw a great potential for chemical engineering in Norway, and wanted to introduce it here trough a course curriculum at the Faculty of Chemistry at the Norwegian Institute of Technology in Trondheim. He travelled to England, as well as to Germany, Sweden and Finland, where he found laboratories and engineering colleges where chemical engineering had been introduced. In particular he found inspiration in Emil Kirschbaum's work on "Apparatebau" in Karlsruhe.
In the 1930s Leif Tronstad, a professor in technical inorganic chemistry in Trondheim, also travelled extensively in Europe. In his diary he wrote about his own reactions to the introduction of chemical engineering as a new discipline. Manchester had been a pioneering site for chemical engineering, but Tronstad was not impressed by the work being done in this field there. After meeting several German colleagues, who reported on the lack of scientific results from other European chemical engineering laboratories, Tronstad's negative impression of the novelty was strengthened.
This paper explores how these different forms of chemical science were debated, how they were sought appropriated to the education of Norwegian engineers, what kind of buildings, laboratories, instruments and curricula were seen as required, and how these chemical disciplines related to different transnational scientific communities and industrial practices.

Nationalization or Denationalization. Scandinavian Collaboration on the Development of Nuclear Power Reactors, 1953-1970

Henrik Knudsen Department of Science Studies,
Henry Nielsen University of Aarhus,
DENMARK

During the politically unstable period just after World War II, two of the Scandinavian countries, i.e. Norway and Sweden, embarked upon projects aimed at utilizing nuclear energy for civilian and, to a certain extent, military purposes. Initially these countries had hoped for technical support from the United States, but when these hopes were dashed by the American policy of nuclear secrecy, the projects were converted into national efforts instead. Early results hereof were marked by the inauguration in 1951 of Norway's first experimental reactor at Kjeller, and in 1954 of Sweden's first research reactor built into the bedrock under the Royal Institute of Technology in Stockholm.
For many reasons, no similar initiatives were taken in Denmark before 1953 when the US Atoms for Peace Program was announced by President Eisenhower. The creation of the Danish Atomic Energy Commission (1955) and the inauguration of its prestigious Atomic Energy Research Facility at Risø (1958) indicated that the Danish political and scientific establishment was now determined to catch up with its Scandinavian neighbours.
Thus, after 1953 all three Scandinavian countries were doing research and development within the field of nuclear energy, relying heavily on know-how and technical support obtained through bilateral agreements with UK as well as USA and through international collaborative bodies like the European Nuclear Energy Agency (ENEA). As nuclear energy technology builds on global standards transcending national borders and as the Scandinavian countries share a high degree of political, economic and social homogeneity, it is no wonder that several initiatives were taken to coordinate the development of nuclear power reactors in Denmark, Norway, and Sweden.Our paper will briefly outline the motives behind some of these denationalization projects. The main part of the paper, however, will be devoted to a discussion of the historical, political, social, and cultural factors that in the end grinded these efforts to a halt, and instead set each of the Scandinavian countries on its unique national nuclear technological trajectory.

S14 What does it Mean to Be an 18th Century Empiricist? Construction and Circulation of a Pluralistic Concept

Coordinated by **Anne-Lise Rey (University of Lille I, France)**
Siegfried Bodenmann (University of Berne / Euler-Archive of Basel, Switzerland)
Chaired by **Anne-Lise Rey (University of Lille I, France)**
Siegfried Bodenmann (University of Berne / Euler-Archive of Basel, Switzerland)

«Le chancelier Bacon […] embrassa le premier un plus vaste champ: il entrevit les principes généraux qui doivent servir de fondement à l'étude de la Nature, il proposa de les reconnoître par la voie de l'expérience, il annonça un grand nombre de découvertes qui se sont faites depuis.[…]Newton parut, & montra le premier ce que ses prédécesseurs n'avoient fait qu'entrevoir».
In the entry « Experimental » of the Encyclopédie, d'Alembert exposes how fundamental Bacon and later Newton were for the development of the empirical sciences. This seems to confirm a largely admitted pattern of the traditional historiography of science which identifies newtonianism with the birth of classical science. That view roughly privileges a scientific method that proclaims the benefaction of a remote baconian inductivism and find its motto in the newtonian "hypotheses non fingo". In this tradition, the circulation of objects of investigation, instruments, detailed instructions, elaborated reports or any other elements which might allow the reproducibility of an experience or an observation is constitutive for the advancement of science.
At the same time, the medical sciences – and to some extent also the empirical chemistry – offer in the 18th century a distinctive but coexisting empirical tradition which is much more ambiguous. As Jaucourt points out in the Encyclopédie, empiricism refers simultaneously to a practice of medicine that disregards scientific theory and relies solely on practical experience but also to what he calls a sort of charlatanism: a practice of some contemporary physicians to exercise without any profound knowledge.
The plurality and ambivalence of the notion empiricism, which is alternately incensed or disqualified depending on the fields of knowledge in which it appears, do not only question its definition in general but also the mythical character of experimental science in the enlightenment. We assume that the only way to comprehend the multiple faces of empiricism is to reconstruct the way the concept circulated and how it was appropriated, readjusted or even transformed by different actors and institutions. The numerous conceptions propagated by the notion rest upon its repeated reception in distinctive cultural and epistemological boundaries.
Furthermore, we seek to replace the various forms of empiricism in their dialogues with systems and metaphysical principles. One only need to look at some of the most renowned 18th century empiricists like d'Alembert, the marquise du Châtelet, Maupertuis, Boerhaave, 'sGravesande, Musschenbroek or Haller to understand that they were far from simply rejecting any metaphysical device. In fact, the scientific method of the enlightenment can be conceived as the intricate result of a rather unexplored inter-relation between empiricism and metaphysical principles. To identify the different world views and systems of thoughts which are underlying the multiple expressions of empiricism is to understand the inventiveness and creativity of the science process.

Newton's Empiricism at the Crossroad : on the Meaning, Use and Fate of the Experimentum Crucis

Philippe Hamou Institut de Recherches Philosophiques,
Université Paris Ouest Nanterre la Défense,
FRANCE

In the famous article on Colours and Light of 1672, published in in the Philosophical Transactions, Newton claimed that he had demonstrated the heterogeneity of white light and refuted the alternative theory of modification, through the exhibition of a single experiment, called, in a baconian guise, "experimentum crucis". As he wrote then to Oldenburg, the demonstration was a rigid consequence of the experiment, not an hypothesis or inference to the best explanation. Some twenty years later in the printed text of the Opticks, this experiment has lost its name and unique privilege and features among many others, in a complex and somewhat less peremptory argumentative pattern. How shall we interpret this change, or shift of emphasis? Are there two roads of newtonian empiricism, two different ways of taking over the baconian legacy ? And how, through the prism of Newton's Opticks, did Eighteenth-century scientists and philosophers perceived this methodological legacy?

Eighteenth Century Newtonianism and Four Kinds of Empiricism

Eric Schliesser Philosophy and Moral Sciences,
Ghent University,
BELGIUM

The main intention of this paper is to show how in the aftermath of Newton's Principia the authority of Newton could be challenged on Empiricist grounds. In my paper, I shall first distinguish four forms of (epistemic) Empiricism prevalent in the Eighteenth century. They are based on: 1/ theory-mediated-measurement; 2/ experiments; 3/ the investigation of ideas; and 4/ fact-gathering (natural history). Of course, in practice, inquirers could combine and blend those four forms in various ways. The first two are traditionally traced back to Newton's Principia and his Opticks respectively (I.B. Cohen).
The second half of my talk will depict how the Principia was popularized in Holland and in Scotland by people such as 's Gravesande, MacLaurin and Musschenbroeck, who used experimental demonstrations in combination with (Lockean) investigation of ideas. I will then contrast their approach with the one advocated by Roger Cotes, the editor of the second edition of the Principia.
Eventually, I will show how critics of the authority of Newton (Berkeley, Hume) challenged the Lockean-experimental synthesis from within.

The Experiments of Willelm s'Gravesande: a Validation of Leibnizian Dynamics against Newton

Anne-Lise Rey Université Lille I/ UMR STL,
FRANCE

Willelm's Gravesande has written an Introduction to Sir Isaac Newton's philosophy or more exactly Mathematical elements of natural philosophy, confirmed by experiments. If he certainly was one of the most important spreaders of the newtonian physics, experimental methodology and epistemology in the 1720's, his empirical claim somehow turned against him: applying Newtonian methodological tenets, in the end he was led to validate the Leibnizian principle of the conservation of living forces against the Newtonians themselves. That's why he had to face the anger of Samuel Clarke who, in a volume of the Philosophical Transactions of the Royal Society for the year 1729, accused him of having written this book with the aim of « darkening Newton's philosophy ». In his answer, which s'Gravesande published as a Supplement to the Essay upon a new theory of the collision of bodies, he developed an hybrid methodology leaning both on experiments and reason. In my paper, I shall thoroughly analyse this interesting combination.

Medical Empiricism and Baglivi's De Praxi Medica (1705): a Paradoxical Legacy

Raphaële Andrault UMR 5037 - Cerphi, ENS-Lyon, and
Fondation Thiers, Institut de France,
FRANCE

We want to examine the emergence of Early Modern Empiricism in Medicine through the study of Baglivi's De praxi medica. This physiologist will allow us to analyze the self-conscious elaboration of an empiricism, which, on the one hand, is naturally supposed to rely only on the observation of phenomena, but, on the other hand, is defined in contrast with the methodology used by the so-called "empirical" physicians: Baglivi criticized those physicians not only because they thought that the Medicine was necessarily uncertain, but also because their observations were unconnected, and thus did not follow the natural laws regulating diseases. As a matter of fact, Baglivi describes the proper methodology of a reformed Medicine as a third way between the sect of the Empiricists and the sect of the Rationalists. More generally, this study will teach us how: 1/ the elaboration of a medical empiricism in the Early Modern Period was partly based on a critical History of the Medicine that has been left to the Enlightenment, via some theoretical oppositions that until now have structured the historical understanding of the discipline (solidism vs humorism, iatromechanicism vs iatrochemistry, etc.); 2/ paradoxically, Baglivi has been seen as a Iatromechanist and a systems-maker (notably by the Empiricists of the medical school of Montpellier, who have yet retained Baglivi's discoveries about the fibers): drawing the history of Baglivi's reception will enable us to show the metamorphoses of medical Empiricism; 3/ the agnosticism about the very nature of the physiological causes (the one we can find in Condillac for instance), with which the Empiricism is generally identified, have been partly rooted in some interpretations of the Cartesian program – and of the machine analogy–, which were widespread among the anatomists of the late 17th century (specially Steno): this feature compels to see the rewriting of Descartes as one of the positive, and not only negative, sources of the medical Empiricism of the Enlightenment.

Was Early Eighteenth Century's Chemistry an Empirical Science?

Bernard Joly Univ Lille Nord de France,
FRANCE

The "Table des différents rapports observés entre les différentes substances" which Etienne-François Geoffroy established 1718 seems, at first sight, to have been built solely on the basis of many observations made by chemists in their laboratories during the seventeenth century as well as on the works that himself and others chemists of the Parisian Académie royale des sciences, such as Wilhelm Homberg and Louis Lémery, had recently undertaken. In respect thereof, it seems that Geoffroy can be called a Newtonian because he didn't build any hypothesis, refraining from giving any references to chemical principles or theories.
At the same time, he was said by Fontenelle and others to have introduced tenets of the Newtonian attraction, while we can see that, in fact, he was alluding to Homberg's theory of the « Soufre principe » and maybe also to some alchemical considerations taken from the works of J.-J. Becher. Hence, on closer examination, the « Table des rapports » appears to be overload with theories. Moreover, in the early Eighteenth century, Chemistry seems to have made the same ambiguous use of laboratory operations that ancient alchemy: experiments weren't designed to confront the theory with matters of fact, but rather to visualize or to make visible the main aspects of a chosen theory.
In my paper, I shall explore precisely those intricate links between theory and experience, in order to specify the limits of empirical knowledge in Eighteenth-century chemistry.

Empiricism as Rhetoric of Legitimation: Maupertuis and the Figure of the Earth

Siegfried Bodenmann University of Berne, and
Euler-Archiv, Basel
SWITZERLAND

In the Eighteenth-Century, Newton is slowly establishing himself on the European continent. At the Parisian Academy of science Pierre-Louis Moreau de Maupertuis claims to be his first French disciple. Although well aware of some obscurities and questions left open by the Principia, he is stroke by the rigour and validity of the attraction law.
Seeking a tangible proof to establish Newton against his detractors, he begins working on the polemical issue of the Earth figure. While Cartesians assume that our globe is flattened at the equator, Newton suggests an Earth being flattened at the poles. 1732 he composes his Discours sur la figure des astres, a pleading for Newton's law but also for what is called today his empirical method. Maupertuis accuses Descartes to have shape a system based on hypotheses who can't account for the observations. Summoning Newton's hypothesis non fingo and emphasising the importance of experience, he prepares an expedition to Lapland in order to prove by measurement the Earth being flattened at the poles.
The account of the expedition (1736-1737) focus on observations, describing in detail every instrument and underlining the accuracy of all measurements made. Unlike other reports penned by some of his travel companions, Maupertuis develops something which can be called rhetoric of empiricism to legitimate the results of the undertaking. In this paper, we aim to show first how Maupertuis hereby not only adopt the Newtonian ideas but also transformed them, eventually combining them with Cartesian thoughts to persuade his readers.
We will see next how the observations were strongly criticized by some contemporary readers who accused Maupertuis to have disposed of instruments made by the English George Graham. They therefore charge him with having use Newtonian devices which couldn't show anything else that a Newtonian truth. On the ground of metaphysical postulates and a patriotic argumentation they hence highlighted the limits of empiricism and raised the issue of theory-laden observations.

The Faculty of Imagination and the Invention of Experiments in Bacon

Doina-Cristina Rusu University of Bucharest,
ROMANIA

Bacon was the first to emphasize the importance of experiments in building a true science. But how is the mind working to be able to produce science? For Bacon there are three faculties of the soul – memory, imagination and reason, concerning with history, poesy and philosophy respectively. Imagination is very important for knowledge transmission and for building a virtuous character. It does so by offering examples capable of representing a model of life. Bacon is defining imagination as "an imitation of history at pleasure", and this is the reason why Bacon's readers discuss about imagination only in an ethical framework.
There is no doubt concerning this ethic function of imagination, but my claim is that it has an important role for the birth of science, because the imagination is the faculty able to see the similarities between things, and to combine and separate parts of the things, the only true methods of science. It is true that these activities are done with respect to mind's pleasure, or according to the laws of nature. In the first case, it is the work of imagination, and if it is done according to the necessity, that it is the work of reason. My arguments are based on Bacon's affirmation that reason is dealing only with general concepts, and it is obvious that experiments are of individuals, even if they can tell us something about species. In conclusion, experiments are not generated by reason, but by imagination, and because of the risk that the latter may transform into fantasia, reason's function is to guide it and to protect it from the idols and passions of the mind.

Fictive Empiricism, Material Experiments — Some Reflections on a Conceptual Anachronism

Marc J. Ratcliff University of Geneva,
SWITZERLAND

Empiricism is sometimes considered as the crucial philosophy of the Enlightenment, being a trend that led the scientific investigation. Yet this view is not consistent with an analysis of eighteenth-century sources, but rather displays a conceptual, anachronistic and terminological confusion. In their texts, the philosophers nowadays called empiricists —Locke, Condillac — refer to human experience to understand knowledge, but not to empiricism. This can be explained by the fact that at that time the term refers to a way of doing something without either guidelines or even limits. Indeed for the whole of Europe an 'empiric' is a quack, someone operating on the ground of his own experience and without a definite framework.
In parallel, with the institutionalization of scientific investigation in the academies since the second half of the seventeenth century, scholars developed bunches of concrete experiments and observations both to describe things and understand phenomena. From the time of Boyle to that of Lavoisier these scholars did not claim their own epistemological trend to be something else than experimental philosophy, physics or art of observation, and never mentioned the word 'empiricism' since its connotation was usually negative.
During the 1780s, the word 'empirical' slowly started to make its way to some scientific texts, though keeping the connotation of acting free from guidelines, against rationality. All this changed around the time of the French Revolution, with major semantic transformations. First, Kant established empiricism to designate Locke's tenets, and philosophy was becoming specialised; second, after the Revolution experimental philosophy had become an issue for historians, and everyone spoke instead of science ; third, some scholars started to define their own experimental research as 'empirical', and, to avoid confusion, called for a more precise definition. In the midst, a second meaning had emerged between 1780 and 1820 that liberated the word 'empiricism' from its bad connotation. It established its modern meaning but gave simultaneously birth to the anachronistic confusion between fictive empiricism and material experimentation, two distinguished activities during the Enlightenment.

S15 'Moved' Natural Objects – Spaces in Between

Coordinated by **Marianne Klemun (University of Vienna, Austria)**
Sabine Brauckmann (Science Center, Tartu, Estonia)
Chaired by **Marianne Klemun (University of Vienna, Austria)**

A culture of natural history in the 18th and 19th centuries cannot be imagined without refering to objects or natural objects and their circulation. Closely connected to this are knowledge spaces, such as the cabinets of natural history specimens, the botanical garden aso., i. e. places into which natural objects are incorporated. Currently there is a boom of research in this respect. This is at first due to the history of collecting them, but furthermore also to cultural, knowledge and science history.
However, in contrast to this focus, here other spaces will be made a topic, which for the time being have not been declared to be independent research topics. These contexts, which we like to term "spaces in between" here, concern neither the collected object´s place of origin nor its destination. Actually, they are located between these two poles, between the starting point and the place of destination, such as a collection.
The topic is the movement of objects outside these points of reference. This "movement" may be of a variety of "natures". It may change the "nature" of the objects themselves, change it into "culture" and make them different. Which cultural practices are involved in these movement activities, and which significance is generated by these activities in different "spaces in between", beyond the material basis?
Quite different phenomena may work as "spaces in between", it may be a tent during a journey, a container, a packet transporting objects, as well as a letter and various kinds of records accompanying the objects. The question of how these lead us towards epistemic references shall be discussed by way of some case examples.

Minerals on the Road. Mineralogical Packages forming Cultural Spaces

Benigna Kasztner Friedrich-Schiller-Universität Jena,
GERMANY

The mineralogical collection in Jena circa 1800 receives constantly a great number of donations. It has been formed by members of the mineralogical society, from all over the world minerals are send to Jena: But there is a long time while the specimen is 'on the road', remaining in the box. And this 'package' is responsible for the following transformation turning a 'natural' object into a 'cultural' one.
The paper will focus the processes framing the complex of specific mineralogical 'packages': Political strategies, scientific networks, cultural connotations. The 'box' will be imagined as 'cultural space' and the natural exemplar serves as juncture of manifold cultural aspects circa 1800. In between the packing and the unpacking a 'piece of nature' changes to a 'piece of culture'.

Making Objects to Move: Minerals and their Dealers in 19th Century

Bernhard Fritscher Lehrstuhl für Geschichte der Naturwissenschaften,
Universität München,
GERMANY

In 1833, the geologist/geognosist Adam August Krantz (1808-1872), former student of the Freiberg Mining Academy, established a "Mineralien-Geschäft" (Mineral Shop) at Freiberg. Just a few years later he moved the firm to Berlin, and, after a new start at Bonn in 1850, it became the well-known "Rheinisches Mineralien Comptoir", still working today. Numerous famous earth scientists, such as Benjamin Silliman (1779-1864), and Alexander von Humboldt (1769-1859), were to be found among Krantz's customers.
The rapid growth of the company within not at least two decades might be seen as a striking example of 19th century need of circulating objects, i.e. of a new 'space' - between scientific, economic, and public/popular uses - to make objects move. The paper discusses the conditions and requirements of its formation, and the transformations of objects within this new 'space'. One of these transformations might be called an 'economisation of nature'; more important, however, seems to be a new kind of objects' accessibility, i.e. objects, and thus: nature itself, became accessible 'by catalogue'.

Field Notebook as a Temporal Mnemonic Tool

Renata Sõukand Estonian Literary Museum, Tartu, and
Institute of Philosophy and Semiotics,
Tartu University,
ESTONIA

In 1888, Estonian folklorist and linguist Jakob Hurt (1839–1907) launched his famous appeal to the "active sons and daughters of Estonia" to collect local folklore. Among other requests (to collect songs, myths, beliefs etc), he listed 54 vernacular plant names (with the Latin equivalent supplied for some) and asked people to send popular descriptions of their use, initiating a long-lasting collecting tradition as well as laying the foundation for future research. Although the first sound recording of Estonian folklore was made in 1912, this method of collection was kept long unused for non-lyrical forms of folklore. Instead of that, professional and amateur folklorists went out using field notebook as the tools of mediation of folk knowledge from the bearer of folklore to fine written reports of expeditions finally stored to folklore archives. Field notebooks were valuable only for the person who firsthand put the keywords of the paper, simply because majority of the information actually transmitted during the conversation, was stored into the memory of the writer. After recall of the information using the field notebook, they were most certainly just destroyed as something that has lost its value. Thus, field notebooks serve as temporal mnemonic tools, being at the same time the "spaces in between" for the information concerning rational knowledge. Using data medical use of herbs repeatedly sent to different collectors by some respondents and comparing the herb use information sent by bearers of folklore themselves with the information collected by professional folklorist, this contribution shows how usage of field notebooks have affected the outcome of the information transfer and how they can be repeatedly used to produce slightly different information sent out again and again.

Metamorphosis between Jungle and Museum. Collections in the Making

Kurt Schmutzer Austrian Broadcasting Corporation, Vienna,
AUSTRIA

Artistically preserved crocodiles, apes, piranhas and birds, intestinal worms conserved in alcohol – millions of natural scientific specimens assembled in museums for Natural History around the world represent the outcome of numerous historic scientific voyages. The zoological collections of Johann Natterer (1787-1843), gathered during his travels throughout Brazil in the years 1817 to 1835, give an exellent example to show how specimens are moved and changed on their way from „jungle" to „museum", between two spaces of knowledge. The specimens shown at the musem are neither an authentical image nor identical with the living animal, they are "made" objects. Before the individual animal becomes part of an exhibition or collection as a classic representative of its species the specimens undergo several transformations. The animal is hunted, skillfully preserved with the help of chemical means, named, described and placed in a system of natural-scientific nomenclature. The specimens are transported from continent to continent, passed on in international networks and at last they are displayed in museums or stored in collections for further studies, allocated within specific cultures of knowledge and "nature". These transformations, produced by cultural practices, alter the animals´s physical composition. Written and visual documentation both verify and influence these procedures. But what consequenzen do these transformations imply regarding the specimen´s scientific value and cultural meaning? Natterer´s reports written during his voyages in Brazil describe these metamophosis in question and they are at the same time part of it. They also give an insight in the techniques naturalists used in order to secure reliable authenticity for each specimen collected in distant parts of the world.

Seeds of Knowledge

Annalisa Managlia University of Bologna,
Umberto Mossetti ITALY
Ariane Dröscher

Botanists (and commercial nurserymen) had been passionately prospecting the newly discovered lands for new plants since the end of the 16th century; these travels resulted in the introduction to Europe of many new exotic plants. Unfortunately, during prolonged see voyages living plants were exposed to marine salt spray, lack of freshwater, exiguity of space, and (at least until Wardian case was invented) this resulted in the loss of 90% of the plants or more. Even the preparation of dry specimens for the Herbaria required special care and a lot of time, especially in the tropical region, not to mention the costs for the shipment of these often-great collections.
The solution of these problems was that plants had to travel as seeds. In Europe they were grown in Botanical Garden and then prepared for the Herbarium collection. This inexpensive method allowed also minor institutions to enrich their alive and dried collections of exotic plants. This is the case of Bologna, where at least two personalities deserve mention: Ferdinando Bassi, a XVIII Century botanist correspondent of Linnaeus, and Antonio Bertoloni, who during the XIX Century received a massive amount of seeds from all over the world, grown them in the botanic garden and realised a valuable herbarium containing hundreds of newly discovered species.
Seeds are compact and minute carrier of a massive amount of (genetic) information that can be transferred and preserved without particular complications and that finally expresses its complexity in the form of a living plant in the botanic gardens.
This means that the botanic gardens are not a final destination but a place for additional, pivotal transformation before the selected material become part of a museum collection, a "space in between" that connect the "information for doing a plant" and the plant itself.

When the Natural Object Itself Becomes the “Space in Between”

Raivo Kalle Estonian Literary Museum, Tartu,
ESTONIA

This communication explores the situations occurred in history of Estonian ethnobotany, when the natural object itself become the “space in between”, meant only to mediate some knowledge related to it, and not actually meant to be preserved and stored in knowledge spaces. For botanists, plants as natural objects have always been important material to collect and store. Removed from the place of origin, correctly dried and identified they are stored in the places of destination, accompanied with the information on the place of origin, identifier, date, vernacular names, use, etc what is considered important. Still, some collected specimens miss sufficient information required to become valuable for botanical means. Examples discussed here, are samples of folk medicinal plants, collected by the traditional users to accompany the information of their use, sent to the collectors, who explored Estonian ethnobotanical knowledge in 19th century. First collector was pastor, Estophile and amateur botanist Johann Heinrich Rosenplänter (1782–1846), who related vernacular names to species using specimens sent by collaborators in addition to described use. His herbarium, of ca 1000 specimens is stored, but categorized as useless for botanical means. 60-70 years later doctor Mihkel Ostrov (1863–1940) initiated the collection of the information on plant use by announcing it in three widespread Estonian newspapers. He received at least 240 specimens, accompanied with the descriptions of plant use. Information accompanied the plant binomials detected using sent specimens is still preserved, rewritten by Osrtov, but original contributions with specimens have disappeared. When the plant is meant to serve only as a mediator of the information, the sample itself, after the extraction of required knowledge, is proved useless and gets lost in the core of history or is preserved for a just “historical value”.

Culinary Interspaces: Baltic Gardening and Nutrition in Early Modern Times

Ulrike Plath Under and Tuglas Literature Centre,
Estonian Academy of Sciences,
ESTONIA

Before the boom of potatoe in 18th-19th century, nutrition habits in Northeastern Europe were bound on meat and cereals. Yet throughout history different vegetables and fruits, both domestic and imported or naturalized, were in use and of greatest importance for the daily diet. In Early Modern Times seeds and knowledge about vegetables and fruits from all parts of the World spread fast to the North, hand in hand with technological innovations that enabled cultivation of plants sensible to cold. With these vegetables and fruits even nutrition habits of different social classes changed step by step and fruits and vegetables got more and more part of everyday nutrition, as it is reflected in the early cooking books (First Baltic cooking books published in 1781).
In the paper I will highlight changes of vegetable and fruit cultivation and nutrition habits of the Baltic countries Estonia, Livonia and Curonia in Early Modern Times (16th-19th cc.), the impact of imperial belonging to Sweden, Poland and Russia on nutritian habits, the modernisation of glass house techniques and knowledge about plants. their cultivation and use in medicine and as symbols for social standing. What impact had the ups and downs in the use of imported and naturalized vegetables and fruits on the use of domestic one? When did foreign fruits and vegetable became familiar? How long did it take and how was it politically supported?

The Beauty on Display. The “Perfumery Filtz" “ and its Beauty Products in the Nineteenth Century Vienna

Teodora Daniela Sechel Central European University, Budapest
HUNGARY

The Parfumerie J. B. Filtz is the oldest perfumery in Vienna. It represents a mirror of the nineteenth century historical events and social values. The perfumery business of Filtz family, the quality of aromas and cosmetics they produced were famous in all the Habsburg Monarchy and beyond.
The perfumery was grounded in the middle of the turmoil and war at the 23. April 1809 by Anton Filtz . Initially he imported the cosmetics from France and England encouraged by the presence of French troops and later by the participants to the Viennese congress during 1814 to 1815.
Later he and his sons created their own creams, soaps, pomade and eau de toilette. In 1831, the son of the founder, Johann Baptist Filtz, invented a new beauty cream entitled "Really Parisian ladies-Conservations-water." He used high quality oils made out of Bergamot, lavender, Muskatnuss, carnation, orange, roses, cinnamon or lemon. They mixed oils with real wine spirit and alcohol, distilled with special method in order to transfers the aroma to the solution.
The developments of chemistry in the nineteenth century permitted the invention of new types of cosmetics. My paper will analyse recipes of creams and perfumes which are in the archive of the Filtz family. I will use the insights of the history of chemistry and history of pharmacy in order to show the methods of preparation of beauty products and the way in which were used and preserved. This paper uses an interdisciplinary approach because the development of cosmetics reveals a new importance given to body and to beauty, which was one of the ideals of the Viennese society in the nineteenth century.

Teodoro Monticelli (1759-1845) Collection and his European Contacts. The Neapolitan Case

Carmela Petti (1) (1) Centro Musei delle Scienze Naturali di Napoli,
Maria Toscano (2) (2) Dipartimento di Discipline Storiche,
Università degli Studi di Napoli Federico II,
ITALY

Teodoro Monticelli (1759-1845), mineralogist, geologist, universally recognized by his contemporaries as the best of Vesuvius connoisseurs. Man of science but also man of power he had been the rector of the university of Naples, and had been also in touch with a large number of scholars inside and outside Europe, he was at center of a wide and efficient network along which had been circulating minerals, instruments and information; above all scientific theories but also new progressive and democratic ideas. This intense circulation of things and ideas is testified by the Monticelli correspondence, a large number of manuscripts documents very interesting for the history of science, the history of scientific institutions and collections, but also for social and political history. In about two thousands letters received by Monticelli from his correspondents, emerge courses, directions and destinations of these movements. Generally Monticelli established the relationships in the occasion of the visits of Vesuvius by these learned strangers coming from all part of Europe. Proprietor of a large and famous Museum of Minerals, Monticelli exchanged specimens of minerals from Somma-Vesuvius volcanic complex with the ones found in other parts of the world, he had also been selling to a number of museums and private collectors sets of Vesuvian rocks of established cost and composition, found and arranged by a team of expert mineralogists who had specifically this job. Thanks to this activity the Natural History Museum of London still holds a rich Vesuvian collection, called Monticelli collection because bought from Monticelli with the intercession of Humphrey Davy, President of the Royal Society and one of Monticelli's closest friend.
If Vesuvian minerals had been leaving for years Naples toward North Europe, on the other hand lots of equipments, coming from United Kingdom and Germany above all, had been reaching Naples because Monticelli needed scientific instruments to study Vesuvius and his eruptions with modern means, and to adequate scientific institution of South Italy to European standards. Among scientists sending him equipments there was Alexader von Humboldt and Wollaston, who played also a major role in the diffusion of theory of gradualism and of the central fire among Monticelli and his pupils .
Heirs of a long and strong tradition, Monticelli relationships with the United Kingdom where particularly strong that's why he went in touch with the ideas of Lyell, who Monticelli very much supported and likely had known during his stay in Naples, and Babbage, one of his correspondents. After all, Herschel himself appreciated this Neapolitan scholar, as he clearly said in one of his letter to Monticelli.
Monticelli's network make him and his nearest pupils aware of the most modern scientific theories and technical discoveries, but it doesn't really created a school of adjourned scientists. Reasons are probably political ones; in 1830 the death of Francesco I di Borbone, a still young and very well oriented sovereign, and then the succession of his son Ferdinando, determined a drastic cut to the founds destined to university and other cultural and scientific institution, and so the situation begun to get slowly but inexorably worse until 1848, years of the international congress of Italian scientists in Naples, of Monticelli's death, and of the revolutionary disorders which caused the death or the escape of many intellectuals. Just Arcangelo Scacchi, Monticelli's best pupil, stands, as very skilled mineralogist author of the identification some new Vesuvian minerals to represent the high level reached from mineralogy in Naples in Monticelli times.

Global Transportation by Way of Systemic Temporary Spaces: Ship, Island, Botanical Garden, Paradise and Container

Marianne Klemun Department of History,
University of Vienna,
AUSTRIA

In the 18th century, due to the new, worldwide expeditions of European powers, the global transfer of plants from the colonies to the scientific and political centres of Europe was essentially optimized. Circumnavigations of the globe connected Europe´s botanical gardens to the new expositures on exotic islands such as Isle de France (today´s Mauritius), Ceylon (today´s Sri Lanka) and Jamaica.
Botanical garden, ship and exotic island were connected to each other by an exotic connotation, stemming from ideas of the paradise and rooted in exotic plants. On the one hand, the transfer of plants was sped up by the transport of living plants, which became obvious among others by an intensive search for more adequate transfer conditions, on the other hand there was no innovation in respect of containers, despite making the transfer more dynamic. The former happened only in the first half of the 19th century, due to the invention of the Wardian case.
Why the invention of the Wardian case, which counted on a microclimate, took so long to happen, shall be explained by way of the systemic connections of the transfering temporary spaces of ship, garden, island and container.
In his "Natural History of the Tea Tree" (1772), the collector and physician John Coakley recommended to travellers around the world, interested people, botanists and merchants the use of different containers for the transport of plants during journeys across the oceans. John Ellis´s explanations on these activities were completed by a copperplate engraving which illustratively presented rather unspectacular objects to contemporary observers: a wodden box, a willow cask, a wooden chest and a cabinet. What connected these objects to the other temporary spaces and how they made the circulation of plants and the interpretation of the transfer possible is the subject of this lecture.

Technicalities of an "[…] inevitable […] long transportation by sea and by land […]": Natural Objects from Buenos Aires to Madrid (18th Century)

Marcelo Fabián Figueroa National University of Tucumán-Argentina (UNT),
Argentinean National Council for the Science and Technology (CONICET),
ARGENTINA

The study of the practices of gathering information and natural objects undoubtedly has been enriched in the last year by the inclusion of the historical and sociological variables. Therefore, the history of collecting shifted from the consideration of the collection itself to the analysis of collecting practices. Then, they are understood as a specific behavior that connect agents, natural objects, institutions and territories located beyond of the European cabinets or museums during the early modern period. Consequently, circulation of natural objects between non scientific institutions and scientific institutions is a crucial aspect to be consider in order to understand the production of natural knowledge during the 18th century.
My paper is located in that conceptual framework, especially focuses the relationship between Natural history and colonial bureaucracy. It studies the letters written by the viceroys of the River Plate that contain information about the bureaucratic mechanism related to the sending of plants, animals and curiosities asked by the Spanish crown in order to furnish the royal institutions such as the Royal Cabinet of Natural History, the Royal Pharmacy or the Royal Botanical Garden, etc. What agents, skills, devices were used by the colonial authorities to produce a effective transportation of natural objects?, What was the function of the bureaucratic mechanisms in this searching, gathering and transporting of natural information?. In these letters the viceroys registered the technicalities related to the conservation of many natural objects involved in the transatlantic journey that connected Buenos Aires with Madrid. In my perspective these technical solution were based upon a set of non scientific knowledges connected with the bureaucratic sphere in which them were produced.

Collecting and Sending Geological Specimens between the 18th and the 19th Century: a Traveller's Experience

Ezio Vaccari Università dell'Insubria, Varese,
ITALY

Collecting, packing and transporting rocks, fossils and minerals while still working in the field, became an increasingly common practice among travelling geologists during the second half of the 18th century and in the 19th century. Long travels in mountain areas such as the Alps, as well as through the volcanic regions of the Mediterranean, but also in other environments, were often undertaken by geologists in order to increase private collections and public museums, or simply in order to support their studies, theories and analysis. A significant amount of specimens were selected, packed, stored and eventually dispatched well before the end of the travel, that often experienced a series of difficulties before arriving to their destination. The aim of this paper is to investigate the styles and the practices involved in the organization and secure dispatch of the constantly increasing amount of geological material being collected in the field.

S16 Science in the Public Sphere: Barcelona,1868-1939

Coordinated by **Agustí Nieto-Galan (CEHIC - Universitat Autònoma de Barcelona, Spain)**
Chaired by **Agustí Nieto-Galan (CEHIC - Universitat Autònoma de Barcelona, Spain)**

In recent decades, the history of the popularisation of science has emerged as a dynamic field of research at international level. Further the history of the great luminaries of science, an approach to local contexts that have not played a leading role in the emergence of modern science seem particularly rewarding. In these places, the wide circulation of popular books, articles, lectures and exhibitions enriched a scientific culture that enjoyed notable independence from the great names of the 'universal science'. In the same way, boundaries between expert and lay knowledge, between professional and amateur science, were very loose and not well defined. Professional science was weakly institutionalised; popular science had a very prominent place among middle classes, and or even among lower classes. It was perhaps the only way – together with some science teaching in primary and secondary schools – of acquiring a general knowledge of the universe, life, the human body or agricultural techniques, often presented in a highly utilitarian way. With this framework in mind, we attempt to take the city of Barcelona as a historical category, in a period of time (1868-1939), in which an enormous amount of primary sources on "popular" science was produced. We will then extract new lessons about the circulation of scientific knowledge in that local public sphere, which might enrich the mainstream historiography on the field. Therefore, this symposium aims to present a set of case studies issued from the research done at the Centre d'Historia de la Ciencia (CEHIC) at the Universitat Autònoma de Barcelona (UAB). We will cover themes such as: Science in the Barcelona international Exhibitions, Science in the local zoo, the public scandal of Darwinism, displaying electrical technology to the public, the role of medical museums, and the use of scientific periodical.

The Edison Tin Foil Phonograph in Barcelona: A Demonstration at the Free Athenaeum of Catalonia (1878)

Xavier Vall Centre d'Història de la Ciència (CEHIC),
Universitat Autònoma de Barcelona,
SPAIN

During a period of great fascination with technological progress, Thomas A. Edison was widely perceived as a luminary. In particular, his phonograph, invented in 1877, attracted, in spite of precedents and limitations, great admiration and high expectations. On 12th September 1878, following its display in several European cities, a phonographic soirée for members and guests was held at the Free Athenaeum of Catalonia in Barcelona, founded in that year as a reaction to the banning of Positivist or Darwinist lectures at the Barcelona Athenaeum. The innovative firm Francisco Dalmau and Son, Opticians Manufacturers, had imported a phonograph for the School of Industrial Engineers of Barcelona. They experimented with the device, connecting it to a Gramme Dynamo, instead of to a clockwork mechanism, and changing the material of the membrane, for instance. Before Tomàs J. Dalmau presented the phonograph at the Royal Academy of Sciences and Arts of Barcelona, he participated in the phonographic soirée at the Free Athenaeum. His demonstration was preceded by a dissertation of the writer Joaquim M. Bartrina, an editor of the Gaceta de Cataluña, science popularizer and Darwin translator. Having gained notoriety because of the suspension of his lectures on La América Precolombiana at the Barcelona Athenaeum, he became a board member of the Free Athenaeum. Although many other activities, sometimes repeating the Bartrina-Dalmau tandem, took place at this centre until its disappearance in 1882, this amazing phonographic demonstration contributed especially to consolidate it as a leading institution for the local popularization of science and to propagate its views. Other scientists or amateurs were also interested in the phonograph, which was used at other locations (at the Barcelona Athenaeum as well), even in conjuring performances. The paper will analyze a case of technological circulation and its social projection in a context of ideological controversies.

History of Science – History of Language. Notes on the Diccionario Enciclopédico Hispano-Americano (1887-1899)

Pilar Pardo Herrero Universitat Autònoma de Barcelona,
SPAIN

Encyclopedic dictionaries and encyclopedias are important instruments in the popularization of science and technology as they provide a wide audience with a general overview of human knowledge. In the 19th century, a major work was produced in Barcelona for Spain and Latin America, the Diccionario Enciclopédico Hispano-americano, published by Montaner y Simón between 1887 and 1899. As the dates show, the DEH first appeared five years before the fourth centenary of the discovery of America. This is relevant because it shows how there was interest in the new continent for several reasons: a consideration of a common contemporary history and a common vision of the world, a consideration, to a certain extent, of American Spanish and the general history of the Spanish language, and the belief that people in America could be good consumers of this kind of product. Although this is a highly interesting aspect, it only forms one element of the context of this report. Following the theme of the symposia we will concentrate on some aspects that are more directly related with the city of Barcelona as a place of knowledge production and the scientific and technical entries in the dictionary as part of the history of the language of science.
In terms of Barcelona's role as the city where the DEH was developed, we will examine the editors from different fields of science that worked with the publishers on this project. This information reveals the scientific level of the dictionary and also the kind of theories it contemplates, particularly in relation to the participation of Catalan specialists (Blas Lázaro e Ibiza in botany, José Rodríguez Mourelo in chemistry, Ricardo Beltrán y Rózpide in geographic sciences).
In the case of scientific and technical entries, by analyzing in detail some examples taken from the dictionary, we will reveal its importance in the history of the language of science.
All of this will tell us more about the scientific and technical knowledge that was circulating in Barcelona in the late 19th century.

Science Popularization at the Martorell Museum around 1900

José Joaquin Varela Restrepo CEHIC, Universitat Autònoma de Barcelona, and
Museu d'historia de Medicina de Catalunya,
SPAIN

The creation of the Martorell Museum in Barcelona in 1882, and its consolidation as a place for collection, exhibition and research was a crucial step for the popularisation of natural history in the city. The museum library kept guides, handbooks, taxonomical reviews, and a large number of science books, but also popular science books by foreign renowned popularisers such as Camille Flamarion and Louis Figuier, together with interesting local works. This was for instance the case of the ornithologist Emili Tarré (1858-1918), who used poetry to transmit his knowledge on Catalan fauna in his collection Nostres Besties (Our Beasts; 1911-1918). Miguel Cuní i Martorell (1827-1902) was another Catalan populariser of natural history. He wrote a large collection of books under the title Excursión entomológica y botánica a… (Entomological and Botanical excursions to…; 1880-1890) visiting different places in Catalonia like Montserrat, Gerona, Camprodón, etc. Norbert Font i Sagué (1874-1910) combined the geological and paleontological research with his firmly based beliefs as a Catholic priest in titles such as El diluvi biblich segons la geologia (The biblic deluge according to geology, 1909).
The aim of this paper is to show some of these relevant local popularisers of natural history in late 19th century and early 20th century Barcelona, in order to show how their works contributed to building a particular style of local science and national identity.

Displaying Science and Technology at the 1929 Barcelona International Exhibition

Jaume Sastre Juan CEHIC-UAB,
SPAIN

The 1929 Barcelona International Exhibition took place, from May 20th 1929 to January 15th 1930, during the Primo de Rivera dictatorship, in a large park on the Montjuich hill. Although its architecture and its lasting impact on the transformation of the city have been studied, not much is known on the 1929 Barcelona International Exhibition from the perspective of the history of science popularisation.
This paper tries to explore the public image of science and technology in the Exhibition and place it in the context of the city's scientific and political culture of the time. Through a set of still unexplored primary sources (reports from visitors, journalists, scientists or workers, photographs, audiovisual material, etc.), this paper aims at reconstructing the experience of visiting the displays in sites such as the Chemistry Pavilion (Palacio de la Química) or the Electricity and Metallurgy Pavilion (Palacio de la Electricidad, Metalurgia y Fuerza Motriz).
Thus we will be able to obtain a first picture of the exhibition as a scientific and technological popularisation site, by answering to the questions regarding what discourse on science and technology the organizers intended to project, how were science and technology portrayed within the pavilions, and, last but not least, who came out of it with which perceptions on science and technology.

The Popularization of Electrical Household Devices in Barcelona in the 1930s. The Journal Electricidad Industrial y Domèstica

Jordi Ferran Boleda CEHIC - UAB,
SPAIN

In 1930 the journal Electricidad Industrial y Doméstica was launched in Barcelona - a publication devoted to popularisation of new electrical household devices. In the preceding years, industry electrification and public electric illumination systems had been introduced in Catalonia. Electricity producers had to find new consumers to buy their energy surplus. This journal is an excellent example of the strategies used to convince domestic users of the benefits of electricity.
From 1930 to 1933 the journal published dozens of articles introducing several electrical devices:
•to make domestic tasks easier (irons, vacuum cleaners, washing machines, dishwashers, stoves, ovens, millers, etc.);
•for domestic comfort (heaters, fan, etc.);
•and others for personal use or entertainment (hairdryer or radio).
Many of these articles had a common characteristic: there was an underlying discourse in the identity of the journal as the 'expert'.
To analyse the role played by this journal in the popularization process we use the concept of advertiser, proposed by Ruth S. Cowan in 1976 in her studies of household technologies in the United States: the advertiser was the link between technological change and social change in the nineteen twenties. It is the necessary link that permits the successful introduction of a new technological device.
The dominant view of popularization in 1976 was the deficit model. Nowadays, new approaches to popularization allow us to revise the advertiser concept from the point of view of popularization. We can build a new approach to the study of the popularization of new technologies by adding to the advertiser concept ideas from other fields: studies of household technologies, gender studies, design studies, market studies or, as in this case, the analysis of the construction of expert identity.

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Specialisation and Popularisation of Medicine: Barcelona, 1920-1938

Alfons Zarzoso (1,2) (1) Museu d'Història de la Medicina de Catalunya,
Enrique Perdiguero-Gil (3) (2) Universitat de València,
Àlvar Martínez-Vidal (2) (3) Miguel Hernández University,
SPAIN

In this contribution we wish to merge two topics directly concerned with science in the public sphere. On the one hand, we wish to consider the process of popularisation. This concept has been recently criticised as too wide a category of analysis for an understanding of the relationship between science and its publics. However, we still believe such a concept useful and suitable for our purposes as we consider all scientific communication as a form of popularisation. We wish to avoid a clear division between experts and lay publics. Another advantage of this approach to popularisation is that there is more than one single method to bring science and the public in contact. On some occasions the experts do not use mediators to reach the lay public. They first spread knowledge and seek support among the non-expert audiences in order to overcome competition among the experts.
On the other hand, the process of specialization of medicine is a good example to illustrate, in part, the absence of mediators. The setting-up of medical specialties was not only a response to the need to divide work due to the advances in knowledge (G. Weisz). It was also a means to medicalise practice and to subject more and more aspects of human life to the medical gaze. This process began during the first decades of the last century, and has great vitality today. The concept of medicalisation has been also subjected to criticism, especially if it is understand as a process from above to below. However, medicalisation is a more complex phenomenon with several actors performing several roles in different directions. In fact people do not always suffer medicalisation. On some occasions they ask for medicalisation, and this is the reason why experts, working to consolidate a speciality, canvass public support, without seeking consensus with other medical doctors.
With this historiographical background, we will illustrate these processes using some examples of the medical press published in Barcelona in the 1920s and 1930s, and focusing our analysis on two medical specialties: paediatrics and surgery. We are considering a variety of medical sources. First, the one hundred volumes of the Monografies Mèdiques, a periodical series edited in Barcelona between 1926 and 1937, which has recently been the subject of a preliminary analysis published by two of us; secondly, the newsletters of the Catalan societies of paediatrics and of surgery; thirdly, the collection of medical guides edited by the Sindicat de Metges de Catalunya i Balears (the Catalan and Balearic Medical Association), where most of the physicians are registered under their speciality; and, fourth and lastly, the classification of specialities adopted by an emblematical medical journal –La Medicina Catalana. Portantveu de l'Occitània Mèdica (1933-1938)–, which included in its pages the abstracts, written in Catalan, of thousands of articles from the main medical journals of the time (American, British, French, German, Italian, Latin-American, Portuguese, Russian and Spanish).

Medical Knowledge in Popular Sports Newspapers in Barcelona, 1935-36

Yoko Tochigi Autonomous University of Barcelona (UAB),
SPAIN

This paper approaches the circulation of medical knowledge in Barcelona, in the local sport newspapers. It will analyse the section "Página medical" in El Mundo Deportivo, one of the main representative of the daily press, exclusively devoted to sport. From 11 April of 1936 to 17 July of 1936, just up to the beginning of the Spanish Civil War, several physicians weekly wrote at the "Página medical". They included articles in one or two pages, dealing with a wide range of specialities such as hygiene, cardiology, otorrinolaryngology, physical therapy and educational policies.
In the early twentieth century, some physicians began to pay attention to sport medicine, mainly reacting in front of the growing interest for modern sports such as football and the success of the Olympic Games. In 1920s, sport medicine associations were founded in Germany and France. In 1932, the first International Congress of sport medicine was held in Italy. In that context, Catalan and Spanish physicians attempted to promote sport medicine in their own country, in order to increase their scientific authority in the practice of sport.
The paper emphasizes the physician's public campaigns for the promotion of physical activity, in particular those who publish their articles in the "Página medical". Questioning the expertise of amateur sport practitioners, the new sport physicians tried to control "the practical science of the health" through a new medical specialization, which was legitimised by the newspaper readers. In the section, they often presented foreign sport medical theories, but also expressed their own political views on the need to promote sports and physical education as an important part of the educational system as a whole.

S17 The Dialectic Relation between Physics and Mathematics in the XIXth Century

Coordinated by **Evelyne Barbin (Université de Nantes, France)**
Raffaele Pisano (Université de Nantes, France)
Chaired by **Leo Corry (Tel Aviv University, Israel)**
Danilo Capecchi (Università di Roma La Sapienza, Italy)

The aim of Symposium is to analyse historical problems related to the use of mathematics in physics as well as to the use of physics in mathematics and to investigate Mathematical Physics as precisely the new discipline who is concerned with this dialectical link itself. So the main question is : When and why the tension between mathematics and physics, explicitly practised at least since Galileo, involved in such a new scientific theory? Particularly we have to explain the way in which this science allowed an advanced mathematical modelling in physics on the one hand, and the invention of new mathematical ideas on the other hand. Of course this problem is related to the links between institutions, university, schools for engineers, industries. These last years, many historical researchs are led around mathematics and physics in this period. The purpose is to confront these researches from the theme of the Symposium. Since the second half of 18th century, new instruments produced many data and improvements of the scientific knowledge and its applications. So, at the turn of the 19th Century, the link between mathematics and physics was very strong already. For the new generation (e.g Cauchy, Navier, Lamé), which continued this work, a new challenge too is to build a peculiar science of this link between mathematical and physics. Furthermore, the reverse link, the one by which physical ideas had influenced the world of mathematics, was not at all new at these times, but perhaps it came to a kind of maturity, and some mathematicians could considered it seriously. It seems that it was in these times, in the first half of the 19th century, that a true double thinking of "mathematics and physics" took its true start. The question is to precise this historical point.

Group Theory and Crystallography

Bernard Maitte CHSE,
Université de Lille 1,
FRANCE

The French molecular approach led to the distinction of fourteen types of lattice system, while "Natur-Philosophy" can count 32 classes of symmetry. At the end of the century, the mathematical study 230 different groups belonging to 32 classes, 14 networks and 7 systems.
In this paper, I will show how, in the continuity of the founding works of Romé de l'Isle (1772) and René-Just Haüy (1801), introducing a triperiodic crystalline structure composed by "integrant molecules" filling the space (7 systems), Gabriel Delafosse (1843) introduces the concept of the crystal lattice repeating "polyhedral molecules" which do not fill the space.
This view helps explain the "notable exceptions" to the "law of symmetry" of Haüy (the "mériédries"). This approach is generalized in 1848 by Bravais in his study of "systems composed by systems of points" (enumeration of 14 modes of networks ").
Meanwhile, the German crystallographers, based on continuous view of matter characteristic of the "Natur-Philosophy", describe attractive and repulsive forces fighting them in space.
From this idea, they induce the concept of the "axes of symmetry" (Weiss 1805). The combination of these elements of symmetry concurring, discussed by Weiss, continued by Mohs and Hessel, leads in 1830 to the counting of 32 "classes of symmetry"
The combination, by Sohncke, of networks and those of classes that he knew would lead to the enumeration of 61 various "groups of space" (1879). It is with an entirely mathematical approach, without figure, introducing elements of symmetry non-concurrent and introducing the problem of the regular partition of the sphere, that Fedorov and Schoënfliess manage to count, independently of one another, 230 groups of symmetry (1891).
The determination of groups of space is now complete. It can bring together the concepts of systems, classes and types of networks. The "groups", counted without reference to ideas of Galois and its successors, will play an essential role in physics after the work of Pierre Curie (1894).
It's a whole century of efforts from crystallographers working in various contexts and with different pre-supposed that I retrace.

Geometric Algebra versus Vector Algebra as Physical Mathematics: Bridging Past and Future

Josep Manel Parra Serra Departament de Física Fonamental,
Universitat de Barcelona,
SPAIN

An obvious subject open to the analysis of the dialectic relation between physics and mathematics in the XIXth Century is the emergence of the so called vector calculus. Its final acceptance by physicists and engineers was enforced by the theoretical and practical relevance of Maxwell's electromagnetic theory. And shaped the way in which physics laws and reasoning are expressed from High School to University and research. Thus at first sight it may seem strange the poor degree of integration of this essential part of the physical mathematics within the mathematical curricula of scientists and engineers: it is usually left to the student the task of identifying an orthogonal set of basis vectors e_i in the study of linear algebra/geometry with the i,j,k universally used in physics.
Although a detailed historical account (Michael Crowe's History ov Vector Analysis) explains why Grassmann and Hamilton's notations are still competing 170 years after its inception, a deeper analysis of the question will reveal much more: this apparently academic problem or divide is but a (privileged?) example of the outcome produced by the clash of competing philosophies that contributed decisively to the growth of Mathematical Physics and also to an unprecedented divorce between the two disciplines. William Kingdon Clifford synthesis between Hamilton and Grassmann's systems constitutes a missed oportunity in the past that an historical thematic analysis (Gerald Holton) offers to our present day reconsideration. In it the hindsight of historians like M. Crowe and mathematical physicist's like Freeman Dyson can be confronted with the foresight of Clifford, Hamilton and Grassmann. Evidence for a necessary change from vector algebra to geometric algebra is then presented as a paradigmatical example that the historical approach with the most complete available historiography is, also in the mathematical sciences, a two-way phare: useful to understand the past but also to illuminate the building of the future.

On the Birth of Electromagnetic Theory

Raffaele Pisano Centre François Viète – Université de Nantes,
FRANCE

In the 19th century, a complex system of approaches, models, and theories circulated. In order to interpreter mathematically any kind of motion by means of central forces–differential equations, a mechanical scientific program in «Traité de Mécanique céleste» (1805) was presented by Laplace (1749–1827). Fourier (1768–1830) proposed a strong mathematical approach by differential equations (1807; 1822) without considering nature of heat and experiments. For new fields of electricity and magnetism phenomena, Ampère (1775–1836) also presented a mathematical approach (1820; 1828) basing on previous Ørsted's (1777–1851) experiments (1820); latter showed that new and not mathematical interaction, outside of mechanical foundations, could be observed. In this view, the lack of infinitesimal analysis in Sadi Carnot's (1796–1832) theory (1824), in Ørsted's works and in Faraday's (1791–1867) «Experimental Researches in Electricity» (1839–1855) are emblematical expectations. Particularly, Faraday – without formulas – introduced the basis for the concepts of field and vectors in electromagnetic induction theory. After the second half of 19th a mathematical approach still strongly emerged. Stressing mathematics–physics relationship, many theories were included in mechanics becoming new «rational–analytical» theories, where principles «ne présuppose aucune loi physique» and experimental studies were not in attendance. E.g., in the wake of Fourier, propagation, velocity applied, etc… was proposed (1861) by Lamé (1795–1870). In late (electrothermal and) electromagnetic theory an advanced use of mathematics was presented (1864–1873) by Maxwell (1831–1879) to mechanically («vortex») explain new faraday's phenomena by means of a unique mathematical scheme described by his four equations. Even if he frequently claimed that his work («Treatise») is a mathematical interpretation of Faraday's physics, the approach was strongly different: abstracts concepts and new mathematical problems. The four equations and Lorentz's law essentially completed the classical electromagnetic theory. My talk will focus on Faraday and Maxwell.

Mathematical Physics in Italy: the Theory of Elasticity

Danilo Capecchi Università di Roma La Sapienza,
ITALY

In the second half of XIX century there was in Italy an important group of mathematicians busied with mathematical physics. The most prominent of them are Enrico Betti (1823-1892), Eugenio Beltrami (1836-1900), Gregorio Ricci-Curbastro (1843-1925), Valentino Cerruti (1850-1909) and some other whose activity will persevere for many years in XX century: Vito Volterra (1860-1940), Carlo Somigliana (1860-1955) and Tullio Levi Civita (1873-1941).
In the paper I will speak of the contribution of this group to the theory of elasticity.
Probably the best representative writing on continuum mechanics and elasticity as mathematical physics theories is the book Teoria della elasticità by Enrico Betti (1872-1873). The book is interesting not only for the particular results found but also, may be mainly, for its framework which will become paradigmatic for the development of subsequent texts on elasticity, not only Italian.
Betti's interest, as typical for mathematical physicists of the period, is concentrated on the mathematical aspects of a physical theory. Physical principles are not discussed but only exposed in the more formal way as possible. The objective is to arrive without epistemological or empirical problems to the formulation of differential equations which rule elastic problems, after which Betti uses all his skill to solve it. Solution is given without any comment of its empirical value.
Beltrami has no written a complete book on elasticity but his contribution to this field is perhaps more original of Betti's one. A similar discourse holds true for Cerruti, Curbastro, Volterra and Somigliana.

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Mathematical Language as a Tool for Representing Space, Matter, and Interaction

Ladislav Kvasz Charles University in Prague,
CZECH REP.
Comenius University in Bratislava,
SLOVAKIA

In the paper I will analyze the role played by the mathematical language in the development of physics from the Newtonian period until the birth of relativity theory. I will study four aspects of mathematical language, namely:
- derivative power -- which new scientific laws can be analytically derived using the particular mathematical language
- expressive power -- which new physical phenomena can be represented by means of the particular mathematical language
- explanatory power -- which problems that the previous theories were unable to explain can be explained by means of the language
- integrative power -- what kind of unity beyond the observed phenomena allows us the mathematical language to perceive.

These four aspects of mathematical language were introduced in my recent book PATTERNS OF CHANGE, LINGUISTIC INNOVATIONS IN THE DEVELOPMENT OF CLASSICAL MATHEMATICS (Birkhauser 2008) and were used as a tool for the reconstruction of the development of mathematics. Here I would like to show their relevance also in the analysis of the development of physics of the particular period.

The Mathematical Physics in the Style of Gabriel Lamé

Evelyne Barbin (1) (1) Centre François Viète,
René Guitart (2) Université de Nantes,
(2) IMJ, Université Paris-Diderot Paris 7,
FRANCE

As a resumption of the Poisson's project of a complete Traité de Physique mathématique, Lamé provided an introduction to Physique mathématique through a serie of papers in the period 1830-1840, and later in four books edited between 1852 and 1861. In the introductions of these books he explained that the Physique mathématique has been a creation of the beginning of the XIXth century, by men as Laplace, Fourier, Fresnel, Poisson, Cauchy. He strongly claimed for the unity of pure and applied mathematics. He emphasized on the technical unity of mathematics for physics, because there is always to solve almost the same equation, the Poisson's equation or the Laplace's equation. At the level of the explanation of phenomenons, an other unity have to be associated to this technical unity: for Lamé it is the existence of aether. His main technical inventions are the calculus of curvilinear coordinates and especially with ellipsoidal coordinates, and the 'famous Lamé's equation', deeply studied by Hermite later. The Lamé's project was re-opened by Mathieu, in some sense a student of Lamé, which put explicitly his work (entitled Traité de Physique mathématique) under the patronage of Fourier, Poisson and Lamé.
In 1892, Pierre Duhem wrote about Mathieu's work: 'The death of Lamé resulted in finally bringing mathematical physics [Physique mathématique] into discredit in France'. This opinion is related to the question of fashion in science in the French centralized context. We would like to examine what was this French Physique mathématique and the reasons supporting its announced possible discredit at the turn of 1870. For this purpose, we shall examine the role of intertwinings of physical and mathematical creations, the link between the mathematical processes of calculus and integration of differential equations and the successive developments and explanations of physical phenomenons.

The Interaction of Physics, Mechanics and Mathematics in Liouville's Research

Jesper Lützen Department of Mathematical Sciences,
University of Copenhagen,
DENMARK

According to Joseph Liouville mathematics oves its most important progress to physics and in particular to mechanics. In fact many of his own most important research was directly or indirectly inspired by physical problems. In the talk I shall exemplify the physical origin of some of Liouville's theories and results. Some of them are surprising. For example it is rather surprising that his theory of differentiation of arbitrary order (fractional calculus) was a result of his attempt to find elementary forces in a Laplacian approach to physics, and that his celebrated theorem about the constancy of volume in phase space was inspired not by thermodynamics but by perturbation theory in celestial mechanics. I shall also show the close link existing between Liouville's research in mechanics and his research in differential geometry.
The talk will exemplify the close links between mathematics and physics in France at the beginning of the 19th century.

The Emergence of Mathematical Physics at the University of Leipzig

Karl-Heinz Schlote Sächsische Akademie der Wissenschaften zu Leipzig,
GERMANY

Mathematical physics became a prominent discipline at the university of Leipzig due to C. Neumann and K. von der Mühll in the second half of the 19th century. However, this blossom of mathematical physics caused also a delay in the development of theoretical physics. A professorship for theoretical physics was established not until 1894. In the talk I would discuss this development as well as Neumann's views to mathematical and theoretical physics. A comparison of this development with those at other universities above reveals interesting differences in the process of establishing theoretical physics in the physics department. Neumann's opinion about mathematical physics played an important role in the discussion about the characterization of mathematical and theoretical physics.

Searching for the Foundations of Physics in the Late Nineteenth Century: Carl Neumann, Paul Volkmann, Aurel Voss

Leo Corry Tel Aviv University,
ISRAEL

Heinrich Hertz and Ludwig Boltzmann represent two well-known examples of physicists who actively contributed to the question of the foundations of mechanics at the turn of the twentieth century. Although this was not a main topic that dominated the concerns of their fellow physicists in the German-speaking world, Hertz and Boltmann were not alone in this pursuit. In the present lecture I would like to focus on other physicists who expressed similar concerns and came forward with their own original ideas in this regard: Carl Neumann (1832-1925), Paul Volkmann (1856-1938), and Aurel Voss (1845-1931). By considering their works, we gain additional historical insights on the ways in which the question of the interaction between physics and mathematics was conceived in this crucial period of time.

S18 Chemical Order in Transit: Comparative Studies of the Response to the Periodic System

Coordinated by **Masanori Kaji (Tokyo Institute of Technology, Japan)**
Chaired by **Masanori Kaji (Tokyo Institute of Technology, Japan)**

In spite of several precursors, it is agreed that the periodic system or ”law” dates from 1869, when it was independently introduced by D. I. Mendeleev and L. Meyer. Although not of a truly revolutionary nature, the periodic system, especially as developed by Mendeleev, is generally recognized as a watershed in the history of the chemical sciences. Inspired by earlier comparative reception studies (of, e.g., Darwinism and relativity theory), we focus on how the system was received in various countries and communities from about 1870 to 1920. For example, who introduced and responded to the periodic system in various national settings and when did it occur? How did the system become visible in journal articles, chemistry textbooks, and the more popular literature? When and for what reasons was the periodic system eventually accepted as a natural framework for inorganic and general chemistry? The aim of the symposium is not only to present national case studies and collect data from various countries, both in Europe and elsewhere, but also to discuss them in a comparative framework.

The Reception of the Periodic System in Denmark

Helge Kragh University of Aarhus,
DENMARK

I examine how the periodic system was introduced in Denmark, how it was used in chemical textbooks, and the way it was developed by a few of the country's chemists. Particular attention is paid to the work of H.P.J. Julius Thomsen, who provides an important example of neo-Proutean attempts to understand the periodic system in terms of internally structured atoms. Moreover, I discuss Mendeleev's connection to Danish science by way of his membership of the Royal Danish Academy of Sciences and Letters.

Piccini, Ciamician, and the Periodic Law in Italy

Marco Ciardi University of Bologna,
Marco Taddia ITALY

The paper discusses the reception of periodic law in late nineteenth-century Italy. The research main objective is to fill a serious gap in the ambit of studies in the history of chemistry in Italy in the period that runs from the mid-nineteenth century to the early twentieth century. Despite the unquestionable level of professionalisation and specialisation that the historiography of science and technology has attained also in Italy, the temporal arch that the study intends to consider, still today represents a largely unexplored territory, firstly for the lack of a systematic exploration of primary sources, such as collections of letters, manuscripts and archive documents.
In the period considered, despite a series of delays and shortcomings mainly on the structural and organisational levels, Italy played a leading role thanks to the work of several extraordinary protagonists like Stanislao Cannizzaro, Giacomo Ciamician, and Augusto Piccini. If the relationship between Cannizzaro and Mendeleev are well enough known, we have more to learn about Ciamician and Piccini. For example, a fundamental spectroscopic study of the young Ciamician about spectroscopic analogies between elements in the same group was remembered by Mendeleev in his 1889 Faraday Lecture; at the same time, Piccini studied with originality many aspects of periodic law, and he was in correspondence with Mendeleev.
The study will especially concentrate on the development of Mendeleev’s ideas in Italy under the profile of theoretical development, as well as in relation to the growth and definition of its pedagogical uses by means of a survey of Ciamician and Piccini notes and textbooks.

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Appropriating Periodic Law in Late Nineteenth-Century Spain: Chemical Classifications and Evolutionary Cosmology

José Ramón Bertomeu Sánchez Instituto de historia de la medicina y de la ciencia "López Piñero",
Rosa Muñoz Bello SPAIN

The paper discusses the different meanings of periodic law in late nineteenth-century Spain. First, we discuss its pedagogical uses by means of a survey of around seventy Spanish textbooks published between 1870 and 1920. In spite of its pedagogical origins, periodic law was hardly perceived as a new organising principle for Spanish textbooks. For many decades, teachers kept using renewed versions of some well-established nineteenth-century chemical classifications. When it arrived to Spain in 1880s, periodic law was regarded as a starting point for discussing general theories about the nature of matter and the evolution of the universe. Thus, in the second part of the paper, we focus on two late nineteenth-century authors who played a major role in the appropriation of periodic law in Spain: José Rodríguez Mourelo and José Muñoz del Castillo. Rodríguez Mourelo supported an anti-atomistic approach, largely based on Marcellin Berthellot's ideas and the evolutionary approach offered by William Crookes in his Genesis of elements. Using a similar evolutionary approach, Muñoz del Castillo regarded periodic as a sort of geological scale of the evolution of universe, showing different phases of the nebular condensation. His cyclic classification of chemical elements in three independent groups was largely moulded by his Laplacian ideas about the evolution of the universe. Finally, we discuss how the local context of reception and appropriation largely shaped the meanings and unforeseen uses of the periodic law in late-nineteenth-century Spain.

Antropoff's Periodic Table: History, Significance, and Propagation from Germany to Spain

Claudi Mans (1) (1) Universitat de Barcelona,
Eugen Schwarz (2) SPAIN
(2) Universität Siegen,
GERMANY

The University of Barcelona has recently restored a mural of the periodic table (PT) of chemical elements in one of their historical classrooms. It had been painted in 1932 under the leadership of professor of organic chemistry Garcia Banús. This PT follows the model of professor of physical chemistry Andreas von Antropoff (Univ. Bonn), who designed it together with M. von Stackelberg (both Easteuropean refugees) in 1925 seq. as a "bifurcation table". In effect, he combined suggestions already proposed earlier by Bayley (1882), Thomson (1895), Werner (1905), Bohr (1922) and others. He successfully overcame the disadvantages of the common rectangular tables (breaking the connected series of elements), of short forms (neighborhood of dissimilar elements), of longer forms (gaps in the shorter periods) and of spiral forms (complex shapes). His rectangular tree-model highlights the connectedness of the series of elements, of the bifurcations of groups into main and sub-groups, and of chemical similarity. Mazurs (1974), who had classified about 700 PTs, counted Antropoff's among the oldest, most popular and good ones. The table was quite successful and spread quickly around the world in the form of an Atlas, as well as murals and wall tables. After World War II, Antropoff's nationalistic ideas were incorrect; he lost his position. The Atlas can still be found in libraries of Britain, France, Germany, Italy, the USA and other countries. The PT went out of fashion, though it was reinvented by Pauling, and reconstructed by Scheele (1949), Schenk (1951) and Stewart (2007). The mural in Bonn disappeared; versions can be found on the internet. In this communication, the relevance of Antropoff's PT will be commented, and some details of the circulation of the model from Germany to Spain will be illustrated.

Echos from the Reception of Periodic Table in Portugal

Isabel Malaquias Departamento de Física, CIDTFF,
Universidade de Aveiro,
PORTUGAL

During the last quarter of 19th century in many countries the periodic classification gradually entered chemical teaching and research. One can ask what happened in Portugal. Was it a similar situation or a delayed one? What is the remaining echo's of this introduction at the university and secondary level, through professors, researchers and/or textbooks?
Second half of nineteenth century Portugal began slowly moving towards modernity in a so-called regeneration movement. Great efforts were tried at the time to modernize the country and among them the implementation of secondary studies namely the scientific ones. Nonetheless industrialization was slow and that also influenced possible developments related with scientific research, namely the creation of research schools, scientific societies. Among all these difficulties and a quite probable alienist position towards central chemical research problems, one can find some editions of Portuguese university texts made upon the classes of the Coimbra University professor (at least since 1894) where for the first time we are able to learn/ read about the periodic classification in Portuguese, a lost Mendeleev letter about Portuguese experiments on iodine as well as the possible first presentations of periodic law in secondary schools textbooks. In one or two cases it is also achievable to find tentative arguments on the implications of the periodic law on the structure of matter, namely from 1880. In all these cases there is a generalised sense of acceptation.
In this communication we will present our findings on the subject and will try to characterise the personalities involved, their sphere of action, contextualising them in the framework of an international interaction / cooperation with more updated centres and /or personalities and find out foreign influences upon the books produced in Portuguese.

Chemical Classification and the Response to the Periodic Law of Elements in Japan in 19th and Early 20th centuries

Masanori Kaji Tokyo Institute of Technology, JAPAN

Japanese intellectuals started to learn Western science and technology through Dutch in 1770s, since the Netherland was the only European country with which Japan had any diplomatic relationship at that time. In the 1830s Yoan Udagawa (1798-1846), a physician and a scholar of "Dutch learning", became interested in chemistry and wrote the first chemistry textbook in Japanese (1837-47) based on twenty-four books on chemistry and pharmacology in Dutch, including a Dutch translation of Laviosier's famous Traité de chimie élémentaire.
In 1882, thirty-five years after the last publication of Yoan's textbook, Naokichi Matsui (1857-1911) an American-trained chemist and a young lecturer in the Faculty of Science at Tokyo University mentioned "Mendeleev's periodic law" at a meeting of the Tokyo Chemical Society. This society was the first chemical society in Japan, founded in 1878 by graduates of the Tokyo University. This must have been one of earliest mentions of the law in Japan. A chemistry textbook for middle school, published in 1893 contained a chapter on the periodic law. The author, Hikorokuro Yoshida (1859-1929), was one of earlier graduates of the Department of Chemistry of Tokyo University and one of the first professors of chemistry at Kyoto Imperial University.
Between these dates Japan experienced a major transition of modernization following the Meiji Restoration in 1868 and science, including chemistry was institutionalized.
Masataka Ogawa (1865-1933), who belonged to the first generation of modern Japanese chemists, claimed in 1908 to have discovered a new element, which he called "nipponium." Even though he ascribed its place in the periodic table wrongly, Ogawa's work showed that Japanese chemists started to contribute to the research in the periodic system in early 20th century.
This paper will analyze Japanese chemistry and its response to the periodic law between the 1830s and the early 20th century.

The Early Reception of Mendeleev's Periodic Law in Russia

Nathan Brooks (1) (1) New Mexico State University, USA
Masanori Kaji (2) (2) Tokyo Institute of Technology, JAPAN
Igor Dmitriev (3) (3) St. Petersburg State University, RUSSIA

This paper will examine the reception of Dmitrii Mendeleev's Periodic Law in Russia in the first few decades after it was first proposed in 1869. Like in other countries, Mendeleev's first announcements of the Periodic System did not elicit much attention from other chemists. Still, Mendeleev believed that his idea was important and he continued to work out the details as best he could, both through experimentation and the collection of data to refine the original conceptions. Mendeleev finally summarized his work on the Periodic System, which he now called the Periodic Law, and published it in German in 1871. By this time more Russian chemists had started to give credence to Mendeleev's ideas. Mendeleev quickly recognized the significance of the discoveries of some of his predicted elements and he began to publicize the accuracy of his predictions. These predictions impressed numerous Russian chemists as early as 1870, even before the discovery of the predicted elements, while most foreign chemists were not influenced by the predictions at this time. Several other factors were at play in Russia, however. Mendeleev taught introductory chemistry at St. Petersburg University and taught many students, who then went on to teach in secondary schools. Mendeleev used his textbook Principles of Chemistry in which he presented his Periodic Law and this textbook had a great impact on his students. We will also examine how other chemistry textbooks in Russia presented the Periodic Law during these years. In addition, we will examine some of the most important Russian popular science journals to see how they presented the Periodic Law. Finally, we will examine how Mendeleev's failed election to be a member of the Imperial Academy of Sciences transformed him into a national hero and, thus, had an impact on the reception of the Periodic Law.

About the Periodic Table in German Scientific Papers and the Influence of Scientific Networking for its Acceptance in the End of the 19th Century

Gisela Boeck Institute of Chemistry, University of Rostock, GERMANY

A first survey of German chemistry textbooks for middle and high schools, popular books and pedagogical journals showed the interest of the authors in questions of the classification of chemical substances and of the order of teaching. The "methodical textbooks" started with substances which were known by the readers or pupils. The "systematic textbooks" used "artificial" and "natural" classifications.
One should expect a significant change in the favoured classification after 1870 in consequence of the periodic law which was discovered by Dmitrii I. Mendeleev (1834-1907) and Lothar Meyer (1830-1895). But the survey has shown that the periodic table is mentioned rarely. Only in some textbooks it is used for a new arrangement of the chemical knowledge which the author wanted to be taught.
In a next step a number of scientific texts will be included in the survey. Of special interest will be the focus on references to the periodic law, its discovery and its discoverers, information of new discovered elements and their arrangement in the periodic system, on discussions of the terms "element" and "atom".
Furthermore the influence of the scientific networking will be regarded. It will be explained how the networking between a number of scientists like Meyer, Mendeleev, Victor von Richter (1841-1891), Friedrich Beilstein (1838-1906), Jacob Volhard (1834-1910) and Paul Walden (1863-1957) influenced the acceptance of the periodic system. It will be also considered if there is a specific influence of the German-Russian relations in the end of the 19th century.

Mendeleev's Phenomenological Periodic Table was not Theoretical enough for Immediate Adoption in Britain: a Textbook Study

John Oversby University of Reading,
UNITED KINGDOM

In a survey of British Chemistry textbooks from around 1880 to 1940, adoption of Mendeleev's Periodic Table as a guiding framework for inorganic chemistry was hardly apparent. Only towards the end of this time in history
was the Table, and Mendeleev's role in constructing it, mentioned, almost in parenthesis. The paper will describe and interpret the dominant frameworks that authors employed, of metals and non-metals divided on the
base of similar properties, that seem to hint at the chemical reaction
basis of the Table. The largely phenomenological approach of existing
textbook structures, supporting a strongly descriptive approach, appears to be a continuing success. Since Mendeleev's table had a similar approach, and theoretical substantiation did not appear until a theoretical atomic structure had been well established by the late 1920s, a claim will be made that the novel advances made by Mendeleev did not justify radical
reorganisation of the pedagogical order previously existing. It seems that change only occurred when a move from a phenomenological approach to a sub-microscopic quantitative theoretical approach took place. In Britain, this move occurred around the 1960s, probably as the result of a shift from theoretical chemical training took place in universities, and these graduates then moved into teaching. Evidence from undergraduate textbooks over the period supports this claim. The paper will elaborate both the claim and the textbook evidence that supports it.

The Reception of Mendeleev's Periodic Law in France, 1870-1920

Antonio García Belmar (1) (1) Universidad de Alicante,
Bernadette Bensaude Vincent (2) SPAIN
(2) Université de Paris Ouest,
FRANCE

This paper presents the first results of a larger study about the reception of Mendeleev's periodic law in France, between 1870 and 1920. The presence of references to the periodic law will be explored in several areas of scientific activity. We will look, in the first place, at the uses of periodic law as a chemistry teaching and learning didactic tool. For that purpose, we will observe how periodic law was integrated in chemistry textbooks and official curricula. We will also look at the available student manuscript notebooks in order to compare the way periodic law was introduced through printed textbooks and oral lectures. Special attention will be paid to the way periodic law interacted with the well established classificatory systems used by chemistry textbooks authors and teachers to organize the contents of printed or oral chemistry courses. Second, we will examine some of the main scientific journals of the time to analyze how the periodic law was perceived by the French scientific community and how this idea interacted with the existing controversies concerning the structure of matter. Finally, our study will also try to identify the existence of publications intended to the popularization of Mendeleev's periodic law in France.

The Reception of Mendeleev's Periodic System in Sweden and the Discovery of New Elements. A Non-revolutionary Event

Anders Lundgren Department for history of science and ideas,
Uppsala university,
SWEDEN

Chemistry in Sweden during the end of the 19th century can be characterized as an atheoretical chemistry, with stress on analytical ability and on laboratory work. In this chemistry, the periodic system was accepted almost without discussions. But also was not the way chemistry was done much influenced by the periodic system. Swedish chemists continued their analytical work as before, including determinations of atomic weights. The philosophical problems imbued in concepts like atoms, elements, simple bodies etc were in general neglected, or left to philosophy, a discipline almost scorned by most chemists.
One aspect of chemistry related to Mendeleev's system was the discovery of new elements. Such discoveries were routine among Swedish chemists, with the isolation of the rare earth metals in the middle of the 19th century as a peak. But also Filippium, Pelopium, Vasium etc were discovered, and by some chemists isolated. Almost all of these new elements turned out not to be elements. The increased hunt for new elements coincided with an increased knowledge of Mendeleev's system, which however at the same time seemed to put a limit to the amount of possible new elements. This paper will discuss the relation between a practical, non-theoretical laboratory chemistry, and a theoretical chemistry, created by someone who has been called a non-laboratory chemist. Focus will be on how everyday work in the laboratory, interacted with the theoretical development in chemistry. A study of the reception of Mendeleev in Sweden (or presumably in any other country) can in this way be seen as more than just a study in reception – it can also be seen as a study of the interaction between practice and theory, and of circulation of knowledge, not only between different countries, but also between different parts of chemistry.

S19 Circulation of Mathematical Knowledge in 18th-Century Britain: New Perspectives

Coordinated by **Mónica Blanco (Universitat Politècnica de Catalunya, Spain)**
Olivier Bruneau (Université de Nantes / Université de Brest, France)

Chaired by **Mónica Blanco (Universitat Politècnica de Catalunya, Spain)**
Olivier Bruneau (Université de Nantes / Université de Brest, France)

Mainly as a consequence of British unconditional adherence to Newtonian methods, the mathematical activity in eighteenth-century Britain has traditionally been regarded as "in decline". This picture, mostly moulded by early nineteenth-century English scientists, exaggerated in the way the so-called "British mathematical isolation." In addition, the fact that the mathematical sciences were banned from the Royal Society in the second half of the century - under the presidency of Joseph Banks - cannot be overlooked. Several authors have already made a call for revision of this picture. The aim of this symposium is to provide new insights into the mathematical activity in eighteenth-century Britain through the analysis of communicative practices involved, both at national and transnational level. We are particularly interested in studying mutual exchanges between British and continental European mathematics, either out of individual initiative or on behalf of learned societies. Alongside the Royal Society, this symposium encourages the study of mathematical societies emerged in eighteenth-century Britain, like the Spitalfields Mathematical Society. This scenario provides also a good opportunity to discuss the role of correspondence in the progress of private knowledge towards public knowledge. Concerning the circulation of mathematical texts, we would like to explore how the publishing and bookselling trade worked, who published what, why and for whom, taking into consideration not only books, but also translations, new editions and journals. Finally, we are also interested in discussing educational matters such as teaching institutions, their curriculum of mathematics, training programmes for mathematics teachers or the writing and reading of educational books on mathematics. The analysis of the reading practices of educational books, extended by a survey of their actual uses, fits conveniently into the framework of appropriation, since some of the readers later became authors of new educational books.

Teaching the Methods of Fluxions in the 18th-Century Great-Britain: the Case of Colin MacLaurin

Olivier Bruneau Centre François Viète - Université de Nantes,
PaHST - Université de Brest,
FRANCE

Mostly known by his Treatise of Fluxions (1742) in which he presents the state of the art in the methods of Fluxions with an axiomatization, Colin MacLaurin (1698-1746) is an university professor. Initially at Marishall College (Aberdeen) and after at the University of Edinburgh, he teaches pure and mixed mathematics more than 6 hours a day.
The aim of this paper based on an unpublished manuscript of MacLaurin is, firstly, to compare this one with his Treatise of Fluxions and some textbooks on fluxions and secondly, to discuss the place of MacLaurin in the teaching of Fluxions and in the circulation of fluxional knowledge in GB and in France.

Francis Blake and the Method of Fluxions

Mónica Blanco Departament de Matemàtica Aplicada III,
Universitat Politècnica de Catalunya,
SPAIN

In 1750 Thomas Simpson (1710-1781) published the "Doctrine and Application of Fluxions", which the author considered to be a new book rather than a second edition of his "New Treatise of Fluxions" (1737). It is true that both works contained the direct and the inverse method of fluxions. However, in the preface of the "Doctrine and Application of Fluxions" Simpson stated that this second work was more comprehensive and the principal matters were handled in a different way. In this regard, the relationship between Thomas Simpson and Francis Blake (1707/8-80) seems to have been crucial in the different approach that Simpson adopted in his work of 1750. Although his usual place of residence was Herrington (near Durham), Francis Blake spent some time in London. There he became a friend and a pupil of Simpson, who had set himself up as a teacher of mathematics in Spitalfields around 1736. Between 1738 and 1740 Simpson and Blake exchanged letters on the subject of the method of fluxions. An immediate outcome of their correspondence was an anonymous tract, "An Explanation of Fluxions in a short Essay on the Theory", published in 1741 and written by Blake himself. Actually, Simpson mentioned Blake's short treatise in his preface of 1750 and acknowledged his indebtedness to it. Focusing on the direct method of fluxions, the goal of this contribution is to analyse the impact of the communication between Blake and Simpson on the writing of the "Doctrine and Application of Fluxions". Beyond this particular episode, this analysis provides new insights into the communication of mathematical ideas as developed in Spitalfields at the time.

Mathematical Knowledge in Navigation: Exploring the Transfer of Skills in the Years up to The Almanack

Jane Wess The Science Museum, London,
UNITED KINGDOM

It is well-known that one of the major drivers for mathematics in the 18th century was the demand for improved navigation. While the history of the chronometer method has received the most attention, the astronomical methods have also been lucidly documented particularly by Derek Howse and Allan Chapman. Mary Croarken has provided a lively account of the compiling of the Nautical Almanack during the last third of the century. There have also been studies undertaken on mathematical education aimed at aspiring navigators, and contemporary texts are available. In addition to written material, 18th century navigational aids, including mathematical rules, abound in all major collections of scientific instruments.
This paper aims to bring these components together to explore how the mathematical skils necessary for improved navigation were transferred and disseminated, taking as a starting point Samuel Newton's 'An Idea of Geography and Navigation...' of 1695, and an end point the stable running of the Almanack computations achieved around 1789. It will explore where the expertise resided at different times, question how this expertise was used and communicated, and note any shifts in the skilling or de-skilling of navigators. It will also aim to incorporate the role of the leading mathematicians, and those with commercial interests represented by the East India Company and the Merchant Adventurers.

British Influences in the Introduction of Calculus in Spain (1717-1767)

Elena Ausejo University of Zaragoza,
SPAIN

It is well-known that military men and Jesuits appear as first protagonists of the process of introduction of calculus in Spain. The reorganization of the colleges left after the expulsion of the Jesuits (1767) marks the end of a first stage in this process when considered from an educational point of view, focusing in teaching institutions and textbooks.
The systematic collection and analysis of teaching materials from Spanish military and Jesuit teaching institutions –manuscript courses, examinations and textbooks– enables to conclude that the main trend in the introduction of calculus was fluxional, although references to the differential approach can also be found.
Under the reference to Newton's De methodus fluxionum (1742), the two main influential British textbooks are MacLaurin's Treatise of fluxions (1742) and Simpson's Doctrine and Applications of Fluxions (1750). The first one was the basis of the military engineer Pedro Padilla's De los cálculos diferencial e integral o méthodo de las fluxiones (1752), the only textbook on calculus actually printed in this period –to be used at the Academy of Corps Guards. Simpon's work was re-elaborated by the Jesuit Tomás Cerdà in differential notation, and was probably used at the Colegio de Nobles de Cordelles in Barcelona. It is also worth mentioning that Cerdá was a disciple of the Jesuit Esprit Pezenas, MacLaurin's translator into French (1749), and the most probable source of Padilla.

S20 Circulations of Mathematical Texts, Ideas and Practices (1870-1945)

Coordinated by Frédéric Brechenmacher (Université d'Artois, France)
Chaired by Frédéric Brechenmacher (Université d'Artois, France)

This symposium offers a forum for presenting and discussing recent perspectives and methodological issues concerning the circulation and production of knowledge in the mathematical sciences in the period 1870-1945, highlighting the role of local communities, networks and public spheres, as well as of various forms of transmission, such as journals, correspondences and international or intercontinental lecture tours.
These issues provide opportunities to crossbreed the results of historians working in various fields of the mathematical sciences.
Some recent publications have especially drawn attention to the networks in which mathematical texts could be read at different levels, and within which ideas and practices circulated. The identification of these complex networks raises some issues related to disciplines and communities formations, evolutions and connections. For instance, the way algebraic or arithmetical practices circulated through various disciplinary frames (Analysis, Geometry, Mechanics etc.) raises some issues related to the complex interactions between mathematical themes and the social identities of some networks.
Current research projects devoted to the study of correspondences and of journals have also recently highlighted the importance of a more accurate description of the various public spheres in which mathematics have been circulating inside some communities at the turn of the 19th century.
Finally, the investigation of mutual exchange of ideas and practices betwenn the realms of pure mathematics and theoretical physics can contribute to shed new light on the emergence of innovative impulses in both fields.

Introduction of Elementary Divisor Theory in Spain

Yolima Álvarez Polo (1,2) (1) Universidad de la Rioja,
Luis Español González (1) SPAIN
(2) Universidad Distrital Francisco José de Caldas, Bogotá,
COLOMBIA

The aim of this proposal is to present the reception of the elementary divisor theory (Weierstrass, Karl. Zur theorie der bilinearen und quadratischen formen, Berlin 1868) in Spain.
This work has two parts. The first one deals with the emergence of the theory as a research subject in the Spanish mathematic. To do this we locate and analyse their sources in other countries. In the second part we study the texts of higher algebra and analytic geometry that include this theory and were used in Spanish Universities or Technical Schools, we also regard the genealogy of the references used by the authors. The period that we are considering is the first half of the twentieth century, divided in two stages by the Spanish Civil War (1936-1939). In the first one a close to a formulation based on analytic geometry and determinants is found. In the second one, elementary divisors appear in terms of algebraic structures, that is, the new image of algebra since 1930.

"Neighbourhoods" versus "Accumulation Point": a Second Front in Wartime

Laura Rodríguez Universität Leipzig,
GERMANY

In 1906 Frigyes Riesz developed a concept that happens to be closely related with today's concept of topological space. Riesz called it "mathematical continuum" and defined it by axiomatising the concept of accumulation point. Eight years later Felix Hausdorff introduced, independently of Riesz, today's concept of topological space in terms of neighbourhoods in his famous book "Gründzuge der Mengenlehre". In 1917 and 1918 Maurice Fréchet attempted to improve Riesz' concept of mathematical continuum by introducing an axiomatic definition of the concept of neighbourhood. Fréchet, who at that time was working at the front as translator for the British Army, did not know Hausdorff's book. Also during the war but at the other front Vietoris was studying the relationship between Riesz' mathematical continuum and Hausdorff's topological space. In the years that followed other mathematicians continued investigating that relationship, Tietze and Sierpinski among them. The dilemma "accumulation point" versus "neighbourhoods" that was already present in Riesz' work transformed into a front, at least for Fréchet, between Riesz' mathematical continuum and Hausdorff's topological space.
My paper will deal with the reception of Riesz' mathematical continuum both before and after the publication of Hausdorff's book till the 1920s, focusing on the issue of the relationship between Riesz' mathematical continuum and alternative definitions in terms of neighbourhoods. As I will show, the reception of Riesz' concept can be traced to the USA, Austria, France, and Poland. My aim is to show that the reception of Riesz' mathematical continuum provided the framework in which Hausdorff's concept of topological space could truly established itself and that this process marks the first stage in the emergence of 'general topology' as a new branch of modern mathematics.

Circulations of Algebraic Practices (1870-1940) : Networks, Communities and Disciplines Formations, Evolutions, and Connections

Frédéric Brechenmacher University of Lille - North of France;
U. Artois;
Laboratoire de mathématiques de Lens;
FRANCE

Between 1870 and 1940, algebra took on various and changing identities depending on the communities, networks and disciplines in which "algebraic practices" were circulating. It is our aim to study how algebra circulated between and interacted with various disciplines which in turn will shed light upon the evolutions of these disciplines as algebra progressively took on a fundamental role in the organization of mathematical knowledge.
In order to tackle these issues, this talk will focus on the circulation of certain practices of algebraic manipulations of "forms" between France and the United State. Instead of developing a global approach to the historical questions posed above, this talk will thus be devoted to a few relevant contexts in order to develop some detailed results as well as to highlight some methodological issues and open problems.
In doing so, it will be necessary to investigate sources which to date have not received adequate historical attention, among others the published and unpublished works of both famous (such as Dickson and Jordan) and authors (such as Séguier and Autonne) who are lesser-known today. Although prominent algebraists such as Dickson made extensive references to papers published in France, and despite the roles played by algebra in the development of the American mathematical community, our knowledge of these French works and authors is still very limited.
We thus aim also to highlight some new sources in order to understand how they formed a part of various networks and communities in which these researches circulated. In doing so it is necessary to describe the collective phenomena of circulations in order to highlight individual achievements of mathematical creation. In particular, the circulations of algebraic practices between France and the United States shed new light on the development of international disciplines such as linear algebra in the 1930s.

Nationalism, Internationalism, and Community Formation: Mittag-Leffler and Individual Agendas in the Circulation of Mathematical Knowledge and Practice

Laura E. Turner University of Aarhus,
DENMARK

The Swedish mathematician Gösta Mittag-Leffler (1846-1927) was renowned during his lifetime (and furthermore by historians of mathematics today) as a disciple of Weierstrassian analysis, as the founder and editor of the international mathematical journal Acta Mathematica, and for his contributions to complex analysis, specifically the Mittag-Leffler Theorem. In addition, in 1881 he became the first professor of mathematics at Stockholms Högskola, and founded the Scandinavian Congress of Mathematicians in 1909.
Over the course of his career he cultivated a large and diverse collection of correspondents (including scientists, royalty, journalists, and politicians), and through the extensive networks in which he embedded himself he worked to further a rather complex set of personal, academic, and political goals, many of which he connected to the issues of international communication in mathematics and the matter of the professionalization and international recognition of the small Scandinavian mathematical communities on the northern European periphery.
By focusing on Mittag-Leffler's propagation of Weierstrassian analysis and Cantorian set theory throughout several networks in which he operated (specifically Acta Mathematica's readers and contributors, the research-oriented community of students and "post-docs" he cultivated at Stockholms Högskola, and the mathematicians with whom he engaged in personal and scientific correspondences), this talk aims to highlight the importance of individual agendas in the circulation of mathematical ideas, texts, and practices, and to demonstrate the complexity of the interactions between the networks involved.

Mathematics and Culture. Cultural Relativism vs. Continuity : Spengler's "Decline of the West"

Bjoern Schirmeier Museumslandschaft Hessen Kassel,
GERMANY

The appearance of Oswald Spengler's "Decline of the West" in 1918 was, in the perception of many contemporaries, a marking point, that signified the beginning of a new era after World War I. In his book Spengler tried to show that mathematics not only always corresponds to the style of a culture, but it is also the founding stone of a high culture itself. The way numbers are perceived differed in each high culture, resulting in Spengler's thesis that there is not only one mathematics but many. Thus each number conception relates to the symbol each high culture could be characterized with.
During the early 1920s German mathematicians from different sub-disciplines reacted to these thesis in different ways, from writing small reviews in journals like "Die Naturwissenschaften" to publishing books containing up to 200 pages. They all seemed to agree that mathematics and culture are interdependent, but disagree about the diversity of mathematical cultures.These responses to Spengler argued historically thus emphasising the importance of the history of mathematics. But in contrast to him they stressed the continuity of mathematical development.
These discussions of Spengler's thesis in Weimar Germany will be compared to international reactions of mathematicians in Europe and, if time permits, in the U.S..

The Swiss Mathematical Society as a Promoter and Center for National and International Exchange in Mathematics

Erwin Neuenschwander Institut für Mathematik,
Universität Zürich,
SWITZERLAND

The Swiss Mathematical Society (SMS) was founded in 1910 to enable better international recognition of the work of Swiss mathematicians. The SMS normally held two meetings per year, where Swiss mathematicians presented their work to their colleagues. In the spring sessions from 1914 to 1935 the society regularly invited renowned mathematicians from abroad to keep in contact with the worldwide development of mathematics; these included W. Blaschke, C. Carathéodory, E. Cartan, F. Enriques, M. Fréchet, J. Hadamard, E. Hecke, P. Montel, C. de La Vallée Poussin and H. Weyl. These lectures were replaced in later years by the so-called "Journeés" on a specialised field of mathematics, in which several invited speakers presented the newest developments in that field.
In 1932 the SMS launched its own journal, the Commentarii Mathematici Helvetici (CMH), made possible by a subsidy from the Swiss government. To get a more secure financial basis for their journal, the SMS set up the Foundation for the Advancement of the Mathematical Sciences in Switzerland which from 1964 onwards also gave travel grants to young scientists. The CMH attracted many important mathematical papers and gave some independence to Swiss mathematicians to publish their work in their own country during World War II. In 1975 the SMS also took over the editorship of the more generally oriented Elemente der Mathematik, a journal founded in 1946 by the SMS member Louis Locher-Ernst
Switzerland also hosted three International Mathematical Congresses, in 1897, 1932, and 1994. They attracted 208, 667, and 2'536 mathematicians from all over the world. The SMS was highly influential in organizing these congresses, and has also always determined the Swiss National Committee representing our country in the General Assembly of the International Mathematical Union (IMU). From 1955 to 1986 the SMS and the Swiss Universities often provided the president or secretary of the IMU (H. Hopf, R. Nevanlinna, G. de Rham, B. Eckmann, K. Chandrasekharan, J. Moser).
Scientific societies, professional journals and international congresses are very important for the circulation of scientific ideas. The paper will demonstrate this with the help of the archive of the SMS (37 big archival boxes) which I have been studying for the 100th anniversary of the society. For further information see E. Neuenschwander, 100 Jahre Schweizerische Mathematische Gesellschaft in: B. Colbois, Ch. Riedtmann, V. Schroeder (eds.), math.ch/100, EMS Publishing House 2010, p. 23-105.

Uncertainty Squared: The Mathematical Construction of Quantum Probability

Arianna Borrelli Bergische Universität Wuppertal,
GERMANY

In 1916 Albert Einstein employed the statistical-mechanical approach for studying the thermodynamic equilibrium of matter and radiation on the basis of Niels Bohr's notion of quantized atomic energy transitions ("quantum jumps"). To each spontaneous or stimulated transition Einstein associated a specific, if unknown, coefficient determining its probability. In the years 1925-27, quantum mechanics and its "statistical" interpretation emerged, and Paul Dirac, in an attempt to use the new theory to compute Einstein's probability coefficients, came across those both formal and conceptual problems which would later plague all who tried to use the probability values obtained through quantum mechanics to perform a statistical-mechanical calculation.
My paper shall focus on the earliest attempts to come to terms with what was later conceived as the difference between "quantum" and "statistical" probability – attempts which preceded the explicit formulation of this difference by John von Neumann (1932). Earlier on, as I will show, although it was accepted that the probabilities derived from quantum mechanics would combine differently than the "usual" ones, this fact was not seen as excluding the possibility of interpreting the former in terms of the latter in a more or less straightforward way. I shall first discuss the work of Dirac and will then focus on von Neumann's "Probabilistic-theoretical structure of quantum mechanics" (1927). In this paper, von Neumann literally dissected quantum mechanics by means of mathematical and logical-analytical tools developed specifically for this task. He laid bare its inner workings and then reassembled out of them instructions for dealing statistically with quantum systems – offering also a new, expanded notion of what a quantum system is. These foundations would later form the basis for his more famous theorem.

Representation Theory in Quantum Mechanics

Martina R. Schneider Johannes Gutenberg Universitaet Mainz
GERMANY

When group theoretic methods were introduced to quantum mechanics in articles by Heisenberg, Dirac, Wigner, von Neumann and Weyl in 1926/27 many physicists became interested. However, understanding and applying the group theoretic method turned out to be problematic as it was based on the representation theory of finite and infinite groups, a mathematical area which was unfamiliar to most physicists.
In my talk, I will explore how this mathematical background was treated by the various authors contributing to the group theoretic method in quantum mechanics between 1926 and the early 1930s. What mathematical literature was cited and used? Did they give the reader an introduction to the representation theory and how did they do it? When did they stop doing so and why – was it because they had assumed the reader was already familiar with the mathematical background or had they referred him to an introduction offered elsewhere? What role did modern algebra play in the expositions on the group theoretic method? In answering such questions a network of citations, references and methods with regard to the use(s) of the representation theory within the quantum mechanical context will emerge.

S21 2010, the Bicentenary of the Annals of Mathematics of Gergonne: the Emergence of the Journals of Mathematics in 19th Century and Their Role in the Diffusion and the Progress of this Science

Coordinated by **Christian Gérini (Université Paris 11 - Orsay, France)**

Chaired by **Norbert Verdier (GHDSO, IUT de Cachan, Université Paris Sud 11)**

This symposium will deal with the new ways of circulation of mathematical knowledge during the 19th century thanks to the journals of mathematics which appeared first in France (1810), and then in whole Europe.
We commemorate in 2010 the bicentenary of the edition of the first great journal of mathematics, the “Annales de Mathématiques Pures et Appliquées” de Joseph-Diez Gergonne (22 vol., 1810-1832).
This journal profoundly modified the ways of circulation and of diffusion of this science. All examples showing the enrichment of the mathematics and of their diffusion thanks to this journal and the Journal of Liouville (since 1836), the Nouvelles Annales de Mathématiques (1842-1927), etc., will be welcome.
The initiative of Gergonne has quickly involved many mathematicians all over Europe in this new form of communication. But the French initiatives also incited Germany and neighbouring countries of France to publish journals specifically devoted to mathematics: Journal de Crelle (since 1826), Annali di Matematica (since 1858), etc.
Thus, we can also measure in which way a kind of modernity and of specialization had emerged in the mathematics thanks to those journals.
Those large topics and the subjects of this symposium allow an exploration of many other fields, and especially: the links between different populations of mathematicians and between the journals themselves (eg how publishers exchanged items), the difference between what was called "pure mathematics" and "applied mathematics", the educational issues versus the theoretical progress through the articles and the editorial policies, etc…

The Circulation of Mathematics in the Europe of the Beginning of the 19th Century: the Fundamental Contribution of the First Journals Dedicated to this Science

Christian Gérini Groupe d'Histoire et de Diffusion des Sciences d'Orsay (GHDSO), Université Paris - 11 Orsay,
FRANCE

The edition of the first great journal of mathematics in 1810, the Annals of Gergonne, profoundly modified the ways of circulation and of diffusion of this science. We shall show by examples the enrichment of the mathematics thanks to this journal: the Gergonne's initiative quickly implicated mathematicians of whole Europe in this new form of communication. But we shall also see how it also incited Germany and nearby countries of France to publish journals dedicated to the mathematics: Correspondence of Garnier and Quételet, Journal of Crelle, etc. We shall see finally how much the exchanges of articles between these newspapers were important and created customs which goes on today.

Mathematical and Physical Journals and the Image of Applied Mathematics in 19th C Germany

Thomas Archibald Dept of Mathematics,
Simon Fraser University,
CANADA

Over the course of the nineteenth century, the nature of the application of mathematics to the physical sciences altered profoundly. In this paper we examine the evolving disciplinary terrain of nineteenth century mathematics with particular regard to the role played by journals and their editors. In particular, The Journal für die reine und angewandte Mathematik, Annalen der Physik, and Mathematische Annalen exhibited evolving editorial policies that reflect both the personal tastes of the various editors and the shifting role mathematics played. We shall concentrate on the period from about 1850 to 1890.

Joseph Liouville (1809-1882): Lector, Author and Successor of J.D. Gergonne (1771-1859)

Norbert Verdier GHDSO & IUT Cachan,
Université Paris-Sud 11,
FRANCE

In 1836, the young Joseph Liouville founded the Journal de mathématiques pures et appliquées known as Liouville's Journal and presented as a successor of Gergonne's Annales de mathématiques pures et appliquées. Before being a redactor of his Journal, Liouville is a lector and an author of Gergonne's Annales. Thanks to Liouville's archives – staying in Bibliothèque de l'Institut de France [3] and in Archives de l'École polytechnique [4] – and to Liouville's Journal, we will study the links between Liouville and Gergonne in order to do comparisons (continuity, discontinuity, ruptures) between their journals which are the first models of mathematical press in France and in Europe. Our Talk is an extension of preliminary works on this subject ([1] & [2]).

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A Decisive Journal in Portuguese Mathematics. Gomes Teixeira's Jornal de Sciencias Mathematicas e Astronómicas (1877-1905)

Luis Saraiva CMAF,
University of Lisbon,
PORTUGAL

Francisco Gomes Teixeira (1851-1933) can be considered one of most remarkable Portuguese mathematicians in the history of mathematics, and certainly the most important in what concerns interaction with the international community of mathematicians. The Jornal de Sciencias Mathematicas e Astronomicas (Mathematical and Astronomical Sciences Journal), founded in 1877, is due to him. This journal, published in Coimbra, lasted until 1905, when it was substituted, in what concerns the subjects of the journal, by the Annaes da Escola Polytechnica do Porto (Annals of the Oporto Polytechnic School), another journal directed by Teixeira. It was the main means through which Portuguese mathematics was revitalized. It contributed in an essential way to change the course of Portuguese mathematics. This journal allowed Teixeira to create a dynamic way to promote the discussion of mathematics themes between Portuguese and distinguished non-Portuguese mathematicians and in this way helped to reintroduce Portugal in the international network of mathematicians. It also tried to mobilize the community of Portuguese secondary teachers, creating a section for them, which included, among other items, lists of problems to solved, and the publication of the best solutions sent by the readers.
In our talk we will analyse the journal's contents, its writers, the net of communication constructed around the journal either in Portugal or in the international community. We will also discuss the section that existed in the journal's beginnings for secondary school teachers.

The Annali di Matematica and the Rendiconti del Circolo Matematico di Palermo: Two Different Ways in the Diffusion and Progress of Mathematics in Italy

Aldo Brigaglia Dipartimento di Matematica e Applicazioni,
Università di Palermo,
ITALY

The very fast development of Italian mathematical community in the second half of 19th century, immediately after the completion of the process of political unity, was clearly indicated by the renewal (1857 – 1858) of the Annali di Matematica edited in Roma by Barnaba Tortolini and now co edited by Betti, Brioschi and Genocchi. In a thriving political atmosphere, the Italian mathematicians were eager to establish strong links with the most important European scholars and the journal was the main tool towards this goal.
In this context mathematical and socio-political issues are strictly interrelated and the extant large correspondences between Italian mathematicians of the period can help us to understand better the scientific project of the young scholars.
These events have been studied in the last twenty years or more by many historians of mathematics (above all by Umberto Bottazzini), but I think that the study and the publication of many important correspondences of Italian mathematicians can throw a new light on them.
During the sixties of the 19th century the new generation of young Italian mathematicians, mainly Betti, Brioschi, Cremona, Beltrami and Casorati not only gave some important contributions to European science, but contributed very heavily to the construction of the main organizational structures of the mathematical community (journals, academies, faculties, etc.); I will try to describe their cultural and editorial politics towards the main scientific trends of European mathematics.
In a very different context (both in the scientific sense and in the political one) the first Italian mathematical association, the Circolo Matematico di Palermo was born (in 1884). Starting as a peripheral association (with only 27 members, all leaving in Palermo), in a few years the Circolo became the representative of the whole Italian mathematical community and, starting with the new century, the greatest international association.
In 1914 the Circolo had 924 associates (only one third of them were Italians; in the same year the Deutsche Mathematiker Vereinigung had 769 associates, mainly Germans) and in 1909, among the components of the editorial board of its journal, the Rendiconti, we may find Enriques, Levi Civita and Severi, Poincaré, Hilbert, Klein, Moore, Liapunov and Fredholm.
The active cultural politics of the director of the Rendiconti, Giovan Battista Guccia, mainly directed to have in the Rendiconti not only papers of the most famous mathematicians (above all of Poincaré) but also of some of most gifted in the younger generation – Frechet, Landau, Lebesgue, Fredholm, Weyl, …
This kind of strong internationalization of the Italian mathematical community is, in my opinion, the natural development of the efforts of the older generation of Brioschi and Cremona but the social and cultural milieu both Italian and European, was not developing in the same direction. So, immediately after the first World War, the Circolo entered in an ever deeper crisis. I will try to analyze the many international (the emergence of nationalist tendencies even in the scientific community), national (the fascism), and local (the deep economic and social crisis of Sicily) that, at the end, made it impossible to conserve for the Rendiconti the status that it had gained before.

Mathematical Journals in Spain during the Nineteenth Century and the Beginnings of the Twentieth Century

María del Carmen Escribano Ródenas Quantitative Methods Department,
Gabriela Fernández Barberis Faculty of Economics and Business Science,
University San Pablo CEU, Madrid,
SPAIN

In Spain, the Nineteenth Century, was a very difficult period in general and, especially in issues related to Mathematics Science, in particular. Generalized opinion in relation with the Spanish backwardness of that period in Mathematics subject was very important. So, the Mathematics Journals that were coming out in other European countries in that century have had a delay in Spain. Although some of them appeared in the first half of the century, their publication made intensify at the end of the Nineteenth Century and at the beginnings of the Twentieth Century.
Prominent Spanish Mathematicians were interested in promote Mathematics in Spain and from them emerges the idea of edit Mathematic Journals were it would be possible to publish some articles and information in relation with Mathematics but develop in and out our frontiers. In this work paper are revised the first eight Mathematical Journals published in Spain from Nineteenth Century that emerges, in most of the situations by private initiative:
El Periódico mensual de Matemáticas y Física, el Progreso Matemático, Aspirante, Archivo de Matemáticas Puras y Aplicadas, Revista Trimestral de Matemáticas, la Gaceta de Matemáticas, Revista de la SME, y la Revista Matemática Hispano-Americana. Of course, some of the previous Journals only consisted of few volumes and its length was, relatively short; because of the fact that most of times there were not enough economics resources.
In Spain, the Mathematic Science spreading began its evolution thanks to the forthcoming of those journals with the collaboration of no Spanish mathematicians.

Investigating 19th-Century Mathematical Journals: Importance and Use of Other Periodicals in Nouvelles Annales de Mathématiques from 1842 to 1870

Liliane Alfonsi Groupe d'histoire et de diffusion des sciences d'Orsay (GHDSO),
Université PARIS SUD,
FRANCE

One way to investigate 19th-century mathematical journals is to see their importance and their use in other reviews. The purpose of my talk is to deal with this subject from an example, Nouvelles annales de mathématiques, a French journal created by Orly Terquem in 1842 whose announced purpose was to prepare young men for the entrance examination of Ecole Polytechnique. My study will cover the years 1842 to 1870, trying to answer the following questions:
How many journals are there? Which journals are mentioned? on which occasions and themes? For what scientific, educational or political aims are they employed? Is there an evolution due to different editors, public expectation and political events?
In discussing those points I will focus my analysis, first, on a quantitative and qualitative study to measure the importance of the other periodicals on different subjects and at various times, and second, on a reflection upon the use of these journals in order to serve the editors' goals.

The "Rivista di Giornali" (1859-1880) and the Circulation of the European Mathematical Culture in 19th Century Italy: a Case Study

Giuseppe Canepa Università di Genova,
Giuseppina Fenaroli ITALY
Ivana Gambaro

The first issue of the "Rivista di Giornali", conceived by Giusto Bellavitis (1803-1880), was published in 1859 as a part of the "Atti dell'Imperial Regio Istituto Veneto di Scienze, Lettere ed Arti".
At that time Bellavitis, as a full professor of "Geometria descrittiva con disegni" at the University of Padova (in the Regno Lombardo Veneto, part of the Austrian Empire), was in touch with some of the most outstanding mathematical personalities both Italian and European, as testified by his copious correspondence.
As "a self made man" in the field of mathematical research, he got a position at the University of Padova, though lacking an academic training and a regular university degree, and showed a true interest in the contemporaneous events of the Italian Risorgimento. By publishing the "Rivista di Giornali" his aim was to develop a tool for the Italian research community, not organized yet within a unified Italian State, apt to synthesize the most relevant new ideas and cultural stimuli in the field of pure and applied mathematics by means of the reviews from national and international scientific literature.
Our aim is to analyze the topics the "Rivista di Giornali" deals with and the width of its circulation in the main Italian universities and research centers. In particular our interest is focused on reviews and comments related to articles published on the "Nouvelles Annales des Mathématiques", on the "Journal de Crelle", and on the "Annali di Matematica pura e applicata".
[This communication deals with the outcome of a research project developed within a PRIN Project coordinated by Prof. Aldo Brigaglia, Department of Mathematics, University of Palermo (Italy)]

Annales de Gergonne and Nouvelles Annales : from Elementary Geometry to Higher Geometry

Jean Delcourt Department of Mathematics,
University of Cergy-Pontoise,
FRANCE

1810 : First issue of Annales de Gergonne
1813 : Poncelet finds by himself projective geometry in the prison of Saratov.
1822 : Traité des propriétés projectives des figures
1832 : Last issue of Annales de Gergonne
1842 : First issue of Nouvelles Annales, Gerono and Terquem.
1846 : Chasles is appointed to the chair of higher geometry at the Sorbonne.
1852-1865 : Traité de géométrie supérieure, Traité des sections coniques;
A few dates, two journals of mathematics, and two great French geometers. In the first half of 19th, a new geometry is growing : synthetic, projective, higher geometry...

We suggest observing, by studying precisely the contents of both journals, how the new ideas are passed on in the successive generations of professors and students, who constitute the great majority of their readers and how certain methods (those of the projective geometry in particular) are imperative(lead) (or not) little by little. It will also allow us to bring a precise lighting on the differences between magazines(reviews) and to know better their authors.
To stay in reasonable limits and also to be able to enter the detail of the contents, we chose to limit ourselves to the theory of the conical sections and, as regards the Nouvelles Annales, in the date of 1865, that of the publication of the second treaty of Chasles.
We shall lean on the exhaustive corpus of articles published on this theme, as well as on the composed questions and the published answers to these questions, we shall also use the « base auteur »l of Nouvelles Annales.

The Circulation of Knowledge in Journals and Periodic Publications at the End of the 19th Century. The Example of the New Triangle Geometry

Pauline Romera-Lebret Centre François Viète,
Université de Nantes,
FRANCE

At the end of the 19th century, a new chapter of the geometry was born: the new triangle geometry. Developed at first by amateur mathematicians as Émile Lemoine and Henri Brocard, its development came true thanks to articles published in diverse mathematical journals as the Nouvelles Annales de Mathématiques, Mathesis, the Journal de Mathématiques élémentaires or the Journal de Mathématiques spéciales. We suggest showing how these articles can be considered as exchanges among the protagonists and how much these journals served the necessary emulation for this corpus of knowledge to become coherent. We will follow the evolution of particular objects like the Lemoine point or the Brocard points from the first article of presentation to the adoption of a common definition. Then, we will see appearing networks of fundamental articles. We will also look at the links authors/journals but also articles/journals to understand the role played by these various journals in the history of the new triangle geometry.

The Foreign Correspondents in the Annals of Gergonne

Georges Thelot Académie de Nice and
GHDSO, Université Paris-11 Orsay,
FRANCE

Based on works by C. Gérini [1] and Dhombres & Otero [2] about the Annals of Pure and Applied Mathematics (1830-1832) of French mathematician J.-D. Gergonne (1771-1859), our work was specifically concerned with the many contributions of foreign authors in this journal.
Gergonne has originally conceived his newspaper to attract the teaching community of his country. He succeeded in bringing the Annales to a level which quickly also attracted the French elites, but also mathematicians from all over Europe. But that population of foreign authors and their articles in the Annals has not been specifically studied, what we set out to do.
We therefore present here the first results of our study: the geographic origin of these authors, their works of mathematicians, the distribution of their articles in different areas of mathematics of their time, their correspondence with the editor.
To give an example, we study the contributions of WHF Talbot (Scotland, 1800-1877) in the vol. 13 & 14 (1822-1825) , who began his brilliant scientific career in publishing in the Annals.
The success of the Annals also inspired in 1826 A. L. Crelle (Berlin, 1780 – 1855), who created in Berlin his Journal für die reine und angewandte Mathematik and immediately began a regular correspondence and exchanges of articles between the two journals.
We see here a new process that occurs in communication between European mathematicians: simultaneously publications in several newspapers, trade between publishers, and therefore a wider and faster diffusion than the epistolary exchanges between individuals that existed before. In the last part of our presentation, we will so more closely study the connection between the German journal and the French one.

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S22 Applied Biology: Practical Tasks and Fundamental Research

Coordinated by **Natalia Beregoy (Russian Academy of Sciences, Russia)**

Chaired by **Eduard Kolchinsky (Russian Academy of Sciences, Russia)**
Natalia Beregoy (Russian Academy of Sciences, Russia)

By studying the structural organization of applied science history, we have come to the conclusion that the main role in developing fundamental biology has been played by the circulation of ideas between the applied field and theoretical research. Many of those who have made great contributions to theoretical biology devoted a substantial period of their lives to finding solutions to questions of direct practical importance, such as agriculture or medicine. What we therefore propose is to organize a symposium that shows in several papers various ways of forming the discipline of applied biology, its institutionalization, and the role of eminent biologists in this process. We wish to discuss how the interaction between the so-called "near-biological" spheres of the economy (such as agriculture, forestry, fishery, veterinary medicine, etc.) and medicine with "pure" science led to developing the scientific profession of applied biology. The Symposia will include a wide range of topics describing different aspects of applied biology and its role in science and society, with broad geographical focus. (1) From the Scientific committee of the Ministry of State Property to the System of VASKhNIL; (2) Fighting against cattle plague in Russia: 1800-1900; (3) Vegetation studies: practical tasks – fundamental researches; (4) How to make a drug from the theory: to the history of antibiotics; (5) Hugo de Vries' involvement in plant breeding; (6) Early colonial science in Belgium/Congo; (7) Botany as Big Science –Applied Biology in Berlin, 1810-1840.

Institutionalizing Applied Research in Biology, Russia

Eduard I. Kolchinsky St. Petersburg Branch of the Institute for the history of science and technology,
Russian Academy of Sciences,
RUSSIA

Conventionally, the establishment of the V.I. Lenin All-Union Academy of Agricultural Sciences (the VASKhNIL) in 1929 has been considered as an outcome of rapid institutionalization of biological research in line with the Bolsheviks' agenda. In reality, scholars themselves initiated and supported the process using Bolshevik authorities in order to implement their own vision of the advancement of science in Russia. The foundation of VASKhNIL was not the beginning but the result of almost century-long process of institutionalization of applied research in biology that began in 1837 inside the Ministry of State Domains. The Ministry was active in promoting new methods of land cultivation and rational use of natural resources. Under the aegis of the Ministry various academic committees and commissions were established that included agronomists, cattle breeders, ichthyologists, soil scientists, entomologists on their boards. When in 1894 the Ministry of State Domains was reorganized into the Ministry of Agriculture and State Domains, its Academic Committee defined the research agenda, planned and supervised research in the fields of agriculture and management of biological and water resources. The Academic Committee set up agricultural laboratories and experimental stations, and outlined their research programs and instructions. There were even plans for establishing the Central Institute of Agronomy, however in practice its academic and administrative tasks were divided among various bureaus affiliated with the Academic Committee (for entomology, applied biology, zootechnology, soil science, zoology of fur-bearing animals and marketable fish, etc) and created in 1894-1899. In 1901 an Academic Commission was established at the Academic Committee, which was concerned with organizing agricultural research institutions, experimental studies in agriculture and seed-farming. It was these bodies (bureaus and the Academic Commission) that eventually became the foundation for the future institutes of the VASKhNIL with Nikolai I. Vavilov serving as its first president.

Botany as Big Science. The Case of Berlin University, 1810 to 1840

Staffan Müller-Wille University of Exeter,
UNITED KINGDOM

Botany developed as a "Big Science" in the Early Modern period already, with its central institutions–botanical gardens–taking on the role of hubs for the global transfer of plants of medical, agricultural and industrial significance. This paper will look at the role botany played in the first three decades of the University of Berlin, established in 1810. The research focus in these years was on plant taxonomy and biogeography, and most resources went into the establishment of a botanic garden and global collection of plant specimens. However, the botanists in charge, most prominently Carl Ludwig Willdenow (1765-1812) and Heinrich Friedrich Link (1767-1851), also had a strong interest in the application of botany to promote medicine, agriculture, and industry. I will argue that this resulted in a network of close ties with other institutions and organisations – such as the medical faculty, the forestry school, or the Association for the Promotion of Horticulture (Verein zur Beförderung des Gartenbaues) – which created niches for what in hindsight appears as advanced biological, rather than traditional natural historical work, such as the early cytological work of Matthias Jacob Schleiden (1804-1881).

Belgian Nurseries Introducing Novelties: did Belgian Taxonomists really Benefit from the Horticultural Industry and Plant Hunters (1830-1865)?

Denis Diagre National Botanic Garden of Belgium,
Université Libre de Bruxelles,
BELGIUM

It is well known that natural sciences are indebted from the collecting trips that took place during the XVIIIth and XIXth Centuries, and even before. This is apparently logical, since some of the naturalia hunters were state funded and were meant to bring new material for national industries and for the collections of museums and botanic gardens. Yet, in Belgium, the majority of plant collectors were commissioned by nurseries or by rich collectors. Moreover, even the government supported travellers tended to send the most valuable crates to rich customers and nurserymen. As a consequence, the thousands of so-called "novelties" that came to Belgium between 1830 and 1865 were described and illustrated in horticultural magazines (Belgian or foreign), rather than in scientific literature. For that reason, the benefits for Belgian botany – especially for taxonomy – are questionable. Some questions might help us work out what one of the most famous horticultural industries on Earth either brought – or did not bring – to the "fundamental" Belgian botany. Among them: what kind of education/training had the collectors? What were the choicest botanical groups? Why did the Belgian State let nurseries and hobbyists take charge of the collecting policy, if there was one? Did the plant hunters collect herbaria or only living plants/seeds? Where are they now? Were the plants properly described? If Belgian academic science did not benefit from plant hunting, who did, and why (social, economical, ideological background)? Does taxonomy of some attractive plant groups now pay the price for the past situation?

The Expeditions of Academy of Sciences of the First Half of the 19th Century and the Development of Practice Biology in the Russian Empire

Tatiana Feklova Saint-Petersburg branch,
S.I. Vavilov's Institude for the History of History of Science and Technology,
Russian Academy of Science,
RUSSIA

The first half of XIX-th century for the whole world – is the period of formation of the capitalist relations. At this time the Russian science has came to a new stage of their development. Industry development puts the other purposes and problems before a science. The XVIII-th century was a century when enormous territories of the Russian empire practically have not been studied also any find was of interest. Before scientists the problems of more purposeful approach to the researches have been put. Expeditions were an integral part of activity of the Academy promoting its further development and prosperity. They helped to create the data-base for the future development of the science.
First of all, the expeditions gave the wide opportunities for carrying out the researches in the field of geography, biology, zoology, ethnography, etc. Secondly, expeditions allowed improving scientific methods. During the travel, the scientist developed their own technique and methodology of researches which subsequently, after completion, could enter into a scientific arsenal.
From the total number of the analyzed expeditions (41 expeditions made by Academy of sciences as separately, and together with the ministries) the 15 have led to appreciable breaks in a science, from them the 7 expeditions – especially in the biology.
Now the differentiation of science has practically reached their apogee, but initial division of sciences has begun in the first half of XIX-th century. During long-term expeditions the methods which subsequently have become in the basic ways of collect of materials, appeared and fulfilled. The collected data, after their processing and the analysis led to occurrence of new branches of sciences, including the biology. Thus, expeditions were that areas, on which new methods were tested.

Botany and Horticulture: Practical and Fundamental Links (1820-1850)

Cristiana Oghina-Pavie (1) (1) Centre de recherches historiques de l'Ouest,
Stéphane Tirard (2) University of Angers,
(2) Centre François Viète d'épistémologie et d'histoire des sciences et des techniques,
University of Nantes,
FRANCE

During the first half of the 19th century, horticulture defined its profile in France as a professional and economic domain. The botanical researches nourished the empirical development of garden nurseries, and of the cultivation of fruit trees, vegetables and seeds. Horticultural practices, such as grafting, cutting or the selection of fruits or ornamental varieties have called for botanical explanations and experimentations. We will especially focus on anatomical and physiological topics constituting common interests for botany and horticulture.
The lecture will analyze some of the above mentioned exchanges in France, in the context of the creation of the Société d'Horticulture de Paris (1827), around the Chair of Culture in the Muséum National d'Histoire Naturelle and in some local societies, in particular in the area of the city of Angers, where professional activities in horticulture are traditional and intensive.

Zemstvos and Naturalists: Objectives of Applied Research, Methods of Fundamental Science

Anastasia A. Fedotova St. Petersburg Branch of the Institute of the History
of Science and Technology named after S.I. Vavilov,
Russian Academy of Sciences,
RUSSIA

In their recent works historians of Russian science emphasise that many projects, which were carried out in the field of natural history in the European Russia in the late 19th century with funding provided by local elected authorities (the zemstvos), could be defined as applied research only in terms of their objectives but not their methods and results. For example, Vasilii V. Dokuchaev's expeditions to Nizhnii Novgorod and Poltava provinces were very important for genetic soil science, however they failed to achieve their explicit practical goal of cadastral surveying. In my paper I attempt to analyse some reasons accounting for this tendency.
In the 19th century many Russian naturalists and agronomists sought to prove that the study of local nature was essential for the advancement of agriculture. In my view, their views were a reaction not only to a primitive state of agricultural production in the country but also to the failures in a 'blind' transfer of Western European practices. European education in agrology, as well as European literature in that field proved to be insufficient for transforming rural economy into successful agricultural enterprise. At the same time the tsarist government still refused to acknowledge that agriculture required specialised knowledge. When in the last two decades of the 19th century scientists began to study local natural environments, they were very excited about these projects, as they were convinced that the study of natural history was the first step towards rationalising agricultural production in Russia, while they never questioned their own research design: they did not consider the need to change their methods and research objectives. Many of these projects pursued applied objectives but employed methods borrowed from fundamental science. Therefore their results contributed primarily to the advancement of fundamental science. Thus in the late 19th century we observe a conspicuous gap between primitive methods of agricultural production and advanced state of research that was hardly relevant for everyday agricultural management.

Fighting Against the Cattle Plague in Russia: 1800-1900

Natalia Beregoy St. Petersburg Branch of the Institute for the History of Science and Technology,
Russian Academy of Sciences,
RUSSIA

The cattle plague is one of the few diseases of the cattle that was completely dismissed everywhere already in the beginning of the 20th c. The story of the fight against the cattle plague is interesting because it shows how practical tasks in the 19th c. led to the development of fundamental research, and a role of state support and economic factors in revealing practical value in basic research.
The cattle plague was a main enemy of agriculture and economy of Russia and Eastern and Central European countries from the beginning of 18th c. This problem gained serious interest from some scholars in the end of the 18th c. In the beginning of the 19th c. many scholars believed that the cattle plague had so called "native land", a place where it spread out from which was the steppes in the South and East of Russia. This situation might bring up sanctions against Russian cattle and therefore economic problems, and that’s why in the 1830-ies the cattle plague became an object of scientific research. All these actions had practical value.
In 1840-ies with the governmental support the first basic researches of a cattle plague which had direct applied value, namely researches of inoculation, began in Russia. But there was a party in the academic community that was not in favor of cattle plague inoculation. And despite all positive results the government decided to stop funding inoculation research. Since 1970-ies the main measure of fight against cattle plague was killing of all ill and suspicious cattle. The knowledge produced in laboratories did not find practical applying, partly because manufacture of vaccines and whey was very expensive.
But the laboratory researches not only did not stop, but paradoxically gained the state support in the 1920-ies. On this example we see, how applied problems become stimulus to development of basic researches which continue to develop, even when not economically determined.

S23 Darwin in Urban Contexts, 1859-1930

Coordinated by **Katalin Stráner (Central European University, Hungary)**

Chaired by **Daniel Schümann (Universität Bamberg, Germany)**
Hans Henrik Hjermitslev (Aarhus University, Denmark)
Katalin Stráner (Central European University, Hungary)

Although Charles Darwin spent the major part of his life in rural seclusion, cities were arguably the chief places where his ideas were circulated. Enhanced means of communication, such as railways, mail, and telegraph, undoubtedly largely contributed to this process; however, Darwin could not possibly have achieved his current fame without the bustling and energetic urban environments all over the world where new scientific theories fell on fertile ground. Universities and colleges, publishing houses, periodicals, but also public lectures and learned societies played a major role in blazing a trail for Darwin's ideas. Cities were all the more important, since in Darwin's lifetime, as well as in the ensuing decades, national boundaries were not clear-cut in many parts of the world. Major centres of civilization developed into centres of migration, leading to a dissemination of various notions of 'Darwinism' across national and cultural borders. In many cases, cultural diversity and ethnic conflicts also influenced the reception of evolutionary theories, especially when the general public participated in those debates. The symposium deals with the reception and adaptation of Darwin's ideas from an urban perspective, gathering together speakers from various fields and diverse cultural and geographical backgrounds: they will address questions of Darwinism in urban centres – and in some cases, peripheries – of Europe, the Americas and the Ottoman Empire.

Darwin's Vienna, 1859-1914

Werner Michler Institut für Germanistik (Department of German),
Univ. of Vienna,
AUSTRIA

The contribution will focus on the different ways of ‚reception' of Darwinism in Vienna from its inception up to WWI. My major points will be: a) the interplay between science, general public and institutions (‚public science'): universities, university extension movement, museums, schools; political institutions; b) discursive conjunctures and figurations & trajectories: ‚Darwinian' concepts shaping notions and recognitions of the urban poor; feminism; antisemitism; c) Darwin within the literary and artistic culture of „Fin de siècle-Vienna" (Schnitzler, Hofmannsthal, Beer-Hofmann, Freud, Mach).

Darwin in Budapest and Beyond: An Attempt at the Decentralisation of the Hungarian Reception of Darwinism

Katalin Straner Central European University, Budapest,
HUNGARY

Is it possible to differentiate the Hungarian reception of Darwinism from its reception in the Hungarian capital? Budapest, which was coined from Buda, Pest and Óbuda in 1873, the same year when the Hungarian translation of The Origin of Species was published, was without doubt the centre of the country in every respect, and as such, it still dominates the discourses of the reception of Darwinism in Hungary. The Austro-Hungarian Compromise of 1867 marks a powerful shift in the development of the country and the city itself, and one of the concerns of this paper is how this change affected cultural and scientific processes such as the reception of Darwinism. However, the analysis will move beyond the differences of perception of Darwinian evolution in 1859 Pest and 1875 Budapest, and look at individual agents and patterns of reception in smaller cultural centres and intellectual hubs in less central parts of country, making a step towards the decentralisation the Hungarian reception of Darwinism.

The Mind of the Beast: Darwinism and Concepts of Animal Intelligence in Dublin, 1859 to 1890

Juliana Adelman Department of History,
Trinity College Dublin,
IRELAND

This paper will focus on the implications of Darwinism for ideas of animal intelligence. It will use the 1878 meeting of the British Association for the Advancement of Science as a focal point. At this meeting, held in Dublin, George Romanes gave the presidential speech in which he outlined his ideas about animal intelligence. The paper will compare both popular and scientific concepts of the animal mind which were current in Dublin before and after this speech and also examine direct reaction to the speech. The central questions regarding animal intelligence during the nineteenth century were whether human intelligence was different from that of animals in degree or in kind and what actions of animals should be attributed solely to instinct. These questions were of even greater importance once resistance to Darwinian evolution had emerged and seemed proof (or disproof) of the barrier between man and animal.
Despite Romanes's claim in his book Animal Intelligence to separate anecdotal evidence from that of trusted authorities, this paper will demonstrate that the spheres of common experience and scientific work in animal intelligence were highly permeable. In Dublin, in particular, there were many overlaps between religious, scientific and literary communities and writers on intelligence accepted a wide variety of types of evidence in stating their claims. This paper highlights the importance of various sites within the city where animals were encountered (from the menagerie to the theatre) in understanding the complex origins of Dubliners' ideas about the animal brain.

Darwin in Ottoman Istanbul 1859-1922

Cemil Ozan Ceyhan Istanbul Technical University,
TURKEY

Modernity formation attempts in Ottoman Empire aroused a huge amount of new ideologies. From politics to social and natural sciences, these modern ideas had an important impact and reflection in Turkish intelligentsia. Among these new ideologies, positivism and materialism have one of the major roles to affect generations during last two centuries. Under these circumstances, Charles Darwin and his theory of evolution were introduced in Istanbul by the help of those positivist and materialist movements. As Istanbul was the capital of Ottoman Empire, it was the heart of the many debates including Darwin and his ideas. There are plenty of books and periodicals published in Istanbul that carry the discussions about fundamentalism and positivism including Darwin and his theory of evolution. This study mainly focuses on these books and periodicals in terms of Darwin and Darwinism.

From Beirut Into the Muslim World: Responses to al-Muqtataf's Darwinism Debate

Rainer Brömer Fatih Üniversitesi Istanbul,
TURKEY

The initial circulation of Darwinism in the Arab and Islamic world was largely fostered by a periodical based at the Syrian Protestant College in Beirut. This journal, al-Muqtataf (The Anthology) later had to move to the city of Cairo, due to a major scandal at the college in 1882, connected to the work of none other than Darwin himself. Al-Muqtataf, though edited by two Christian graduates from SPC, served as a vehicle for the spread of popular science wherever Arabic was the language of education, as far afield as Muslim India. Thus, Darwin (and later Spencer and Haeckel) became household names among Arabs of all faiths and Muslims of all languages. Evolutionist terminology was at the forefront of the late-nineteenth-century effort to accommodate the latest western scientific concepts in a modernised form of classical Arabic, another movement intimately connected with the cities of Beirut and, subsequently, Cairo and Damascus. Interestingly, as is shown in the work of Ceyhan, Turks in the Ottoman capital produced their own Darwinian terminology, using a different set of (equally Arabic) terms compared to those introduced by native speakers of Arabic, notwithstanding the fact that the first major Muslim Arab response to Darwin by Husein Jisr had been translated into Ottoman Turkish at a very early date. My talk will analyse the intellectual relations between Beirut and Constantinople in contrast to the Arabic and Indo-Iranian responses to al-Muqtataf's presentation of Darwinism.

Darwinism, Arts and Literature in Rio de Janeiro in the Beginning of the 20th Century

Heloisa Maria Bertol Domingues (1) (1) Museu de Astronomia e Ciências Afins - MAST/MCT,
Magali Romero Sá (2) (2) Casa de Oswaldo Cruz - COC/FIOCRUZ,
Rio de Janeiro,
BRAZIL

Since the 1870's, Darwin's theory has been disseminated among intellectuals and scientists in Brazil. The capital city of Rio de Janeiro, just as other capitals in the world, was re-urbanized in the beginning of the 20th century inspired by the reform of Hausmann in Paris. Behind the process of modernizing the city was the initiative of sanitizing the Brazilian capital, what was undertaken under the coordination of the hygienist Dr. Oswaldo Cruz. Among intellectuals, Euclides da Cunha, a military who followed positivist orientation and was adept of Darwin's theory, based his main publication Os Sertões (The backlands) on the interpretation of Darwin's ideas. The book describes the struggle in the hinterland of the country between a group that supported the imperial government and the troops of the newly installed Republican army. The publication praises both the natural settings and the toughness of the hinterland man, contrasting him with the polite but weak urban men, susceptible to diseases. Literature and urban architecture applied the scientific precepts of Darwinism, in order to solve social, political and cultural questions of the city and the country.

Theories in Transit. How German Cities Shaped Polish Notions of Darwinism

Daniel Schümann University of Bamberg,
GERMANY

In the second half of the 19th century cities were the main interfaces where Charles Darwin's ideas were disseminated across the various cultural borders of Continental Europe. This was primarily because, outside France, university education was generally not very centralised and standardised. Germany and Italy may be the best examples for this multi-centred approach to evolutionary theory. While the reception of Darwin's ideas in Germany has been relatively well documented by historians of science such as Eve-Marie Engels, Thomas Junker, and Uwe Hoßfeld, little research has been carried out so far on how German universities and urban environments helped shape notions of Darwin's ideas outside the German-speaking areas. Germany and the Habsburg Empire were not single-nation states, but German was the main language in which Darwin's ideas permeated into their various scientific communities. The paper looks at the impact of German cities from a Polish perspective and tries to determine the geographical hubs from which Darwin's ideas migrated into Polish-speaking communities. Not all of the cities where Darwin's ideas were circulated were traditional centres of academic learning. There were also cities with major scientifically-oriented publishing houses (such as Stuttgart) or that were the home towns of popular materialists (e.g. Darmstadt, the home of Ludwig Büchner). Due to an increasingly developed railway network, travelling became very popular among scientists, lecturers, and students; this meant that the academic 'catchment areas' of German and Austrian cities quickly extended eastward, allowing Polish naturalists, as well as the educated public, to participate in contemporary debates over Darwin's theories.

Darwin in Copenhagen and Askov: Evolution in Urban and Rural Contexts around 1900

Hans Henrik Hjermitslev Aarhus University,
DENMARK

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, Darwinism was advocated by the literary critic Georg Brandes and a circle of university-trained freethinkers in urban Copenhagen. Detailed historical studies have demonstrated how Danish freethinkers applied Darwin's theory as a vehicle for progress and change. In this sense, the Danish case echoes the reception of Darwinism in many other countries, where positivists and radicals were the main actors in the dissemination of evolutionary thought. I argue, however, that in order to understand the specific characteristics of the reception of Darwinism in Denmark, it is necessary to include not only the urban intelligentsia, but also their cultural antagonists in rural Denmark. Here, the so-called Grundtvigians established an alternative Christian folk movement, which came to terms with Darwinism around 1900. In line with the recent historiographical focus on microhistories, local contexts and geographies of science, this paper thus demonstrates how Darwinism was communicated and debated as part of a larger cultural struggle between advocates of competing urban and rural worldviews.

The Reception of Darwinism in Cities. Some Methodological Considerations

Thomas F. Glick Boston University,
USA
Societat Catalana d'Història de les Ciéncies
SPAIN

Has the country study of the reception of Darwinism (or of scientific ideas generally) outlived its usefulness? We have learned much about cultural styles in science, applicable to countries as well as individual national disciplinary groups. Now I ask, what kinds of processes presently underdeveloped or unnoticed might be uncovered by changing the unit of analysis from countries to cities? What will we learn that we don't already know by pursuing urban microhistories of reception? These questions will be addressed with specific reference to the reception of Darwin in Boston, 1859-1880.

S24 Appropriation of Mental Measurement in Different Cultural Contexts

Coordinated by **Annette Mülberger (CEHIC - Universitat Autònoma de Barcelona, Spain)**

Chaired by **John Carson (University of Michigan, USA)**
Annette Mülberger (CEHIC - Universitat Autònoma de Barcelona, Spain)

Scientific ideas and practices are not simply transferred within different research networks but suffer always some kind of transformation according to the cultural traditions of the specific society where these are adopted. Scholars on the periphery are no passive agents but active, they develop strategies of appropriation seeking for contact with well established research groups or simply new ways of thinking and practicing science. It is time to exam this process of appropriation in more detail by looking on how certain scientific techniques and measurements circulated within and outside Europe.
Attempts of quantification can be found nearly in every realm of the so called "sciences" due to the spread of positivism during the second half of the 19th century. Psychology, as well as other sciences, received a strong impulse to develop quantitative methods. The most well known case was the development of the first mental test at the beginnings of the 20th century in France. Much historical research has been done on Binet and the emergence of his test (Zuza, 1948, Wolf, 1969, 1973, Foschi & Cicciola, 2006, etc.). Some historians like J. Carson (2006), Sokal (1990), Zenderland (1998), and others have dealt in detail with the emergence of the intelligence test within the context of the French and American Republic. But none of the works cited deal with how this new technique was transferred and appropriated in other cultural settings in the periphery. In the present session we develop specific case studies dealing with the reactions provoked by the appropriation and popularization of mental tests in different cultural contexts like Spain, Italy, Hungary and Brazil in an attempt to shed new light on the process of appropriation of scientific knowledge and practice.

Intelligence Testing in Barcelona at the Beginnings of the Twentieth Century

Annette Mülberger CEHIC,
Vanessa Moreno Lozano Universitat Autònoma de Barcelona,
Andrea Graus Ferrer SPAIN

Although some serious research has been done in the last years on the beginnings of intelligence testings in the French and North American context, no comprehensive analysis and historical reflection about the appropriation of mental testings in Spain has been done until now. Thus, the present study tries to elucidate how scholars on the periphery received and reacted towards the new measurement devices developed in neighboring France. Who in Spain was aware of the new French proposals?
Our research reveals that philosophers like Eugeni d'Ors was the first to publish a translated summary of the French intelligence test and to recommend its use in Catalan schools. A report of the regional government of 1916 shows that initiatives in this direction had been taken. Also the Institut d'Orientació Professional would enhance the use of mental tests in the city organizing systematic mass examinations in schools.
Focusing on the local context of Barcelona we take a closer look at how and for what purpose the new device was applied in Catalan schools and how the results were exploited. What was the attitude and opinion of experts like physicians, pedagogues and teachers, on the one side, and the lay public, on the other? In the Catalan newspaper we found several comments referring to systematic mental testings done in the city.

When an Instrument Crosses Borders: Measuring Mind in Early Twentieth-Century France and America

John Carson University of Michigan,
USA

How have modern democracies squared their commitment to equality with the fear that disparities in talent and intelligence might be natural, persistent, and consequential? This talk explores the story of how the American and French republics turned to the sciences of human nature, and specifically particular practices of measurement, to help make sense of the meaning of human inequality. These sciences' exploration of the status and character of human mental differences, it contends, provided a range of political theorists, social scientists, and practical politicians with seemingly objective grounds for interrogating the limits of human equality and developing what could be represented as a justifiable basis for social distinctions. In general, mental philosophers and political theorists on both sides of the Atlantic argued that if the "false" distinctions of wealth or family background or beauty or any of the other accidents of birth could be eliminated, then the "true" ones, those reflecting fundamental aspects of a person's nature, could come to the fore. However, over the course of the nineteenth and twentieth centuries, the specific ways in which each society responded to the evolving sciences of human nature diverged sharply as these nations addressed the problem of balancing equality and difference. This talk will investigate the nature of that divergence and the crucial role that determinations of, and contestations over, ways of assessing intelligence played in both societies, constituting shadow languages of inequality used to help organize educational systems, justify racial hierarchies, classify army recruits, and direct individuals onto particular educational and career paths. It will also explore some of the hesitations about, and resistances to, these practices as they were elaborated and enacted.

Psychological Measurement and the First Intelligence Testings: The Case of Brazil

Ana Maria Jacó-Vilela UERJ,
BRAZIL

The European ideas about science, positivism and materialism reached Brazilian intellectuals around 1870. These new ideas were perceived as representing progress and a level of civilization common in Europe and to which Brazil should aspire. Therefore they were appropriated and, in an anthropophagic process well represented by the Modernist Movement in Arts they became a starting point for the proposal of new ideas and practices to improve the social and cultural condition of the country.
Except for the reference to the presence of one or another foreigner researcher, autodidactism seems to have been the usual way of the scholars entered into contact with different psychological tests and their application in Brazil. Psychological tests began to be systematically published in the 1920s. The basis for all later books on the topic is Medeiros and Albuquerque's influential publication of 1924 entitled "Os Tests". This masterpiece would serve as a reference for educators because of its clear exposition and the excellent bibliography.
During this period, educators influenced by Dewey's and Claparède's thoughts begin to consider psychological knowledge as being basic for education, a view called the New School. Training in tests became an important tool for future teacher in order to level the student's mental capacities and empower teaching efficiency. Not only the Binet-Simon test but many other mental tests were used. The movement APICE took place during the next decade when the first Brazilian tests were created: Lourenço Filho designed the ABC test destined to verify the necessary maturity for learning (1933) and Helena Antipoff started to develop and apply her test "Minhas mãos" ("My hands"). One thing is the welcome, adaptation, and appropriation of a certain scientific instrument like the mental test in Brazil and another thing, clearly representing a step further, is the development of new own tests in the peripheral context.

De Sanctis, Binet, and the Intelligence Test in Italy

Elisabetta Cicciola "Sapienza" Università di Roma,
Renato Foschi ITALY
Giovanni Pietro Lombardo

During the last years, the scientific, cultural and political French context of the first intelligence test has been object of a systematic historical research (Carson, 2006; Chapuis, 1998; Cicciola, 2008; 2009; Foschi & Cicciola, 2006). Nevertheless the year of Binet and Simon's test was also a key year for Italian psychology. At the Fifth International Congress of Psychology of 1905 in Rome Sante De Sanctis (1862-1935) and Alfred Binet (1857-1911), in collaboration with Théodore Simon (1873-1960), introduced their intelligence tests to the scientific community of the time. During the same year the first number of the Rivista di Psicologia was issued and the first academic tenures of experimental psychology were established in Rome, Turin and Naples. The temporary coincidence goes even further as in the same year also the Pedagogical schools for the professional training for primary schools teachers were founded and the first "standardized" intelligence tests presented.
Sante De Sanctis' intelligence test and Binet's test were in some aspects different. In particular the De Sanctis' one was constructed on the basis of differential psychophysical research and aimed, primarily, to explore and detect abnormal children. Binet's first version of the test shared the aim of identifying abnormal children but using different tasks. De Sanctis and his co-workers compared both tests and used them in child asylums and special training schools.
This communication is aimed to explore how the intelligence testing was introduced into the Italian and Roman context.

History of Psychological Measurement in Russia and USSR. Some Specificities in the Local Context at the Beginning of the 20th Century

Irène Léopoldoff-Martin Section des sciences de l'éducation,
Didactiques des langues,
Université de Genève,
SWITZERLAND

The rising of the experimental research at the turn of the 19th century is mostly focused on new objective methods and the same interest is shared by scholars in Russia like in Europe and USA. Some specificities will appear in Russia and then, in USSR after the 1st and last International Paedological Congress taking place in Brussels in 1911. The Brussels's Congress brought together scientists from different disciplines like medicine, pedagogy and psychology. At the time where bounderies between sciences were not clearly established, all of them were on the way to investigate in the same new field: the Child and his/her development.
Until early 1920s, there were no systematic differences between what occurred on the international scene with scholars like Stern, Claparède, Binet, Meumann or Hall to quote only some of them and Russian scientists; they were all in close relation. The experimental adventure in the domain of measurement in Russia starts with the personalities like Netchajeff, Bechterev, Rossolimo, Bernstein and Lange. A central place is given to the qualitative and quantitative exploration of the child's potential. Rossolimo creates his own tests, a typology called "Method of psychological profiles", which is known and used by scholars from abroad. In USSR, the psychological and pedagogical streams allow the paedological science to have its own scientific way and use the new techniques of measurement to spread around, until being forbidden in 1936.
One of the main reasons for this decision, and it is still an interpretation nowadays, was the pretended abusive way to use the testing. Our contribution will present the specific reasons why the Soviet Union developed some methods and tried to get massive testing done published in the journal Peadologija and Vygotsky's specific point of view on the matter.

New Problems and New Solutions for Modern Education in the Twentieth Century: Abnormality and Intelligence

Mónica Balltondre Facultat de Psicologia,
Jaume García Tora Universitat Autònoma de Barcelona,
SPAIN

Towards the end of the 19th century it became clear that modern pedagogy should no longer be based on blind instruction of contents and a disciplining of mind and body, but was asked to adequate the teaching to the child's own needs and development. But to do this it is necessary to know scientifically what are the child's own needs and development. Slogans like "pedagogy should enter the laboratory" we can hear from Spanish pedagogues like de Barbens expressed this idea.
In relation to this, the problem of "abnormality" was constructed at that time in the frontier area between the mental healthy and mental ill was essential. Once the necessity to select and treat abnormal children becomes clear, a desperate search for an objective, efficient, simple, precise and standardized measurement takes place that could offer universal results. Binet and Simon were not the only ones developing strategies and techniques for this purpose. During the first decade of the 20th century several methods were already present on the market and were used. Some Spanish pedagogues like Domingo Barnés and Anselmo González were eager to know about these contributions, although they sometimes had different expectations and criteria. The appropriation of measurement techniques in order to determine and unravel intelligence grades opened a potential space for intervention for physicians, psychologists, and pedagogues. In the following competition a re-negotiation of professional delimitations took place. In this paper we take a look on how these issues came up and were dealt with in the Spanish context.

S25 Scientific and Technological Evolution of the Gas Industry

Coordinated by **Joan Carles Alayo Manubens (Universitat Politècnica de Catalunya, Spain)**
Mercedes Arroyo Huguet (Universitat de Barcelona, Spain)
Francesc X. Barca Salom (Universitat Politècnica de Catalunya, Spain)
Chaired by **Mercedes Arroyo Huguet (Universitat de Barcelona, Spain)**
Ana Cardoso de Matos (University of Évora, Portugal)
Francesc X. Barca Salom (Universitat Politècnica de Catalunya, Spain)

Since its origins in the beginnings of XIX century, gas lighting has been a mixture of science and technology. Initially through wood and coal distillation, gas technology was progressively established in different cities.
Because gas technology has been overlooked, we propose to redress the balance by highlighting the work of technicians and promoters of gas installations in cities. In this regard, it is worth noting that Barcelona was the first town in the Iberian Peninsula to adopt gas lighting.
It should also be pointed out that the technological advances that gave rise to the use of other fuels, i.e. petroleum derivatives, are closely related to our understanding of organic chemistry in the XX century. Attention will also be focused on issues such us the introduction and utilization of natural gas. Despite having roots going back many centuries, the technology has been used in the last decades to promote prospecting, extraction and transport of natural gas.
Another subject of interest is the introduction of gas in towns not only from the point of view of individualized studies but also from a comparative standpoint. We seek to highlight issues such as the degree of the implementation of gas technology in an urban environment, the entrepreneurial attitude that gave rise to the urban morphologies, and the impact of law on the development of the gas industry in different countries.
The symposium will discuss the different phases of gas production and distribution in towns. However, it is not easy to find towns where this technology is still in use. Gas installations currently constitute an important part of the universal cultural heritage because many of them had been constructed by prestigious engineers and architects.

Possible subjects for discussion:

Thus the symposium will highlight the historical development of the gas industry, discussing the technological changes of its development and tracing the evolution of gas applications. It will focus on the uneven development of gas introduction in different countries, and will deal with the economic repercussions not only on the gas industry but also on the area in which this technology was installed.

The symposium will focus on five issues:

1.- The internal evolution of gas technology from production to distribution.
2.- The development of gas networks from the technical and geographical standpoints and the comparison with other networks of energy and communication. Attention will also be given to the rationale for the different networks (electricity, railways, etc.)
3.- The evolution of gas applications from gas lighting, domestic applications, heating and thermal and industrial applications to current processes of cogeneration.
4.- The economic repercussions of the introduction of gas installations in different European towns.
5.- The conservation of the heritage of the gas industry that in its time constituted an important technical innovation.

Searching for a Pattern in the History of Gas in Italy from the First 19th Century Experiences until the Big Multiutilities of Nowadays

Andrea Giuntini University of Modena and Reggio Emilia, ITALY

The task to draw an overall history of the gas in Italy industry is not particularly difficult (A. Giuntini, Une croissance sans modèle? L'industrie du gaz en Italie à travers l'analyse de quelques cas urbains, in L'industrie du gaz en Europe aux XIXe et XXe siècles. L'innovation entre marchés privés et collectivités publiques, dir. S. Paquier et J.-P. Williot, Bruxelles, Peter Lang, 2005). A good historiography supports such an effort. Some specific milestones, moments and certain stages can clearly be focused, as it happen for the most part of similar European examples. In particular, the paper will take into account the intriguing linkages between private and public hand, the municipal role, the relationship between gas and modernization. But a more detailed view shows a very broad propagation of individual experiences, from major cities to the minor ones: several stories which are all belonging to the Italian context, but so different each other. Finding out a single homogeneous context is not possible. For may extents we are obliged to deny the existence of a common pattern of the growth of the gas industry in Italy, at least until the discovery of large quantities of natural gas in the early 1950s of the 20th century. Then, things are developing at the time of the change from industrial production to distribution. This ultimately seems to be the most visible core of the question. Notwithstanding some technical and economic standards are protagonists of the long history of gas between XIXth and XXth centuries in Italy. The paper will put into evidence these issues, trying to underline also some quantitative evidences. Finally it will approach the current role of multiutilities in the Italian economy.

Switzerland at the Heart of Europan Technological Circulations in Gas Lighting in the 19th Century

Serge Paquier University of Saint-Etienne,
FRANCE

By adopting gas lihgting in the 1840 and 1850 years, swiss cities belong to the second wawe of diffusion after the prime movers in English, French and Belgian towns. Thus the swiss case shows analogies with many German, Spanish, Italian, Austrian and Scandinavian towns. The new technology diffuses from the West to the East of the country. A first generation of plant adopted distillation of coal (Berne -1843; Geneva-1844, Lausanne-1848). During the 1850 years a second generation of plant (Basle, Zurich, Lucerne) choosed carbonisation of wood under the impulsion given by a German technician. It is a clear demonstration of how the diffusion of new technologies can integrate the local and regional ressources in energy. After the introduction of the railways, at the end of the 1850'years, all gas networks converted to coal. As it is important not to depend of foreign importations for a country which is based on independancy, Swiss technologies using imported coal must work with the minimum of coal and a maximum of efficiency.
This particular context open business opportunities in international markets for high level engineers inspirated by science and linked with the financial network of the Haute banque protestante. A Genevan holding created in 1861 (capital of ten millions of francs) control positions in France (Marseille, Cannes), Germany (Stuttgart) and Italian (Bologne, Naples) towns. As recent researches show it, this Genevan expansion is linked with Belgian and French business men in gas and railway industries. I will also analyse the clear relationship between gas an other urban infrastructures (water adduction since 1860 and electricity since 1880).

Urban Networks of Gas and Electricity in Portugal: Competition and Collaboration (1850-1920)

Ana Cardoso de Matos CIDEHUS,
University of Évora,
PORTUGAL

In the last decades of the 19th century, although the decision to create urban infrastructures for gas was one of the responsibilities of local councils, the concession for gas distribution was granted to private enterprise right from the very beginning. In an attempt to attract private capital, the concessions granted by the municipal councils were for long-lasting periods of time, in order to permit the recovering of the fixed capital investment. Thus, in the beginning of the 20Th century, the introduction of electricity was hampered by the extended contracts established by councils with the Gas Companies to supply gas for public lighting. This situation explains that electricity was often introduced earlier in cities which weren't district capitals and didn't have gas lighting.
In some Portuguese cities the exploitation of gas and electricity was held in a system of competition by different companies. In others, however, the same company had the exploitation of both gas and electricity distribution for public lighting and private consumption. In these cases the company searched for parallel markets for each one of these energy sources and tried to diversified the gas applications
This study will trace the diffusion of gas urban networks in Portugal in comparison with those of electricity and it will analyze also the situations of competition or cooperation in the creation and exploitation of gas and electricity networks.

The Adoption of New Technologies by Spanish Gasworks

Francesc X. Barca Salom Universitat Politècnica de Catalunya,
Joan Carles Alayo Manubens SPAIN

The technology of gas production for public lighting and domestic and industrial uses has become obsolete. The replacement of coal gas by natural gas resulted in the abandonment of distillation and physical and chemical depuration technologies in favour of extraction and distribution processes.
The production of coal gas contains the germ of renewal because of the need for frequent changes due to the deterioration of retorts. As a result, iron retorts were replaced by ceramic ones. Their position changed from being horizontal, tilted, and finally vertical. In order to boost production, the retorts were enlarged before being replaced by chambers. Another change in coal gas production concerns heating, i.e. by coke or tar combustion or by gas producer. Subsequently, new methods were introduced in order to obtain town gas by means of mixing blue water gas and carburetted water gas with coal gas. The decade of the 1960s marked a trend towards a new technology of gas production: cracked gas. This process replaced coal by oil as a raw material, giving rise to a cleaner and more chemical system of production.
This paper provides a preliminary approach to the evolution of technologies of gas production at fifty gas works in Spain. To this end, an attempt is made to gather dispersed and heterogeneous information in order shed light on the evolution of technological change in the cities where this took place.

The Development of Cooking with Gas: Scientific, Technical and Commercial Factors in France, 19th-20th Centuries

Jean-Pierre Williot Université François Rabelais, Tours, FRANCE

The development of cooking with gas from the 1880s onwards is explained by numerous scientific, technical, and commercial factors. It was only in the late 19th century that the use of gas as an energy source for cooking made progress. Improvements in the knowledge of the physics and chemistry of gas together with better control of the calorific value of gas-produced flames decided gas appliance manufacturers to offer cookers which were both more comprehensive in the variety of their functions and more efficient. However, it was only the adoption of the thermostat during the 1930s that made it possible to put onto the domestic appliance market gas cookers which combined all the necessary functions – burners, a rotisserie (roasting spit), and an oven. The gas companies played a dual role in this innovation process. On the one hand they encouraged gas cooker manufacturers to make their equipment more efficient, passing on to them knowledge based on the results of research on flames and combustion that some companies were carrying out in their laboratories, whilst on the other hand they organised very comprehensive forms of commercial propaganda in order to attract ever-increasing numbers of customers. Cookery lessons, during which a theoretical and scientific presentation was given, demonstrations of gas cookers, and showrooms all played their part in helping to mobilise consumer attention. From the selling to a large local authority of a rotisserie-equipped gas oven which enabled several dozens of meals to be cooked in a day to the housewife who had to be convinced of the advantages of cooking with gas – with recipes to prove it, the entire strategy of an industrial network can be analysed. This study shows that the innovation of cooking with gas, developed in France from the 1880s to the 1960s, is at the intersection of scientific knowledge, technical inventiveness, and an energetic commercial attitude.

The Gas Natural Foundations's Museum of Gas. The only Centre in Spain Devoted to Preserving, Disseminating and Studying the Heritage of Gas

Maria Marín Gelabert Fundación Gas Natural, SPAIN

The origins of the Gas Natural Group date back to 1843 with the founding of the Sociedad Catalana para el Alumbrado de Gas. In 1912 the merger of its electricity subsidiary gave it a new name, Catalana de Gas y Electricidad, S.A. Following the sale of its last remaining electricity shares in 1987, it adopted the title Catalana de Gas, S.A. and in 1992 was involved in a take-over merger of Gas Madrid, S.A., becoming known as Gas Natural SDG, S.A. Finally, the take-over merger of Unión Fenosa in 2009 led to the Gas Natural Group that we know today.
Documentation created during the company's 167 years of existence added to items inherited following the purchase of other companies form an invaluable living witness to our long history. In parallel, the library of books brought together and used to create and modernise the company's factories is a source of technological information that makes this much more that just a company archive.
From our long-standing interest in preserving our "papers" came the idea of creating a historical archive to ensure that this documentation would be properly organised, classified and restored. In 1987, the Historical Research Project was launched, which will greatly assist research projects into the gas industry.
1992 saw the founding of the Gas Natural Foundation. One of its current lines of action is the sponsoring of cultural activities that help to preserve and disseminate the historical heritage of the gas sector. Through its Gas History Centre, it maintains, classifies and catalogues the company's Historical Archive. Comprising 53 funds and 3 collections, the archive occupies nearly three linear metres and has almost 68,000 individual records, 11,248 of which belong to its photographic collection. One of the aims of the Gas History Centre is to encourage original research and educational projects that will recover the historical elements of the sector. How the gas industry grew, its involvement in civic life, and technological advances in Spain, with particular emphasis on the people and places that have played a part in creating the world we live in today.
In 2006, Gas Natural's Board of Directors and the Foundation's Sponsorship Board agreed to set up the Museum of Gas project. This museum will bring together the Historical Archive and the company's collection of historical pieces containing over 3000 objects, and will work in tandem with the Gas History Centre. Its permanent and temporary exhibition rooms will display the history of gas with a brief overview of electricity, extending to the hybridisation of natural gas with new energies, and future developments. The complex will also house the Foundation's central offices and services.

Domestic Accidents and Improvements of Gas Infrastructures Safety in the Middle 20th Century

Mercedes Arroyo Huguet Universitat de Barcelona, SPAIN

The well known dangers of fire and explosion were important disadvantages of coal gas use, principally when its utilization was generalized in the domestic space. Sometimes, the accidents motivated by the inadequate utilization of coal gas were consequence in several cases of customer's negligence and in other cases, it were the result of damages in the distribution infrastructures.
In order to minimize these dangers, the gas companies made several efforts to introduce safety measures in the external and internal fields of domestic utilizations of gas.
The managers of the gas enterprise Catalana de Gas y Electricidad were very conscious of these circumstances and in order to solve the dangers, were elaborated numerous statistics on the causes of the accidents originated by coal gas use. The company also took care to know the opinions inserted in the media as well as what happened about these questions in other countries.
In our intervention we will offer, firstly, some references on the economic and industrial context of Barcelona in the years 1950-60. Secondly, we will present several statistics of gas consumption in these years and, related to these subjects, we will show the efforts of the gas company in order to diminish the adverse effects of the erroneous use of coal gas.

The Production and Consumption of Gas in Málaga (1854-2009)

Mercedes Fernández-Paradas Universidad de Málaga
SPAIN

The present work studies the evolution undergone in the production and consumption of gas in Malaga from 1854 -the year of the inauguration of public lighting - to the present day. To this end I have brought together the relevant statistics and analysis of the information, relating it to those factors which have conditioned the development of this activity, namely: the technology used, the business aspect, the spread of electricity and butane gas, the socio-economic structure of the city and the size of its population. The case of Malaga is particularly interesting due to the fact that it was, and still is, one of the largest urban areas in Spain -81.000 inhabitants in 1860 and 566.000 at present- in addition, it underwent a notable industrialisation process from the mid-eighteen-eighties to the nineteen-twenties.

KEY WORDS: Gas industry, Malaga, Production, Consumption, Technology.

Common Channels to Introducing the Technology of Gas in Catalan Towns, during the 2nd Half of 19th Century

Florentí Moyano Jimènez Doctor of History, Universitat Rovira i Virgili, and
Gas Natural,
SPAIN

The case that I've studied with more precision is Reus. The bourgeoisie of this catalanish town looked with keenly all that happened in Barcelone, the most cosmopolitan and important city of Spain. At the same time, Barcelone looked to the north's cities of Europe, specially London and Paris, because it would be on the same level of modernity that them, by gaining the last technologic innovations who could increase his quality of life.
About the gas industry, Barcelona created their first infrastructures three decades after London and two decades after Paris. How Barcelone , the bourgeoisie of Reus had the control of the industry, the trade and the municipal government and therefore they could decide the future of the town. Ten years later, in 1854, the gas industry was installed in Reus. The catalanish bourgeoisie kept nexus between them and they created a channel to technologic knowledge of developed countries.
This communication try to establish this common channels to introducing the technology of gas in the catalanish towns and I take the case of Reus like a example, because at that time it was the 2nd catalanish town in economic and demographic importance. In the beginning, the technologic communications conducted to England and France. England exported technology, technicians and soft coal. France only exported technology and technicians. But also, both countries exported business initiatives. It was a communication channel with only one sense.

S26 The World Exhibitions and the Display of Science, Technology and Culture: Moving Boundaries.

Coordinated by **Ana Cardoso de Matos (Universidade de Évora, Portugal)**
Christiane Demeulenaere-Douyere (Archives Nationales - Paris, France)
Maria Helena Souto (IADE - Instituto de Arte e Design, Portugal)
Chaired by **Irina Gouzevitch (Centre Maurice Halbwachs, France)**
Paulo Simões Rodrigues (Universidade de Évora, Portugal)
Christiane Demeulenaere-Douyere (Archives Nationales - Paris, France)

Since the first World Exhibition that was held in London in 1851, this kind of great events have been essential to present development trends in human civilization and to the progress in science, technology and in different industry branches. Here, countries displayed and publicized their scientific and technological advances and visitors passed on information and reproduced knowledge in their fatherland. They also offered an opportunity for each nation to showcase its innovations in the fine arts. Besides that, governments appointed committees to study the technological progress of other countries. These studies and their reports, as well as the acquisition of machines, models and collections of artifacts, which could serve as models for contemporary craftsmen and manufacturers, as well as a support to industrial schools, were the paramount for the transfer of technology.
The purpose of our Symposium is to studied the circulation and globalization of the scientific, technician or artistic knowledge and the internationalization of the economy and the technology transfer stimulated by the World Exhibitions, whit the contributes of several experts.

Greece at the Paris Universal Exhibition of 1878

Konstantinos Chatzis (1) (1) Université Paris-Est 'LATTS' UMR CNRS 8134, FRANCE
Georgia Mavrogonatou (2) (2) National Technical University of Athens, GREECE

During the 19th century, nations were built in a transnational arena. Indeed, they were forged against a backdrop of many sorts of circulation (of people, ideas, institutions and artifacts). They were also constructed, at least in part, by comparing themselves to one another. Technological achievements were an essential part of the comparison process.
The continuous involvement of the Greek state in the Universal Exhibitions during the second half of the 19th century provides a good illustration of these two above-mentioned processes (circulation and comparison) that participated in the forging of modern nations.
Officially established as an independent state in 1832, Greece, according to the view of its various elite, was destined to be modern and to be part of the advanced West. By steadily participating in the Universal Exhibitions, the Greek state tried, on the one hand, to be acquainted with the technological 'weapons' it needed for its modernization, and, on the other hand, to inform (and be compared with) the industrialized countries about the 'progress' the young state had accomplished since its foundation.
This lecture focuses on the participation of Greece in the Universal Exhibition that was held in Paris in 1878. Compared with the involvement of the Greek state in the previous world's fairs, this participation was very rich regarding exhibits' at the Exhibition of 1851, Greece was represented by 36 exhibitors only; at Paris, they were more than 530' and carefully prepared. Several reports were, in fact, produced, before and after the event, by state engineers and other high civil servants such as Emmanuel Manitakis (Director of the Department of Public Works within the Ministry of Interior for the period 1848-1867) and Alexandros Mansolas (Director of the Bureau of Statistics during the 1864-1882 period). In our study of Greece's participation in Paris Universal Exposition of 1878, a special attention will be given to the various documents produced for and generated by the Greek state's involvement in this event.

An Approach to Science and Engineering in the International Exhibition of Barcelona (1929)

Antoni Roca-Rosell Dep. Matemàtica Aplicada I,
Centre de Recerca per a la Història de la Tècnica,
Universitat Politècnica de Catalunya,
SPAIN

The International Exhibition of Barcelona that took place in 1929 was initially proposed in 1913. The first idea was to devote the exhibition to the electrical industries. The planned date was 1917, but the outbreak of the World War made this plan impossible. Nevertheless, the works for a general International Exhibition began soon.
At that time, Catalonia, as the rest of Spain, was in an interesting process for developing an actual system of science and technology. From 1923, there was a dictatorship in Spain, but scientists and engineers decided to participate in the Exhibition, that was seen as a national objective, situated over the daily political struggle.

Portugal and the 1876 South Kensington Instrument Exhibition

Vitor Bonifácio (1) (1) Departamento de Física,
Isabel Malaquias (1,2) (2) CIDTFF,
Universidade de Aveiro,
PORTUGAL

Exhibitions were a privileged forum for different countries either to confirm or to improve their international standing. Simultaneously they also provided an overview of different nations development levels. In particular, they contrasted the leaders artistic, scientific and technological achievements with those of lesser industrialised nations. Portugal in the 19h century belonged to the latter as recognised by the country elite. In 1875 the Committee of Council on Education approved an exhibition of "apparatus for teaching and for investigation, but also such as possessed historic interest ". Although the event was not a World Exhibition due to its different rules as the organisers carefully pointed out it was to be international to allow "those interested in education an opportunity of seeing what was being done by other countries". Portugal was invited to participate. In this presentation we will analyse the Portuguese response and try to understand the reasons behind the national lacklustre participation - two small instruments were sent to London and two individuals, a University professor and a scientist were commissioned to go to the exhibition and report to the government. The possible effects of the country's lack of national instrument makers, scientific research, low industrialisation and simultaneous occurrence of the 1876 Philadelphia Centennial International Exhibition will also be discussed.

The Universal and International Exhibitions, Paris, 1855-1937: a 'Passerelle' to the Non-European Cultures

Christiane Demeulenaere-Douyere Archives nationales
CDHTE-Cnam, Paris,
FRANCE

The universal and international exhibitions were not only celebrations of trade and technology. They have focused the attention of nations around the world who wished to participate and through their presence and their pavilions allowed millions of visitors to discover distant horizons and exotic countries… Moreover, the obligation to have economic profits from these events led the organizers to increase the "attractions" that would appeal the public and attract numerous visitors. By doing that the exhibitions became magnificent «machines à rêver» [« dream machines »].
Many conditions were gathered to make the fact "expositionnaire" [« expository »] part of the process of "revelation" of non-European cultures: public taste influenced by Orientalism, the need to promote the French colonial empire, the development of anthropology and ethnology that became recognized as scientific disciplines... The exhibitions have played an increase role for this "revelation".
But, is also by participating in these exhibitions that some remote and closed countries, open to the exterior world in the last years of the 19th century, as the ones of the Far East (Japan, Korea, Cambodia, China), were able to advertise their culture and their artistic productions. These countries were also able to have a lasting influence in Western art («japonisme»).
Moments of shared history between the West and the exotic worlds, the exhibitions have contributed to the Western notion of the world and of the other, even if that vision appears to us very marked by its time and very "European-centred". But, world exhibitions were also occasions of mutual discovery and sharing cultures, especially in the artistic plan. World exhibitions were "gateways" for the cultures that had a strong influence on the western art movements.

Circulating Objects, Knowledge and Identities: Colonial India on Display in European and in Indian Exhibitions (1850-1950)

Filipa Lowndes Vicente ISC,
Universidade de Lisboa,
PORTUGAL

In the second half of the 19th century and the first half of the 20th century, India was a colonial space, be it for Great Britain, be it for Portugal or France. By analyzing the different representations of India within the international exhibitions held in Europe during this period we will necessarily be dealing with issues of colonial powers and practices. However, we will also explore another aspect – the role of Indians themselves within these visual representations organized by the colonizers within Europe. This Indian agency within the display of India – in the Portuguese territory of Goa or in British India – necessarily comes to enrich the debate on exhibitions as places for identity formation, hierarchies between nations, and knowledge on the making.

The 19th Century World's Exhibitions and Their Photographic Memories. Between Historicism, Exoticism and Innovation in Architecture

Maria Helena Souto (1) (1) Unidcom/IADE and Escola das Artes/UCP, Lisbon,
Ana Cardoso de Matos (2) (2) CIDEHUS/University of Évora,
PORTUGAL

The series of World Exhibitions that occurred in the second half of the 19th century was essential to the dissemination and popularization of technical advances. In 1867, Paris materialized a new exhibition mode in this type of contests, the National Pavilions. On a whole the pavilions were designed following models of national architecture likely to be easily recognized abroad. The Portuguese Pavilions also give an image of wealth and exoticism, associable to the mythical times of glory of former Portuguese Empire. The World Exhibitions also provided an opportunity for revisiting the past while testing new technologies. Photography, one of the novelties, played a precise and fundamental role right from the beginning: it recorded not only the exhibition as a whole but also the objects on display with a view to publishing the official catalogues.
Our talk will be basically focus on the analysis if the following sources: a) the photographic documents of Portuguese pavilions in 1867, 1878, 1889 and 1900 World Exhibitions, kept at Biblioteca da Ajuda and the Biblioteca Nacional de Portugal b) the photographs taken by Paz dos Reis at the 1900 Fair.

The Counter-Revolution of Progress. Chicago's 1893 World's Columbian Exposition and the Cultural Uses of Science and Technology

Robert H. Kargon Department of History of Science and Technology
The Johns Hopkins University,
USA

For historian Henry Adams the World's Columbian Exposition of 1893, " was the first expression of American thought as a unity; one must start there." America had made a fateful choice between the older, simpler industrial and agricultural system, and in his words the new "capitalistic, centralizing and mechanical" order. The new power elite encompassed not only the finance, commerce, manufacturing, transportation, and distribution of goods, but also the cultural framework within which the new order operated. This paper traces the social and cultural impact of the Exposition's representation of science and technology in America and elsewhere after 1893.

The Science of Architecture. Representations of the Portuguese National Architecture in the 19th Century World Exhibitions: Archetypes, Models and Images

Paulo Simões Rodrigues CHAIA (Centro de História da Arte e Investigação Artística),
Universidade de Évora,
PORTUGAL

To show how in the second half of the 19th century, influenced by the positivist philosophy, the architectonic theory and culture established a determinisc connexion between the historic and territorial specificities of the nations and the formal singularities of the national architectures: a building was seen as a biological structure created by the specific social, moral and physical characteristics of a given environment. This connexion led to the recognition of the national architectonic archetypes in the monuments of the past and allowed to explain scientifically the formation of those archetypes. The world exhibitions were privileged displays for the affirmation and advertisement of these national architectonic archetypes. Portugal did it by sending photo albums and models of its more representative historic monuments to the major world exhibitions.

Inventing a Modern Paris. The Dynamic Relationship between Expositions, Urban Development and Museums

Miriam R. Levin Department of History,
Case Western Reserve University Cleveland, Ohio,
USA

Between 1855 and 1900, Paris was the site of five major expositions. These temporary agglomerations of stuff not only served to showcase scientific and technological innovations. They were stimuli to the embedding of science and technology in the fabric of modern life on a long-term basis. Their construction not only altered the development of the cities infrastructure, put helped through the design and content of scitific and technologically based exhibits to restructure time and space. This paper will explore some of the ways in which this dynamic played out in the Parisian context, focusing on the expositions of 1889 and 1900.

S27 Making Sense of the Aurora: The Northern Light in Scientific and Cultural-Political Contexts

Coordinated by **Robert Marc Friedman (University of Oslo, Norway)**
Chaired by **Robert Marc Friedman (University of Oslo, Norway)**

The aurora borealis has status in the history of science as one of the "great enigmas". In the eighteenth century and well into the twentieth century, scholars strove to explain the nature and cause of the aurora. Why and how investigators attempted to make sense of this perplexing natural phenomenon entails a number of historiographic perspectives involving circulation of ideas, laboratory techniques, visual and narrative resources, and field practices. Circulation occurred not only among different national and disciplinary communities, but also between professionals and amateurs as well as between native Arctic peoples and 'civilised' travellers to the far north.
A central dilemma facing those who sought to understand the northern light entailed constituting the aurora as an object that could be consensually depicted, analyzed, and theorized. Especially before the advent of photographic resources during the 1900s, investigators needed to stabilize this fleeting, ever changing phenomenon, which is only occasionally visible outside of high-northern latitudes. Disciplined observational practices, artistic renditions, textual strategies, and laboratory simulations were all recruited in efforts to bring the northern light into scientific discourse.
The history of studying the aurora also offers insight into cultural-political processes of transforming nature into a resource for regional or national science. The aurora became a research subject for which investigators in the Nordic countries could claim a privileged position because of their geographic proximity to the phenomenon. Yet, others, from mid-latitude centres of learning, developed their own strategies for making competitive authoritative claims about the aurora. More generally, authority to make claims about the aurora depended upon rhetoric strategies drawing upon laboratory and field observations.

The Discovery of the Aurora's Effect on the Magnetic Needle. A Case Study on the Creation of Scientific Authority in Mid 18th-Century Sweden

Sven Widmalm Linköping University,
SWEDEN

During the Enlightenment period research on the Aurora Borealis had a special status in the scientific culture in Sweden. It belonged to a cluster of topics that were considered of special national importance as they seemed to demand that research was conducted in the far north and that such work was therefore a special obligation for Sweden (including, in this period, Finland). Other such topics were cold research, research on the Nordic flora and fauna, and geodetic measurements associated with the question of the "figure of the earth. In short there was a notion that certain topics were peculiarly "patriotic"; scientists lobbied for government support using this rhetoric; it may even be said to have constituted the basis for a kind of research policy.
In the 1740s Anders Celsius established the first modern observatory in Sweden, at Uppsala University. There he and above all his collaborator Olof Hiorter conducted an extensive series of observations on the magnetic needle that led to an important discovery, namely that the Aurora has magnetic properties. This was hailed, by Swedish scientists, as one of the few substantial discoveries in the area at the time and a great example of the fruitfulness of the patriotic programme. Despite the fact that Hiorter actually made discovery it was attributer (by Hiorter and others) to Celsius, who had passed away when it was published.
The paper will analyze the case of this discovery, including its attribution, in the context of Swedish university politics and scientific culture in the mid 18th century.

The Role of the Societas Meteorologica Palatina of Mannheim in the History of Northern Lights Research

Per Pippin Aspaas University of Tromsø,
Truls Lynne Hansen NORWAY

The Societas Meteorologica Palatina of Mannheim (1780-95) is known for its ambitious effort to co-ordinate meteorological observations across national boundaries and to publish them in standardised form. Identical instruments and instructions were dispatched to societies of learning (as well as some individuals) across Europe and beyond. The resulting sets of data were published in the Ephemerides Societatis Meteorologicae Palatinae, 1781-92. Although the Societas has been studied by historians of meteorology, its contribution to understanding the northern light has received much less attention. The Ephemerides' data provide an interesting case of a relatively early effort to use coordinated field observations as part of the long history of efforts to 'stabilise' the aurora as an object for scientific inquiry.
In the Ephemerides we find day-to-day observations of the weather from each station, along with a separate section: 'Meteora'. In this column observations of the 'AB' (Aurora Borealis) are frequently found. With hindsight from present understanding it is possible to analyse different observers' conception of the aurora and to cross-check observations against each other. Are we entitled to speak of 'the' eighteenth-century concept of the aurora, or were there several notions of this fleeting phenomenon in circulation? Our preliminary study suggests that the latter was the case. Stations in the North of Europe, where the aurora are a regular and familiar phenomenon, report observations that seem to make sense statistically and qualitatively with what might be expected. Stations such as those in southern Germany or even Italy reported far too many annual observations based on the probable frequency of occurrence (taking into account sunspot cycles). Furthermore, 'observations' of the aurora were recorded during overcast weather or even during the middle of the day. What did the observers actually see or think they saw? How were the recorded observations analysed and understood?

Science or Wonder? Popularizing the Aurora in the late 19th Century German-Speaking Regions

Ulrike Spring University of Tromsø,
NORWAY

By the mid-19th century scientific expeditions to the Arctic and tourist travel to the sub-Arctic North-Norwegian coast had generated greater interest among reading publics around Europe in the natural world of the far North. Increasingly German-language Central Europe embraced these topics and eventually generated substantial scientific and popular cultural focus on, among other phenomena, the aurora. Although neither scientists nor general public in these regions had regular access to the aurora, they developed highly active cultures of research and popular science writing related to this phenomenon.
The paper will discuss how knowledge of the aurora was constituted in popular scientific texts and images in the second half of the 19th-century in German-speaking regions. The aurora was at that time still a scientific enigma, though on the verge of being scientifically explained. The paper argues that it is precisely in this time of ambivalence that an analysis of practices of producing and circulating scientific knowledge about the North and, in particular the aurora, is productive. One focus will be on the epistemological changes that appear when scientific knowledge is circulated in a popularized form.
The historical context is the period beginning in the late 1860s, when interest in research of the polar regions in the German-speaking countries began in earnest, and ending with the years following the first International Polar Year (IPY) of 1882-83. Carl Weyprecht, polar explorer and initiator of the IPY, and his fellow explorer Julius Payer, contributed extensively to the popularization of the aurora and the polar regions in the German-speaking regions. The paper will take as its starting point the reception of the German and Austro-Hungarian polar expeditions and the preparations for the IPY in newspapers and semi-scientific journals. It will specifically focus on the appropriation of the aurora in these articles and reports.

Making the Aurora Norwegian: Cultural-politics of the Northern Light, ca. 1900

Robert Marc Friedman Institute for Archaeology, Conservation and History,
University of Oslo,
NORWAY

It might seem at first glance that nothing could be more natural, based on geography, than Norwegians embracing the aurora borealis as part of national identity and for that matter also developing a major research tradition based on the study of this phenomenon. Yet, it was not until the very end of the nineteenth century that the northern light emerged prominently in national culture and science. Contingent cultural-politics rather than geography proved critical for this development. Fridtjof Nansen's polar exploits, directly and indirectly, resulted in this development.
In stimulating a polar path to national self-esteem and honour abroad, Nansen's expeditions (including his own visual and textual depictions of the aurora) prompted and made possible the start of sustained research on the northern light and of regarding the aurora as emblematic of national identity. The aurora was transformed from a regional to a national icon as Norway embraced polar component in identity and in its claims for a right to be regarded as a worthy member of fin-de-siècle 'civilised' Europe.
Inspired by Nansen and responding to a cultural-politics based on national honour, physicist Kristian Birkeland embraced Nansen's image and message to the nation: Birkeland sought to create a heroic, if not bombastic, auroral science aiming to assert international hegemony. The broader context helps explain both Birkeland's ability to amass resources to create a sustained research school as well as his choice of a mountain-top auroral observatory and subsequent Arctic fields stations. For Birkeland the scientific justification for these locations and a variety of field practices as well as theoretical assumptions were inextricably entangled with cultural-political concerns.

Between Astrophysics and Geophysics: the French Contributions to the Study of Auroras at the Beginning of the 20th Century

Stéphane Le Gars Centre François Viète, Nantes,
FRANCE

Atmospheric researches were initiated in France during the 1860's by the physician and astronomer Jules Janssen, who created for instance the expression "telluric lines" to name the terrestrial part of the solar spectrum. This work was continuated at the Meudon Observatory at the end of the 19th century, where Henri Deslandres inferred knowledge of atmospheric phenomena by means of mimetic experiments on cathode rays in vacuum tubes.
We will examine how these atmospheric researches were pursued at the beginning of the 20th century. First, we will detail the work of Charles Nordmann, who tried to make a link between auroras and radio waves emitted from the sun, and experimented at the top of the Mont Blanc to detect those waves. Afterwards, we'll examine the way by which the "French school of molecular diffusion", initiated by Jean Cabannes, a Charles Fabry's student, paid attention to the auroras. In the end, we will focus on the researches of Alexandre Dauvillier in cosmic physics, and his participation to the French expedition of the Second International Polar Year (1932-1933) at the Scoresby Sund, during which he ruined the hertzian and ultraviolet theories of auroras, and confirmed the spectroscopic results of Vegard.
In this way, we will point out the place auroras took in atmospheric lights researches in France (auroras, light of the night, sky, zodiacal light, …), the articulation between field observations and laboratory practices, the collaboration between French and Nordic physicians, and we will question the ways and meanings by which atmosphere was at all once an astrophysical and geophysical object.

S28 The Role of the History and Philosophy of Science and Technology for Analysis of Phenomenon of the Scientific and Technological Schools in the Modern Knowledge Society (World Context)

Coordinated by **Vitaly Gorokhov (Russian Academy of Sciences, Russia / Karlsruhe Institute of Technology, Germany)**

Chaired by **Vitaly Gorokhov (Russian Academy of Sciences, Russia / Karlsruhe Institute of Technology, Germany)**
Gotthard Bechmann (Karlsruhe Institute of Technology, Germany)
Alla Lytvynko (G.M. Dobrov Center for Scientific and Technological Potential and Science History Studies NAS, Kiev, Ukraine)
Lilia Ponomarenko (National Technical University of Ukraine, Kiev)

We offer next questions for discussion:
1. The role of the basic researches in the development of the new technologies. The moral responsibility of the scientists and engineers in the face of the general public.
2. Methodological explication of the concept and role of the scientific schools and "invisible colleagues" in the scientific community and for the scientific and technological development. The role of the scientific and technological policy and public opinion in the modern knowledge society.
3. The historical analysis of the scientific schools of the former USSR and the transformation of the classical scientific schools in the virtual research teams ("invisible colleagues") in the world scientific community and in the post soviet space (an example of the different countries: Armenia, Belarus, Moldova, Russian Federation, Ukraine as partner countries and Germany, USA, France, Lithuania as NATO countries).
4. Research university as a new form of the organization and self reproduction of the scientific research from the point of view of the emerging of new international scientific and technological schools
5. The role of the NGOs and in the of the scientific communication between scientists and engineers and general public for the development of the conscience of Peace and Security in the international public opinion

Features of Forming of Scientific Schools in the Area of Statistical Physics in Ukraine and Russia

Alla Lytvynko (1)
Vitaly Gorokhov (2)
(1) G.M. Dobrov Center for Scientific and Technological Potential and Science History Studies NAS, Kiev,
UKRAINE
(2) Institute of Philosophy of the Russian Academy of Sciences,
RUSSIA
Institute of Technology Assessment and Systems Analysis,
Karlsruhe Institute of Technology,
GERMANY

The scientific school is the example of the collective form of creativity. It can be defined as informal authoritative creative collective of different generations of scientists headed by the scientific leader, known in this field of knowledge, who have the same approach to the problems decision. The contribution to the area of statistical physics in Ukraine was made by the scientific school of academician N. Bogolyubov (which has arisen in Kiev, and had the further development in Moscow and Dubna), and by scientific schools of his followers. The beginning of large-scale researches in statistical physics in Ukraine was caused by coming out in 1946 of fundamental monograph of Bogoliubov "Problems of dynamic theory in statistical physics", where he proposed the idea about hierarchy of relaxation times in unbalanced processes and chain of equation for the distribution functions.
Bogolyubov's ideas in the field of statistical physics were developed by his followers in Ukraine, for example by academician D. Petrina, who worked in the field of the classical and quantum statistical mechanics, the quantum field theory. The academician I. Yukhnovsky and his scientific school of statistical physics in Lviv University and Institute of condensed matter physics have results in the sphere of phases transitions and critical phenomena, statistical theory of liquids, solutions and melts of electrolytes, metals and alloys, disordered systems. Another M. Bogoliubov pupil academician S. Peletminsky is the leader of statistical physics department of the National scientific center "Kharkiv institute of physics and technology" and the head of scientific school of statistical physics. S. Peletminsky received fundamental results concerning of methodology of statistical physics. He developed the M. Bogoliubov method of brief description in non equilibrium processes for the wide class of the macroscopic systems.
Bogolyubov came from evacuation to Moscow in 1943 and accepted a position in the Department of Theoretical Physics at the Moscow State University. From 1953 he became the Head of this Department. He was a founder and the first director of the BLTP and director of the JINR in the period 1966—1988. Bogoliubov Laboratory of Theoretical Physics (BLTP) is a part of the Joint Institute for Nuclear Research (JINR), an international centre of fundamental physics. The Laboratory functions as an independent institute carrying research into various fields of theoretical physics in close contact with the JINR experimental laboratories. This allows much room for interdisciplinary investigations and direct interaction between theorists and experimenters. The main lines of research at BLTP are quantum field theory and elementary particle physics, nuclear physics, condensed matter theory, and modern mathematical physics. This laboratory, where Bogolyubov worked for a long time, has traditionally been the home of the prominent Russian schools in quantum field theory, theoretical nuclear physics, statistical physics, and nonlinear mechanics.

Forming of Solid State Physics and Science in Mining Engineering: Aspects of Scientific Schools

Lilia Ponomarenko (1) (1) National Technical University of Ukraine,
Galina Gorokhova (2) Kiev Polytechnic Institute,
UKRAINE
(2) Institute of Philosophy of the Russian Academy of Sciences,
RUSSIA

Solid state is a physical state of matter characterized by stability of shape and character of the chaotic motion of atoms, which do small oscillations near the equilibrium positions. Section of Physics, studying solids is called solid-state physics and is subsection condensed matter physics. Formation of Solid State Physics in Ukraine is connected with the formation and development of theoretical schools of academicians S. Pekar and A. Davydov, as well as an experimental school of academician A. Prihot'ko. Thus, in 1946, Pekar created a model of the interaction of an electron with the crystal lattice and introduced quaziparticle polaron. In 1948, Davydov proved that the collective absorption of molecular crystals, which was discovered experimentally by A. Prihot'ko in 1946 - 1948, are A Frenkel's excitons. These results are fundamental in the Physics of Condensed Matter. Pekar Scientific School was formed in the late 40-th - early 50-th of XX century, on the basis of the theoretical department of the Institute of Physics of Ukrainian Academy of Sciences and chair of the Kiev University, and later at the Institute of Semiconductor Physics in Kiev. Davydov scientific School formed in the Institute of Physics and the Kiev University in the 50-th of XX century and later at the Institute of Theoretical Physics, Prihodko Scientific School - during 50-80-th years of XX century in the Institute of Physics NAS of Ukraine.
Solid State Physics played the very important role for the development of Science in Mining Engineering in the 1960s years. This science (Physical Engineering) came into being first of all as an applied sphere of the Solid State Physics. But in 1970-1980 Science in Mining Engineering is developed as engineering science with the systems orientation not only to the Solid State Physics but also to the chemistry, geology, mineralogy, petrography, mechanics of continua etc. Methods of the Science in Mining Engineering are similar to the Solid State Physics. Subject of the investigation of the Science in Mining Engineering (geological material, rock) is similar to the mining geology. But in the Science in Mining Engineering is very important to calculate also different ecological and economical aspects. That is all the Science in Mining Engineering is developed in the brunch of the Systems Engineering. Professor Vladimir V. Rzhevskii (1919–1992) was Academician since 29.12.1981 in Division of Geology, Geophysics and Geochemistry of the Academy of Sciences of the USSR and rector of the Moscow State Mining University (1962-1992). He was a head of the Scientific School in the Science in Mining Engineering in USSR.

The Historical Development of the Laser Technology as an Example of the Non Classical Engineering Science

Elena Gavrilina Moscow Bauman State Technological University,
RUSSIA

Laser is one of the important inventions of the ХХ century. The creation of laser brings to the development of the novel technological processes, new branches of industry and origin of the principle new mode of the communications, which are very important for the knowledge society. Representative is that in the ХХ century five Nobel prize for physics were given for laser investigation. Well-known that classical engineering sciences are closely connected with natural sciences (especially with physics). At the same time the engineering sciences have own methodology and own specific mode of the knowledge organization – technological or engineering theory. The development of the technological theory and practical applications of the laser technology were going parallel. But the technological theory in the laser technology is based on the non classical physics and can be regard self as the new type of the non classical technology. This is the history about non linear direction from the theoretical scientific knowledge to the technological applications and the important role of the scientific schools. (This report is prepared for the project 09-06-00042 "Technoscience in Knowledge Society" of the Russian Foundation of Basic Research)

Knowledge Society. The Penetration of Scientific Knowledge into Fundamental Areas of Life in Modern Society

Gotthard Bechmann Institute of Technology Assessment and Systems Analysis,
Karlsruhe Institute of Technology,
GERMANY

Many influential social theorists, who have tried to comprehend the unique features of modern society, have emphasized the role of knowledge in social transformations. The transformative power of knowledge, for example, figures prominently in the work of Adam Smith and even of Karl Marx. Most theories of modern society lack sufficient detail and scope in their conceptualisation of the "knowledge" supplied; the reasons for the demand for more and more knowledge; the ways in which knowledge is transferred; the rapidly expanding groups of individuals in society who, in one of many ways, live on knowledge; the many forms of knowledge which are considered pragmatically useful; and the various effects which knowledge may have on social relations. While we are unable to observe and describe future society, we might yet be able to observe what kind of structural change is taking place. We might be unable to position the event between before and after, but we are at least in the position to recognise in which respect the fundamental boundaries of existing societal structures are changing. This is precisely the goal being pursued by the theories of the information society. To this extent, they have a common underlying problem: tackling the issue of social change due to changed communication and interaction opportunities. There is as yet no integrative theory of the knowledge society, i. e., which summarizes all of the essential aspects addressed in the literature. The discussion of the theories of the knowledge society in this report attempts to provide a brief historical sketch of the theoretical investigations, at the same time aiming to focus systematically on those aspects of social development dealt with from the perspective of the information society.

Changing Map of Methaphysics and Perspectives of Research of Scientific and Technological Schools in the "Society of Knowledge"

Natalia Knekht Moscow Institute of Electronic Technology,
RUSSIA

Traditionally, methaphysics is considered as the science about overperceptional basics of being. One of its applications is reflection about basics of science. Historically changing forms of methaphysical conceptions are connected with revolutions in science (in mathematics and in foundations of natural sciences).
These changes may be reflected in the following items.
1. Re-evaluation of methaphysics problems was performed (loosing of belief in thesis about identity of being and thinking, loosing of truth of belief in applicability of thinking to knowledge about being through categories – critics of Kant, thesis about linguistic relativity of Vitgenstein).
2. Problem of substantion is solved in a new way: it is considered in context of various cultures – renessains, new Europe, modern, and, as a consequence – it is localized in special sciences. In the field of methaphysics there appears a problem of thinking of subject of being, proposed by Heidegger.
3. The man and his being in the world becomes the main object of investigations in methaphysics. It is characterized by "care", and it is connected with the fact that specific sciences and technologies become "human-like". This is reflected in rethinking about main categories of traditional philosophy and science. They focus on everyday human being. "Time" is connection with history, and also a structure of human life. Technical world is "second nature", an artificial media in which modern people live.
4. Modern conceptions of "non-substantial work" and ways of freewill including the man into the new forms of social mroduction are analyzed, when he becomes "self-entrepreneur".
5. Self-realization becomes the main job. The conflict is investigated between full instrumentalization of human abilities and their unrestricted prosperity (real knowledge, quick understanding, intuition, self-learnability, self-organization, developing language and imagination, discipline of excellence, improvisation, virtuosity, mimetism and creativeness).

Knowledge System in Crisis: Swedish Philosophy of Science and the Humanities Drift apart. A Late Modern History of the Concept of Scientific Objectivity

Victoria Höög Department of Philosophy and History of Science,
Lund University,
SWEDEN

This paper focuses on the concept of objectivity to illuminate the interdisciplinary negotiations between academic subjects in Sweden from the 1960 to the present. The concept of objectivity held a central theoretical space in almost all academic subjects in Sweden during the postwar period. A salient person in the discussion of the 1970s was Gunnar Myrdal who had focused on the relation between values and the social sciences since the 1930s. For Myrdal, value premises worked as a positive normative ideal. In An American Dilemma he referred to the American democratic "creed" as a substantial inspiring framework for progressive social change to solve American racism. In 1968 Gunnar Myrdal published Objectivity in Social Research. Values were presented as obstacles - yet possible to overcome if the researchers openly declared their valuations. Myrdal's book is one of the first examples of how the concept of objectivity became an engaging topic for debate in the academic circles during the 1970s. Myrdal's view fitted into the traditional view to represent science as a vocation – as Max Weber famously expressed it.
A suggestion is that the concept of objectivity functioned as a "prism" that upheld a shared academic public space between philosophy, the natural sciences, the humanities and the social sciences. Three factors – the dominance of the philosophy of science within philosophy, Gunnar Myrdal's lifelong interest in values and the new left movement's attack on the belief of an objective science – made the question of scientific objectivity to a public and scholarly issue for debate in Sweden and contributed to uphold a shared communicative space.
However, during the 1980s the discussion about objectivity went out of tune. New competing knowledge system emerged with hermeneutics, discourse theory, marxism and Thomas Kuhn's paradigm theory. They supplied the humanities with new theoretical tools and the vocabularies were drifting apart. As a result, a gap between analytic philosophy's quest for impartial truth vs. the humanities' and social sciences' defense for including history, values and local practices in the analysis emerged. The new generation of people in the humanities founded their own philosophies, and neglected the established analytic philosophy. However, in the last decade questions about objectivity have arisen anew, in medical research and climate science. That might indicate that a renewed scholarly public conversation between different academic topics will have space for an alerted philosophy of science.

Nanotechnoscience. Interrelation of the Basic Theories, Modern Experiment and Novel Technologies

Vitaly Gorokhov (1) (1) Institute of Technology Assessment and Systems Analysis,
Anatoly Sidorenko (2) Karlsruhe Institute of Technology,
GERMANY
(2) Institute of Electronic Engineering & Industrial Technologies,
Kishinev,
MOLDOVA

The case of nanotechnology is demonstrated rather the increasable role of the theoretical research for the development of the modern technologies, because in the nanotechnoscience the scientific experiment oft interflow with the engineering design and even with the nanofabfication. This is at the same time a new type of the gedankenexperiment with help of the computer simulation and a creation of the artificial nanoworld. But this experiment is the inseparable part of the modern theoretical investigation. At the same time many important physics research has only become possible because the technology for making nanostructures has become available.
These problems are discussed in the report an example of the investigation of the extinction and recovery of superconductivity by interference in superconductor/ferromagnet bilayers. In superconductor-ferromagnet metal (S/F) contacts the superconducting pairing wave function not only exponentially decays into the F metal, as in the superconductor/normal metal (S/N) proximity effect, but simultaneously oscillates. A variety of novel physical effects caused by these oscillations were theoretical predicted. Some of them have already been observed experimentally. In this work we report on the first observation of a double suppression of superconductivity in Nb/Cu1-xNix bilayers for increasing ferromagnetic layer thickness. In this example we can see that theoretical schemes represent a combination of abstract objects oriented, on the one hand, on the use of the corresponding mathematical apparatus, and, on the other, on the mental experiment, i.e. the design of possible experimental situations.

S29 Biographies of Spanish Scientists during the Franco Period

Coordinated by **Albert Presas i Puig (Max Planck Institute, Germany / Pompeu Fabra University, Spain)**
Chaired by **Albert Presas i Puig (Max Planck Institute, Germany / Pompeu Fabra University, Spain)**

This simposium proposal aims to analyse the role of Scientists in a dictatorship like the Franco regime. Thus, it would be a contribution to the current debate on the relationships between science, politics and social contexts. Likewise, it would incorporate itself into the discussion of the role attributed to individuals actors and cultural traditions in scientific and, ultimately, social development. It aims also to fill a gap in historical reflection on Spain, which little by little is beginning to review its most immediate past. In the intimate understanding of the autarchic state, the first period of the Franco regime believed in science and technology as the motor of economic and social development. A central role in economic and social development was given to scientists, and, with them, to the development of the forces of production. It is within this context that one must consider the efforts generated from the Spanish National Research Council (CSIC), the National Institute of Industry (INI), the Nuclear Energy Board (JEN), the National Institut for Aerospatial Technology (INTA), etc. Reflecting the structure of the dictatorial state, these institutions were often associated with individuals whose action strongly influence spanish science.
In this sense, the analysis of the actions of such individuals is exemplary in proving the characteristics of the conditions of research and political contextualisation of science in the Franco period. Starting from an analysis of the ways of working of such individuals, the symposium here will consider scientific organisation and planning, the analysis of scientific practices and policies, the study of institutions, and the prominent roles of certain figures, among other subjects.

Manuel Lora Tamayo (1904-2002). Chemistry and Power in Franco's Spain

Agustí Nieto-Galan Universitat Autònoma de Barcelona,
SPAIN

As far as its factual reconstruction is concerned, the role of chemistry in Franco's Spain has yet to be sufficiently explored by historians. There is still a lot to do in terms of prosopographies, institutions, and teaching and research practices. A brief look at the last chapter of Manuel Lora Tamayo's La investigación química española (1981) clearly shows the crucial importance of that prosopography and the enormous amount of historical research, which is still to be done. As a chemist-historian, Lora Tamayo contributed to the building of a historical account which mainly legitimised the status quo of the dictatorship in relation to the old times before the Spanish Civil War, in the so called the 'generación de plata'. His 'technocratic' position, often defending the supposed 'neutrality' of scientific enterprise, became a useful tool for the establishment of international relations, mainly with the anticommunist West Germany, and later with France and the US, in the context of the Cold War. The growth of the chemical industry and its multinational character from the 1960s onwards reinforced the alliance between the economic lobby of chemical entrepreneurs and the technocratic plans of the dictatorship.
But, Lora Tamayo was much more than a chemist-historian. He was one of the most prominent organic chemists and the Minister of Science and Education from 1962 to 1968, to later become president of the Consejo Superior de Investigaciones Científicas (CSIC) from 1967 to 1971. Together with a select group of Spanish chemists, he accommodated himself easily to the regime, and contributed actively to the academic reforms of the dictatorship. Benefiting from personal contacts abroad, which had begun in the 1920s and the 1930s, he contributed substantially to the internationalisation of the regime.
Through some relevant episodes of Lora Tamayo's biography, I will try to analyse the role of professional chemists during Franco's dictatorship.

Joan Antoni Subirana and Jaume Palau: the Early Years of Catalan Molecular Biology, 1958-1977

Xavier Calvó-Monreal Centre d'Història de la Ciència (CEHIC),
Universitat Autònoma de Barcelona (UAB),
SPAIN

During the 1960s, the Spanish Biochemistry and Molecular Biology received a decisive impulse for their development. A first generation of biochemists, trained abroad, had returned to Spain and sat up their own research groups mainly with the support from the Spanish Science Council (CSIC). A new generation, their young graduates, completed their training following the same strategy: postdoctoral stages in research centres in foreign countries.
This was the case of Jaume Palau and Joan Antoni Subirana. Trained as chemists, their postdoctoral stages abroad represented a change in their scientific interests, from physical chemistry to structural molecular biology, particularly the study of the nucleohistone. Both Palau and Subirana published their first papers during their postdoctoral training within the research groups in which they were working, Subirana with Paul Doty at Harvard, and Palau with John Butler in London. Their international legitimation allowed them to start a research group on nucleohistone structure studies, with the funding of the extramural program of the NIH.
The aim of my communication is to show the process by which they sat up their research groups in Barcelona and to stress the role played by individual actors and cultural traditions in scientific development. In this case study, it must be considered the efforts generated by the Spanish National Research Council (CSIC), which was instrumental in the set up of Palau and Subirana's research project in Barcelona. In this sense, the analysis of the actions of such individuals is exemplary in proving the characteristics of the conditions of research in the Franco period. As is stressed in the symposium proposal, this communication will also consider the scientific organisation and planning and the analyses of scientific practices.

Enrique Mendez and the Introduction of Protein Sequencing into Spanish Biomedicine: between the End of Franco and the Beginning of Democracy (1968-1998)

Miguel Garcia-Sancho Department of Science, Technology and Society,
Spanish National Research Council (CSIC),
SPAIN

My paper explores the introduction of protein sequencing techniques in Spain with the aim of setting a new perspective in the study of the development and circulation of biology between the 1970s and 90s. I focus on the trajectory of Enrique Méndez, who started his career in the late 60s at the Centro de Investigaciones Biológicas, the first Spanish centre in incorporating a laboratory of molecular biology. He then migrated to New York University and the Roche Institute, where he learnt protein sequencing in the context of investigations of antibody structure. Upon return to Madrid in the late 70s, he established a protein sequencing facility and engaged in collaborative projects at the Hospital Ramón y Cajal, a pioneer in combining research and clinical practice in Spain. At the end of his career, he shifted to the development of kits for the detection of gluten in food processed for celiacs.
Studying protein sequencing in a country which was not involved in its invention shows that the circulation of knowledge and techniques is not historically unproblematic. Protein sequencing was invented by Fred Sanger in the context of purely academic research during the first half of the 50s. However, Méndez learnt an alternative method and applied sequencing to medical problems in cooperation with the pharmaceutical industry. The spread of recombinant DNA during the 80s led protein sequencing and other biochemical techniques to be perceived as out of date. Méndez had to seek new horizons in food science and the development of gluten detection kits to be introduced in the emergent biotechnology market.

The Biography of the Spanish Mathematician Tomás Rodríguez Bachiller (1899-1980)

Mª Ángeles Martínez García Universidad de La Rioja,
Luis Español González Logroño,
SPAIN

We must consider to Rodríguez Bachiller as a mathematician because of his principal professional activity, but it also was an engineer with a minor job in the National Institute of Geography. In general, his intellectual interest was manifold, perhaps influenced by his family since his father worked in the diplomatic service and he was worn in Hong Kong.
Rodríguez Bachiller appeared in the Spanish science scene in 1923, when he was the student who wrote the report of Einstein's lectures in Madrid. He was awarded the PhD in mathematics in 1935, and at once he was full professor of mathematical analysis in the University of Madrid, just before the Spanish Civil War (1936-39). After the war, when Franco Dictatorship purges happened, he was disqualified from exerting public responsibilities. But in 1952 he became the director of the Mathematics Institute of the Spanish National Research Council (CSIC) until 1960.
As well as his teaching and investigative achievements it would also be interesting to recognise his activity as an translator of mathematical textbooks from several languages. It was very accomplished his promotion of the investigation in algebra and topology as branches of the abstract mathematic characterizing the modernity in the second third of 20th century.

Fighting Isolation: the Mathematician Norberto Cuesta Dutari

José M. Pacheco Departamento de Matemáticas,
Universidad de Las Plamas de Gran Canaria,
SPAIN

This presentation describes the fight against isolation in the life and mathematical work of the mathematician Norberto Cuesta Dutari (1907-1989) under the Franco regime. Though he was not close to the establishment and could not profit from a number of opportunities for personal and institutional promotion, he achieved a mathematical production of international quality. His creative papers –dating back to 1943- are still cited today in disparate fields like Descriptive Set Theory and applications in Decision Theory. His contribution to pure Mathematics was gathered in the book Matemática del Orden (1956), a common bibliography item in the field of Set Theory.
The isolation of Cuesta in small cities like Ávila, Segovia, and Salamanca was for him a lifelong concern. Although reasonably close to Madrid, where the regime structures resided, both physically and politically, isolation was not only a matter of geographical distances. He complained often about it a firm manner, but it is difficult to imagine his vital trajectory in places other than those. Isolation showed its face soon: Several attemps to occupy University chairs after he obtained his doctorate in 1943 failed, and it was only in 1957 when he was able to obtain one in Salamanca: He was fifty, therefore lagging some twenty years behind the younger "war generation". Two examples: Pedro Abellanas (b. 1914) and Francisco Botella (b. 1915) were appointed to Mathematics chairs in Madrid in their late twenties, although they had also obtained their doctorates just after the war.
In his continual struggle against isolation, Cuesta promoted a Mathematics degree in Salamanca: the first Math students entered that University in 1971, but times had changed and Cuesta and his ideas had little or no place in this creaure of his. Isolation won that last battle, but the beauty of some of his Mathematics remains.

José Otero Navascués (1907-1983), Science for a Regime

Albert Presas i Puig Max Planck Institute for the History of Science, GERMANY

In his seminal book Syntony and Spark. The Origins of Radio (1976), Hugh G. J. Aitken points out the need for individuals capable of acting in different subsystems of a technological systems, facilitating the dynamitation and the exchange of information. Aitken classifies this individuals as "hybrids", that is, individuals who have a mastery of different scenarios and the capability to generate networks of relations of technology, policy, and economics. One exemple is José María Otero Navascués (1907-1983), the strongman for the development of a scientific infrastructure of Spain during Francoism (1939-1975). Following the concept of "habitus" from Pierre Bourdieu and what I call the "historical space of action", I present the biography of Otero. The historical space of action to which Otero belonged, would be determined by his belonging to the Spanish conservative military technocrats formed in the 1920s and 30s within and which, as one of the sustainers of the Franco regime, would control the technological development of the country. Always with the support of Franco's regime to which he was a faithful servant, Otero determined, well into the 1960s, the scientific agenda in physics and of technology-related research. In a historical period and space of action without stabilised scientific traditions, as the Spain of the 1940s and 50s after the Civil war was, collective processes of innovation could find themselves more influenced by the actions of individuals than by traditions (sometimes reduced to a minimum or non-existent). This particularities facilitates the protagonism of individuals who have the necessary capability and support. The aim of this paper is to present Otero through the consideration of his specific historical space of action during the Fracoism and the Cold War periods, and his action creating the necessary networks for scientific development programs and strategies.

S30 Science and National Identity after 1945

Coordinated by **Oliver Hochadel (Universitat Autònoma de Barcelona, Spain)**
Chaired by **Oliver Hochadel (Universitat Autònoma de Barcelona, Spain)**

Science and nation have proven to be a valuable perspective in the history of science. Numerous studies have shown how closely nation building, national self-assertion and sometimes xenophobia go hand in
hand with scientific endeavors, in particular in the19th century and the first half of the 20th century. Yet there are comparatively few studies for the time period after 1945. And those studies mostly focus
on the period of the Cold War and militarily powerful countries. Yet what about "peripheral" countries that could not bask in the glory of landing on the moon or detonating atom bombs? Did science and
technology have any significance in the construction of their national identity at all? The supposition of this session is that they did indeed play an important role in the smaller and/or less powerful nations. To look at the cases of Spain and Israel, for example, might prove particularly illuminating in this respect in order to understand what was particular about these countries and the allegedly less nationalistically charged times after 1945.
The goal of the session would be to come up with a broader and more nuanced picture of this period that allows for comparisons between the different countries and maybe even aims at a typology. The contributions will address the following issues:
1. The popular science genre is not restricted by the "scholarly straightjacket" and might be thus more revealing.
2. Funding: Whether they like it or not many scientists are "nationalized" through their funding.
3. Symbols of national pride and identity: How are prehistoric bones, a spectacularly long bridge or a medical therapy "charged" with national identity?

Narratives Surrounding the Emergence and Immediate Aftermath of the Atomic Bomb

Maika Nakao University of Tokyo,
JAPAN

The dropping of the atomic bomb was the symbolic event for the Japanese people as they were defeated by Western countries in that particular aspect of science and technology. Nevertheless, scientific periodicals in the immediate postwar period heralded the development of the atomic bomb in the following glowing terms: "a magnificent chapter in the history of science" and "a dazzling enterprise in human scientific endeavours." Though it is important to note that these proclamations were uttered under the GHQ/SCAP press code, several scientists and intellectuals made similar remarks. How did they perceive the atomic bomb soon after its emergence? This paper investigates the Japanese physicists' and writers' perspectives on the atomic bomb soon after its first use. The emergence of the atomic bomb had a strong impact on the Japanese people, in particular among those physicists and writers who could foresee the development of atomic weaponry. Japan was one of the countries that was engaged in atomic weapons research during the Second World War. During the war, the Japanese media fostered the expectation that the development an atomic bomb as a super-weapon would decide the eventual outcome of the war. This paper focuses on such representative figures as Yoshio Nishina, the leader of Japanese nuclear weapons project, and Juza Unno, a science fiction writer who wrote about nuclear weapons during the Second World War. It examines the narratives both in published media and unpublished materials such as diaries, and seeks the complexity and the dynamics of the thinking behind these narratives. In the conclusion I discuss the impact and meaning of the atomic bomb in the context of nationalism by examining the relationship between scientific discourse and nationalistic discourse in the time leading up to, and during the immediate aftermath, of the defeat.

Making Nations outside Spain: The Republican Spanish Scientists in Latin America

Carlos Acosta Rizo CEHIC (Centre d'Història de la Ciència),
Universitat Autònoma de Barcelona, and
CRHT (Centre de Recerca per a la Història de la Tècnica),
Universitat Politècnica de Catalunya,
SPAIN

There is agreement to say Republican Spanish scientists (first third of the twentieth century) as the most important generation that Spain had until democracy. Most of them, exiled before and after the Civil War (1936-1939), have been representatives of one of the 'two nations' in which Spain was divided. These people embodied a form of scientific work that also revealed the social essence of a Spain that poverty-stricken needed to know its own territory looking for resources and trying to catch up with the rest of Europe. The Museo Nacional de Ciencias Naturales in Madrid (MNCN) flocked to the main Spanish naturalists around a way of doing science which, though closer to the French, quickly assimilated to other European schools. The Spanish scientists, most of them involved in politics, specialized and travelled by universities, museums and laboratories on the continent, thanks to the Junta para la Ampliación de Estudios, carried out joint work with foreign colleagues, have exposure and discussion forums, and created networks which, although highly centralized, in Madrid or Barcelona, began to generate a flow of knowledge.

The scattering caused by Franco's victory suddenly cut off this generation of scientists from the Peninsula and its institutions and slowed the momentum achieved thus far. In exile, these professionals and researchers became ambassadors of that Spain dismembered and kept the idea of a 'nation', often sowing the seed in even more peripheral countries such as Latin America.

Perhaps like no other place, in Latin American countries came to appreciate Republican Spain. This is the case of Colombia with the work of the geologist and paleontologist José Royo y Gómez (1896-1961), whose work enabled institutionalize geological research in a country in need of resources.

His work in Spain and Colombia is an example of the use of synergies that were established between politics and science, featuring individuals and institutions (both Colombian and foreign) to strengthen the idea of a resource-rich nation, especially through the Geological Museum of Colombia, an institution that was transplanted in the way of doing basic and applied geological research of MNCN, hence Republican Spain and thus Europe.

Scientific Congresses: Science and Nation Identity. Portugal in the mid-twentieth century

Mª Fátima Nunes CEHFCi – History and Philosophy of Science Research Unit,
M.Margaret Lopes Universidade de Évora,
PORTUGAL

The “Science and Nation” relationship is used as a basis for the analysis of the role played by scientific congresses (national and international events) during the dictatorship in Portugal and its colonial scientific strategy before and after 1950. The perception of nation and science is a useful conceptual framework for this presentation.

It is important to hold debates on the construction of scientific identities as cultural practices and to develop, within the context of the Portuguese New State, the perception of links between science and culture. A focus will be placed on the organization of some major congresses, such as the 3rd International Congress of History of Science (1934), and the cycle the Spanish and Portuguese Association towards the Science Progress, (e.g. 1942; 1950; 1956; 1958).

We intend to focus on:

1.The role played by members of the scientific community and scientific institutions in the construction and legitimacy of the idea of nation and nationalism during the mid-New State.

2.The scientific rhetoric about a «national science» that involved disciplines such as archaeology, colonial sciences, anthropology, geology and natural sciences. These areas of scientific knowledge were used to further the political and ideological interests of the State and its colonial empire and to encourage the contribution of scientists towards the modernization of society.

3.International and national congresses are privileged forums of analysis to show that the scientific, social and political dimension of scientific practices cannot be dissociated. In this sense the lists of participants, scientific commissions of referees, main speakers and members of opening and closing sessions, scientific and political authorities, sponsors and invited institutions need to be considered as part of the formulations of Science and Nation, even at international congresses….

Radio Astronomy in the Postwar Netherlands

Astrid Elbers Leiden University,
THE NETHERLANDS

In the first postwar decade, the new field of radio astronomy grew steadily in several countries, including Great Britain, the USA, Australia and the Netherlands. The instruments it used (radio telescopes) required a lot of funding. As radio astronomy originated from wartime radar research, and the first radio astronomers were mainly engineers and physicists trained in radar technology, military patronage and funding were self-evident. There were good reasons to fund radio astronomy during the Cold War. It was supposed to stimulate technological innovations that could be used for military purposes. Moreover, big science projects served national prestige. Especially in the USA, the ties between radio astronomy and the military were very strong throughout the 1940s and 1950s.
In my talk, I will analyse the funding of radio astronomy in the Netherlands. The Dutch situation differed strongly from the other countries. It has not been thoroughly studied yet. The Netherlands was the only country where radio astronomers were formally trained as astronomers, and where the research exclusively served astronomical goals. At first sight, there are no clear links with the military or with possible spin-offs. Nevertheless, the government and the Dutch Organisation for Pure Scientific Research (ZWO) provided a huge amount of their science budget for radio astronomy. The question is why – in an era of postwar recovery – they gave radio astronomy such a priority.

How an Anglo-American Methodology Took Root in France

Pierre Laszlo Ecole polytechnique, Palaiseau,
FRANCE
University of Liège,
BELGIUM

French organic chemistry had a strong nationalistic bend in the immediate aftermath to World War II. It continued to bask in the glow of the pre-World War I Nobel prize awarded jointly in 1912 to Victor Grignard and Paul Sabatier. In addition, the influence of the two mandarins then in power, Charles Prévost at the Sorbonne and Albert Kirrmann, a Dean in Strasbourg who would be called upon as vice-director at Ecole normale supérieure in Paris, saw to it that the only theory of organic reactions, admissible in the classroom and in the laboratory, was Prévost's. As Mary Jo Nye has shown, a wall was erected against penetration of the ideas of the British school of Ingold and Hughes. Mechanistic chemistry, as was being vigorously studied by the contemporary Anglo-American physical organic chemists, was persona non grata in France. Publication by Bianca Tchoubar, in 1960, of Les mécanismes réactionnels en chimie organique opened a breach. The irony was for Dr. Tchoubar, a militant member of the Communist Party and a lady of fierce opinions, to have become a propagandist for the Anglo-American school of mechanistic studies. Truth for her overruled political propaganda. Her little book was revolutionary in the French context of the times. Together with the GECO (Groupe d'étude de chimie organique) summer conferences pioneered by Guy Ourisson after his return from Harvard, it ushered in the new ideas.
This presentation, based on a study in-depth of Tchoubar's book, will include a portrait of this remarkable woman scientist. It will delve at some length on the renewal of French science initiated by De Gaulle's government after his return to power in 1958. The tension in the French scientific establishment of the 1960s reflected two opposed versions of nationalism, the one conservative, malthusian, inner-directed, the other forward-looking, eager for the recovery of national status, seeing a strong French science as a means for asserting national identity and independence from the two world power blocs.

Spanish Geneticists at the Fringe of the Medicine of the Future: Scientific, Public and Political Discourses

Matiana González-Silva Cente d'Historia de la Ciència,
Universitat Autònoma de Barcelona,
SPAIN

The Human Genome Project was by definition an international enterprise aimed at discovering the common genetic basis of the human genre. Alongside with the promises of bettering the individual health through novel diagnosis tools and genetic therapies, the universality of the human genome served as an important argument for promoting the value of this a branch of research in the media, depicting scientists as advocates against racism and promoters of equality among all human beings. In countries leading the HGP, such an image was crucial for guaranteeing long term funding and consolidating genomics as a leading scientific discipline.
The aim of this paper is to analyze how the human genome scientists were depicted in the press of a country like Spain, where there were almost no experts participating in HGP. On the one hand, the paper analyzes the coverage and public image of the two only Spanish scientists that appeared in the long list of names signing the publication of the human genome sequence in 2001. Roderic Guigó and Francesc Abril were responsible for the software that allowed visualizing all the genes in a single image, and recurrently appeared in the Spanish media as local heroes that had found their way to first hand experience in this scientific breakthrough. On the other hand, it focuses in the public depiction of local genetics in the context of international genetic enthusiasm, asking for more financial support and putting science in the centre of the political game. Finally, it also analyzes the debates on the origins of the alleged backwardness of Spanish science, renewing a long lasting discussion in a completely new setting.
The paper explores the tension between scientific localism and universalism in the increasingly globalized journalistic environment of the late Twentieth century, and in a crucial moment for the consolidation of biomedicine as one of the leading branches of Spanish contemporary science. It also deals with the shifting use that Spanish leaders made of science and the role that the media played in the increasing funding and prestige of Spanish scientists.

Bones Serving the Nation. The Hominid Fossils of Atapuerca and the New Beginning of Spanish History

Oliver Hochadel CEHIC,
Universitat Autònoma de Barcelona,
SPAIN

In 1994 a Spanish research team found in in Atapuerca, a Paleolithic site in Northern Spain hominid fossils that turned out to be more than 780.000 years old, making them the oldest in Europe. Three years later the researchers named a new species: Homo antecessor. In 2002 Spanish historian Fernando García de Cortázar chose for his Historia de España the subtitle De Atapuerca al euro. In his account Homo antecessor is the first man to roam "on Iberian soil".

How is it possible that within less than ten years Atapuerca turned from a practically unknown archeological site to the (however imaginary) starting point of Spanish history? I will argue that this did not happen "by itself". The sheer age of the fossil finds was not enough. The thesis of this paper is that the numerous and intense efforts of the researchers themselves to popularize their findings were crucial. These efforts were taken up by the Spanish media (as well as by museums and political actors) and strongly enhanced.

Numerous studies have shown how closely nation building and sometimes xenophobia go hand in hand with research into human prehistory. Yet with few exceptions they focus on the late 19th and the first half of the 20th century. The example of Atapuerca will show that the strong link between hominid fossils and national identity still exists in the 21st century. Yet the paper will also try to show that there are remarkable differences to the way fossils were appropriated before 1945. The national framing is far less aggressive and chauvinistic. Nowadays the goal is to become a UNESCO world heritage site rather than to create a patriotic shrine. The paper will try and use the case of Atapuerca to sketch this new form of "nationalism light".

S31 Historical Geophysical and Astronomical Data (H-GAD)

Coordinated by **José Vaquero (Universidad de Extremadura, Spain)**
Josep Batlló (Universidade de Lisboa, Portugal)
Chaired by **José Vaquero (Universidad de Extremadura, Spain)**
Josep Batlló (Universidade de Lisboa, Portugal)

On the last decades, scientific libraries and archives have been steadily transformed into centres of interest for astronomers, meteorologists and geophysicists. The origin of scientific data-set, the methodology used to record them, the contemporary scientific problems and the measurement precision are relevant information for the modern analysis of these data. We can highlight some recurrent topics as eclipse observations to determine the Earth rotation rate or solar diameter variations, early meteorological observations, historical descriptions of earthquakes, auroras, tsunamis, and other extreme events. Moreover, analysis of present key issues as climatic change or assessment of natural hazards depends on long well calibrated series of observations.
Epistemology and hermeneutics used for historical studies are, thus, tools for the modern analysis of such data as important as present leading theories and computational techniques. This field of "applied history" has been increasingly developing in the last years and specific issues that involve historians, scholars and scientist are rising.
This symposium will be an encounter point between historians of Science, astronomers, meteorologists and geophysicists interested in historical data and will treat of the gathering, selection, use and discussion of early astronomical, meteorological and geophysical data as well of all methodological issues involved on their analysis.

Warming, Plagues and Revolutions. Social Impacts of the Warming Process – the Case of Serbia

Aleksandar Petrovic Serbian Society of History of Science,
SERBIA

Paper examines records relevant for meteorology and climatology in chronicles written in the Serbian monasteries during XVIII and the very beginning of XIX century. Records of exceptionally warm and dry seasons are especially analyzed trying to get certain connections between them and social, political and epidemiological events. From this perspective present ideology of global warming is evaluated and its potential social impact analyzed.

BACCHUS: Temperature Reconstruction with Vine-Related Records from Original Historical Sources

E. Koch (1) (1) Zentralanstalt für Meteorologie und Geodynamik, Wien,
C. Hammerl (1) (2) Institute for Meteorology and Geophysics,
C. Maurer (2) Univ. Vienna,
T. Hammerl (1) AUSTRIA
E. Pokorny (1)

BACCHUS an interdisciplinary project between historians and climatologist deals with the period starting around 1500 up to now. Only original vine-related historical manuscript sources from the archive of the monastery Klosterneuburg, the municipal archive of Retz and the so called Wiener Bürgerspital Rechnungen are used in order to avoid mistakes arising from later transcriptions and editions.
Since grape harvest dates are intensely influenced by spring to (early) summer temperatures especially in a climatic border region for vine growing, we found highly significant correlation coefficients between single to multi monthly mean temperatures at Vienna - Hohe Warte and GHD. The overlapping period of instrumental temperature records starting in Vienna in 1775 and grape harvest dates enables a temperature reconstruction at a multi-monthly base back till the 16th century. We found warm decades in the 16th century, at the beginning of our series, which were as warm as the 1990s. Afterwards the mean May to July temperatures started to drop; the coldest decade of the record was from 1771 to 1780. A constant temperature increase for more than 30 years, as from the 1970s to the present, seems to be unprecedented during the last 470 years. But it also turned out that probably a change in viniculture took place in the last about 30years as the GHD of this period show remarkable differences of temperature sensitivity to the historical series.

Historical Earthquakes in Tyrol/Austria – from Original Historical Sources to Earthquake Parameters

Christa Hammerl Zentralanstalt für Meteorologie und Geodynamik, Wien,
AUSTRIA

In 2009 a project started, which serves to complete the Austrian Earthquake Catalogue for the Province of Tyrol. This region is one of the most seismic active areas of Austria.
In order to gain a better image in terms of seismic hazard, the project aimed at the investigation of the strongest earthquakes in Tyrol covering a time window from the 16th to the 19th century.
Mostly original sources e.g. from the archives of Tyrolean monasteries, the municipal archive of Innsbruck or from the library and archive of Tiroler Landesmuseum Ferdinandeum are used in order to avoid mistakes arising from later transcriptions or editions.
Some significant examples, showing the applied procedures, from different periods will be presented. The results of the project among others – the transliteration, the interpretation and the documentation of the original sources and the intensity estimation is shown.

Managing of Historical Seismograms for Modern Analysis. Problems and Methodological Approach

Josep Batlló Universidade de Lisboa,
PORTUGAL

Seismology is a modern science and its actual foundations were not properly defined prior to the sixties of the XX century. Also, in the field of seismology instruments play a key role in thinking about the Earth. For this reasons, study of the evolution of the seismic recording and theories is necessary to obtain the needed information from the recorded earthquakes.
But on dealing with old records for present research further problems arise. Previous recorded earthquakes were analyzed following diverse procedures now over seeded and we cannot obtain from them valuable information for our present studies unless those observations are reprocessed from its very beginning.
For this reason, to obtain the presently needed information from the recorded old earthquakes it is necessary to reanalyze the records from its very beginning and this implies to known how the old seismograms were recorded and, at the end, how seismology was done at that moment. For these reasons, study of the evolution of the instruments, the seismic recording and theories pervades the classical scholar research in history of science as becomes necessary for the analysis of the old records.
Here, some different topics related to seismographs preservation and restoration as well as to its implications on the study of the recorded seismograms will be presented.

Aurorae Observed from Iberian Peninsula during 18th Century: Auroral Silverman Minimum Revisited

José M. Vaquero Universidad de Extremadura,
SPAIN

The secular variation of the aurora was examined by S. M. Silverman (1992) who detected a previously unrecognized minimum about 1765 clearly evident in the data in addition to the well-known Spörer, Maunder, Dalton, and 1901-1913 solar minima. I present here a set of observations of the aurora borealis from Iberian Peninsula in the 18th century. Several sources have been used to make this compilation including systematic observations made by meteorologists, popular accounts (printed in booklets), and manuscripts. The number of annual auroras recorded is then compared with some indices of solar activity showing a very good level of consistency between all time series. Moreover, I have assessed the number of auroras observed taking into consideration the phase of the lunar cycle and the evolution of geomagnetic latitude of Iberia. The number of annual aurorae recorded in Iberia is also compared with auroral data published in other catalogues. In particular, a minimum in the number of aurorae recorded from Iberia appears around 1750 providing another view of Silverman Minimum.

History of Science and Climate Reconstruction in Portugal

Maria João Alcoforado (1) (1) Centre for Geographical Studies,
Maria Fátima Nunes (2) University of Lisbon,
(2) History and Philosophy of Science Research Unit,
University of Évora,
PORTUGAL

Historical climatology was not a privileged area of study in Portugal prior to the participation of a group of historians and geographers in the EU ADVICE Project (1996-98. Two periods were studied: The Late Maunder Minimum (LLM1675-1715) and the Early Instrumental Period (1780-1860). Different kinds of data were used for climate reconstruction in southern Portugal.
Institutional and individual documentary sources were used for the LLM and later on for the 18th century, as well as press releases. The records were based on extreme situations with socio-economic impacts and the indices indicate extreme events, rather than average values. Temperature and precipitation indices were derived using the methodology developed by Christian Pfister.The data collected led to the approach of climate history in terms of impact on public opinion and of the pressure on the State; it further led to the reconstruction of models of Social State intervention under a European perspective.
Instrumental meteorological observations started in Portugal during the 1780s. They were carried out by physicists and the military in contact with foreign Academy of Sciences. Instrumental data was collected from the records of Academy of Sciences, the press and several other publications.
The oral presentation will also focus on the outputs of the Advice project and on the ones later produced by the same team, including its participation in two recent studies. One is about the meteorological causes and the impacts of 18th century large storms; the memories of these occurrences is drawn from societies with different cultural and religious traditions . The other refers to temperature reconstruction for the past 500 years, in the countries to the North of the Mediterranean Sea.

Meteorological Instrumental Observations in Barcelona from Historical Documentary Sources. Data Collection and Statistical Treatment (1780-2010)

M. Barriendos (1) (1) Department of Modern History,
M. Prohom (2) University of Barcelona,
J. Via (1) (2) SMC (Meteorological Service of Catalonia),
M. Herrero (2) SPAIN

In a context of significant human-induced global change, studies in climatology have concentrated on two main lines of research: climate modelling to evaluate effects of forcing factors on next future climate, and reconstruction of climatic variability of recent past at high temporal resolution.
For this second objective, main activities focus on detection of proxy-data (i.e. ice-cores, dendrochronology, historical sources,…) and long instrumental records. Unfortunately, the majority of modern climatic series generated by Meteorological Services has a short temporal coverage (less than 120 years). As a result, to know about low frequency climatic/meteorological patterns, documentary sources have to be explored to extend climatic records back to 19th, 18th and 17th centuries.
The present work shows a coordinated effort of the Meteorological Service of Catalonia (SMC) and historians to identify historical sources all over Catalonia, containing meteorological information for period 1750-1950.
First overview show a good number of doctors, naturalists or scholars working on private institutions in different towns but coordinating efforts and methodologies. Historical archives of scientific academies and administrative institutions preserve documents where instrumental data and metadata collection and digitisation is in progress.
At present, main efforts have been centred in Barcelona, following a pre-conceived methodology:
1) Detection of documentary sources.
2) Evaluation of documentary sources distinguishing among metadata, instrumental records and other complementary information.
3) Scanning (or imaging) of documents to preserve a copy in original format.
4) Digitisation of instrumental data.
5) Statistical treatment to connect with modern data series.
Barcelona daily series for temperature, air pressure and precipitation since 1st January 1780 are now being evaluated for quality control and homogeneity (step 5), while daily records for wind direction, sky conditions, humidity and short scattered series are at step 3 and 4.

S32 Nuclear Physics after WWII

Coordinated by **Alexei Kojevnikov (University of British Columbia, Canada)**
Olival Freire (UFB, Brazil)
Christian Forstner (Friedrich-Schiller Universität, Jena, Germany)
Leonardo Gariboldi (Università degli Studi di Milano, Italy)

Chaired by **Leonardo Gariboldi (Università degli Studi di Milano, Italy)**
Christian Forstner (Friedrich-Schiller Universität, Jena, Germany)

Post-WWII nuclear physics represents an exceptional case for the historiography of modern science and technology, especially with regard to the problems of internationalism and the circulation of scientific and technological knowledge. The Cold War created regimes of national security, secrecy, and spy paranoia, with nuclear physics and technology at the top of the list of sensitive items. These political divisions interfered in unprecedented ways with, but at the same time could not entirely prevent the global circulation of nuclear science and technology between the two main political blocks, and also with neutral and third world countries, and within the emerging networks leading towards a unified Europe. The development of international collaborations in nuclear science transcended the existing political and ideological boundaries, as well as the cultural and disciplinary boundaries within physics itself. Post-war decades were also the time of continuous interactions between low-energy nuclear physics and high-energy, or elementary particles physics, and between theoretical and experimental investigations. Furthermore, the practical applications of nuclear physics affected other scientific disciplines, old and new. Apart from the manufacturing of nuclear weapons and nuclear power plants, nuclear physics provided new methods for medical research, the dating of archaeological and paleontological remains, the physical analysis of artistic works, and the tracking of chemical compounds in the environment. In order to analyze the international aspects of nuclear physics during the postwar period, the proposed symposium will bring together historians from various parts of the globe.

From Peaceful Atoms to an Unfinished Power Station: Nuclear Physics and its Application in Postwar Austria

Christian Forstner Institute for HSTM,
Friedrich-Schiller-University Jena,
GERMANY

The paper asks for the historical continuity of the Austrian nuclear programs energy programs in an international network of actors throughout political breaks with a strong focus on the development after WW II. Many Austrian physicists were engaged in the first Austrian attempt to establish nuclear energy after the annexation by Germany in the German Uranverein after 1941. This Austrian-German cooperation and therefore, the whole program, failed with the defeat of the German Reich and its allies. Nevertheless, the vague idea of energy production by nuclear fission was still apparent in Austria's postwar politics, but there was a great lack of money which prevented the development of a national nuclear energy program. This changed with the launch of the American Atoms for Peace program. In the course of this program, three research reactors were brought into service mainly with US-support and the aim of developing a nuclear energy program in Austria. The attempt resulted in the decision of the Austrian government under Chancellor Bruno Kreisky in 1971 to build a nuclear power plant near Zwentendorf in Lower Austria. However, this plant never went into operation. After it was finished in 1978, the Austrian people voted against the startup of the plant in a plebiscite with a slight majority of 50.47%. Finally in 1978, the third Austrian attempt to establish nuclear energy failed, and today, the idea of freedom from nuclear energy is a central part of the Austrian identity.

The 'Atoms for Peace' Program Paves the Way: Turkey's First Experience with a Nuclear Research Reactor

Kaan Ata Department of History of Science,
Faculty of Letters,
Istanbul University,
TURKEY

Turkey joined the Atoms for Peace program which aimed to use nuclear energy for peaceful purposes in 1955. It was the first country signing an agreement with USA within the frame of the program. As part of program, Turkey would establish a nuclear research reactor and the USA would provide the required knowledge, training and the fission products to build and activate the reactor. USA would also provide research facilities in American training centers to train Turkish scientists who will study nuclear energy.
In this context, an Atomic Energy Commission (AEC) was established affiliated with the Prime Ministry of the Turkish Republic in 1956. The Commission was assigned to carry on all nuclear activities at national level and to provide coordination at international level. Within the framework of the AEC's 'atomic reactor' project, a reactor of 1 MW named TR-1 was installed in agreement with American Machine Foundry between the years of 1959-1962. Çekmece Nuclear Research and Training Center (ÇNRTC) which embodied this reactor started the production of radioisotopes to be used in the industry, agriculture, medicine and scientific researches in 1962. To meet the need for radioisotopes, a second reactor of 5 MW named TR-2 was installed in the same building and pool in 1984.
This paper will deal with the following questions by exploring the role and the effect of ÇNRTC in the field of institutionalization of nuclear studies in Turkey: ÇNRTC, has worked for meeting Turkey's need for radioisotopes. Besides fulfilling this task, to what degree was ÇNRTC effective in researches and training activities in nuclear field? Did ÇNRTC contribute to production of nuclear technology? Did it realized effective collaborations with national and international institutions? To what extent did ÇNRTC provide the infrastructure facilities for researches that have been done in the universities? What was the role of ÇNRTC in training researchers and experts in the field of nuclear physics?

Entry of Spain to CERN during Francoism: Valencia's Role

Agustín Ceba Herrero (1) (1) Ph D. Student,
Jorge Velasco González(2) University of Valencia - IES Guillem Colom Casasnovas (Sóller)
(2) Instituto de Física Corpuscular,
Centro Mixto CSIC- Universitat de València,
SPAIN

First entry of Spain in CERN was in 1961. At that time, Spain was a dictatorship that started recovering economically from Spanish Civil War (1936-1939) consequences, which devastated the country.
There was only an experimental group in Nuclear and Elementary Particle Physics. It was directed by Professor Joaquín Catalá de Alemany. in Valencia. It started their activities in 1950 using the photographic emulsion technique. They established in few time a solid network with the main laboratories and Universities of Europe. The group institutionalized partially in 1958 with the creation of Centro de Física Fotocorpuscular in Valencia, funded mainly by Junta de Energía Nuclear. Whereas there wasn't a group in this discipline at the rest of Spain. First it was created in Madrid in Junta de Energía Nuclear in 1964.
The entry of Spain in CERN during francoism has been considered as a political issue more than a scientific one. Spain regime suffered from international political isolation until the half fifties. It was easier to participate in that kind of organizations than in others purely political. However, we can't forget the existence of this centre in Valencia, though its role was peripherical in the Spanish scientific agenda.
This paper tries to answer four questions. Which role played Valencia's centre in Spanish CERN entry? What consequences had entry in research: staff growth, research lines, travels and stays abroad, collaborations, publications, funding..? What relation had the centre with the Spanish Administration? And with Junta de Energía Nuclear's group?
For answering these questions we have looked into CERN Archives among other sources. To end with we must remember that Spain abandoned CERN in 1969, and it didn't return until 1983. Nevertheless, this abandonment would be an issue in another paper.

Keywords: CERN, Spain, Valencia, Catalá de Alemany

Isotope Landscapes and Labscapes in Portugal (1952-1962)

Júlia Gaspar Universidade de Lisboa,
PORTUGAL

Political events led to the appointment of Julio Palacios, professor at Madrid University and an experienced researcher in areas other than nuclear physics, as first director of the Center for Nuclear Physics Studies, and to the choice of its location at a university research hospital, away from the Faculty of Sciences of Lisbon, in 1952. In this site a laboratory was set where isotope applied research was conducted mainly by physicists.
The same year isotope research was also launched at the National Laboratory of Civil Engineering, in Lisbon, by Armando Gibert, ex-teaching assistant at the Faculty of Sciences of Lisbon, and a researcher with experience in nuclear physics. Together with new laboratory premises isotope work took place by the sea-side at the estuaries of the rivers Mondego and Tagus, and at Póvoa de Varzim harbour.
Location in a hospital influenced the lines of research of the Center for Nuclear Energy which included chemical manipulation inherent to isotope handling, cancer treatment, and physicians training. As for Gibert he concentrated on a specific topic – tracing sand movements with radioisotopes. Both groups contributed with papers to the International Conference on the Peaceful Uses of Atomic Energy, Geneva 1955, and published in a small number of foreign journals. However most of the work was addressed to a Portuguese audience through Revista da Faculdade de Ciências de Lisboa, in the case of the university group, and Laboratório Nacional de Engenharia Civil publications in the other case.
This talk uses a comparative approach to contrast different backgrounds, profiles and research agendas of two Portuguese research groups both embracing radioisotopes applications in various labscapes and landscapes settings.

American Influence in the Beginning of Nuclear Physics in Mexico

María de la Paz Ramos Lara Centro de Investigaciones Interdisciplinarias en Ciencias y HumanIdades,
Universidad Nacional Autónoma de México,
MÉXICO

In 1938 arrived to Mexico the expert in nuclear physics Marietta Blau (Austrian physicist), who worked at the Instituto Politécnico Nacional. However, she decided to moved to United States in 1944 without produce any incidence in the development of this field. Years later, several Mexican students returned to Mexico after finishing they doctoral studies in U.S. universities. Two of them promoted the nuclear physics at the University of Mexico. Marcos Moshinsky worked in theoretical nuclear physics while Nabor Carrillo promoted experimental nuclear physics acquiring equipment from U.S. companies.

Nuclear Emulsions, Cosmic Rays and the Brazilian Physics

Cassio Leite Vieira (1) (1) Instituto Ciência Hoje, Rio de Janeiro;
Antonio Augusto Passos Videira (2) (2) State University of Rio de Janeiro and
National Council for the Development of Scientific and Technological Research,
BRAZIL

In this paper, we describe and analyze the beginning and the use of the nuclear emulsions technique in Brazil for at least 50 years. Even though consistent researches in cosmic ray physics has been done in Brazil since the forties of the last century, the physicists in this country only began using this technique after Cesar Lattes' work in Bristol and Berkeley in 1947 and 1948, respectively. Despite the relative delay to introduce nuclear emulsions in this country (when compared to European countries, for instance), Brazilian scientists were quickly familiarized with it and adopted it not only in cosmic rays but also in nuclear physics. In these two domains, nuclear emulsions were employed until very recently. In our work, we will be concerned with the reasons of this longevity. In other words, why the nuclear emulsions technique were employed for so many years in Brazil, even after its vanishing in other physics researches centres in the world?

Nuclear and Subnuclear Physics in Italy in the Second Half of 20th Century

Luca Malagoli Department of Physics, Palermo (I)
History of Physics Group, Association for the teaching of Physics,
ITALY

Before World War II in Italy were active, principally, two departements knowing in all the world: Arcetri (near Florence) and Rome. The promulgation of racial laws (1938) and the worsening of the condition of work caused the departure of most of best know italian physicists.
During WWII the remaining part of ex Fermi's group took a very important decision for their future: to avoid war involvement, they leaved off the studies of nuclear physics. They preferred to move towards different field of research, in which the costs were staked for a Nation hard knocking from the war.
The years immidiatly after WWII were charaterized, in Italy, by a very difficult riorganization, also in the fields of physics. The work of recostruction of italian physics was realized by members of the two principal groups of research presented before the war. It's right to give attention, in particolar, to Amaldi (Fermi's group) and Bernardini (Arcetri's school); with they a large number of important physicists worked to get ahead to the rebuilding operations. The availability of some departments with a good level of research was foundamental to continue in the work of rebuililding, toghether with the help of a research institute, the INFN, placed over all the country.
In particle physics the italian contribution took place in the building of Frascati's Laboratory, where were estabilished an electrosynctrotron, a prototype for more generations of colliders, and the AdA's accelerator with its follower Adone; in the partecipation to CERN's building and in the building of laboratory in Legnaro, Catania and Gran Sasso.
The winning of Nobel Prize by Rubbia (1984) for the discovery of boson vector W± e Z0 represented the peak of italian contribution to particle physics. On theoretical aspect the principal results were the Puppi's triangle, the introduction of Cabibbo's angle and of the fourth quarks by Maiani (with Glashow and Iliopoulos).

S33 Writing the History of the Physical Sciences after 1945

Coordinated by **Xavier Roqué (Universitat Autònoma de Barcelona, Spain)**
Néstor Herran (Université de Strasbourg, France)
Chaired by **Sean F. Johnston (University of Glasgow, UK)**
John Krige (Georgia Institute of Technology, USA)
Dominique Pestre (Ecole des Hautes Etudes en Sciences Sociales, France)

This symposium builds upon the discussions prompted by the 2007 Strasbourg workshop "Writing the History of the Physical Sciences after 1945: state of the art, questions, and perspectives", from which it draws its title. It will also refer to last summer's symposium on “Physics and Cold War” held in Budapest as part the XXIII International Conference on the History of Science and Technology.
The Barcelona symposium would be focused on the history of physical sciences during the Cold War, exploring the main narratives about this historical period, the challenges and constraints regarding the availability of sources, and also the connections with other areas of history, from the history of technology to political, diplomatic, cultural or gender history. Besides presenting current researches, our aim is to discuss methodological approaches, problems and issues regarding our subject, and to engage in a debate about the ways a history of cold war physical sciences can be written or re-written.

The Physical Sciences in the Global Cold War

John Krige Georgia Institute of Technology,
USA

This paper will suggest that new insights can be gained by thinking of the history of the physical sciences from a transnational and global perspective that transcends the usual focus on national histories. To do this is to explore the dialectic between the determination to build a national capability, and the need to embed that agenda in a global framework. It is to engage with the dynamic of transnational flows of knowledge that are mostly state-sponsored and whose configuration is shaped by reasons of state. It is also to explore the effects of an international geography of scientific achievement and the related epistemic authority that accompanies it. In short it is to explore the implications of the preponderance of the knowledge/power nexus in the U.S. after 1945 on the evolution of the physical sciences elsewhere.

Monitoring Radioactivity in Cold War Europe

Néstor Herran Institut de Recherches Interdisciplinaires sur les Sciences et la Technologie (IRIST),
Université de Strasbourg,
FRANCE

The aim of this paper is to trace the extension of networks of radiological surveillance in Europe in the first decades of the Cold War, as a part of systems for the detection of nuclear tests or for monitoring radioactive fallout. In particular, it will focus on initiatives carried in nuclear research programmes in different European nations and collaborations with initiatives such as the Atomic Energy Detection System [AEDS], established by the U.S. Air Force in 1948 with the purpose discovering foreign atomic tests and other nuclear-weapons related activities.

“Good Vibrations”: Nuclear Surveillance during the Cold War

Simone Turchetti Centre for the History of Science,
Technology and Medicine (CHSTM),
University of Manchester,
UNITED KINGDOM

The 1963 Test Ban Treaty prompted nuclear powers to detect atomic tests through new integrated networks registering seismic events. As these events could be either earthquakes or nuclear explosions, it soon appeared that registering seismic waves was going to be fundamental for the future of nuclear politics and international diplomacy. But could the vibrations caused by atomic tests really be singled out? In this paper I seek to recount the history of these networks and their promoters, also shedding new light on how the political debate overlapped scientific enquiries on the nature and predictability of seismic events. This study is part of a broader investigation on the history of geophysics during the Cold War in the context of the project “The Earth Under Surveillance – TEUS”, which is sponsored by the European Research Council.

When France Put the Sun in the Cold War at Odeillo (1948–1991)

Pierre Teissier Centre François Viète,
Université de Nantes
FRANCE

In the late 1940s, a few chemists from the Centre national de la recherche scientifique (CNRS) helped by the Army settled several solar furnaces in the Vauban fortress of Odeillo, in the French Pyrenees. They used the concentration of sunrays to produce high temperatures (3,000°C) and study materials under extreme conditions of temperature and pressure. The Laboratory of Solar Energy became a worldwide famous test facility especially after the construction of the world biggest solar furnace in the 1960s. American and Soviet scientists, military experts and industrialists came to Odeillo to characterize strategic advanced materials.
Simultaneously, the Laboratory promoted "the sun in the service of mankind." This second research on solar housing was at the crossroads of imperialist logics (until the early 1960s and the independence of Northern African colonies) and development cooperation (UNESCO Arid Zone Research Programme). Odeillo's chemists and engineers built original passive solar devices to save energy (Trombe walls) and greenhouses to use brackish water for agriculture.
The case of Odeillo would have been interesting for only one of these two research programs. The test facility demonstrated how a group of pragmatic scholars took advantage of the intermediary position of France between USA and USSR, the "third path" advocated by Charles de Gaulle (troisième voie, 1958–1969), to pioneer the making of huge solar instruments and put the sun in the Cold War. The passive solar program exemplified the technological dream of the same scholars using their know-how to develop cheap devices for commonwealth. Odeillo is an historical puzzle because the same institution intertwined big with little sciences, warlike with peaceful achievements, economic hopes with green utopia, ideological competition with development cooperation. This paper analyzes how all these contradictions of Cold War were concentrated in a picturesque sunny spot in the mountains.

Membership to CERN and the European Scope of Spanish Physics

Xavier Roqué Centre d'Història de la Ciència (CEHIC),
Universitat Autònoma de Barcelona,
SPAIN

Having joined CERN (the European Organization for Nuclear Research) in 1961, Spain withdrew from it in 1968 mostly and officially because of mounting charges and low returns. Over the next 15 years Spanish high-energy physicists had to do without full access to Europe's major laboratory in the field. While withdrawal proved disastrous for experimental physicists, it may have had seemingly positive unintended effects on their theoretical counterparts, as a third of the money saved was directly allocated to a fledging local community of practioners —allowing them, paradoxically, to strenghten international relations.
I will build on joint work with Carles Gámez and the archive of physicist Pere Pascual to recount this story and reflect on its broader implications for the construction of European physics.

United States Nuclear Science Politics towards Latin America: A Mexican Case Study

Gisela Mateos Centro de Investigaciones Interdisciplinarias en Ciencias y Humanidades,
Universidad Nacional Autónoma de México,
MEXICO

After World War II the United States sponsored different programs for donating technological devices to different developing Countries for what they considered the improvement of Science. In particular money and technological devices were given to Nuclear Science in these Countries. The cost of the new laboratories that had to be implemented to host the new equipments were very high and local practices were transformed in order to receive these donations. In particular, in this paper I analyze the donation of the Atomic Energy Commission (AEC) to the National Autonomous University of Mexico's Physics Institute in 1963 of a new nuclear equipment designed and built by the Company Radiation Dynamic, Inc. It was a 3 MeV Dynamitron high current accelerator that have not been tested before; only three were made. As a donation the Mexican physicists built a new expensive laboratory with all the necessary devices designed and constructed at the Physics Institute. The accelerator was set in use in 1965 and very soon it began to have technical problems. After 7 years and with only one publication related to the accelerator, (it burned twice) the physicists disarmed the device and reused the parts that were in good shape. Nothing could be done with this dynamitron and it changed nuclear science local practices. I stress how this donation did not imply benefits for the nuclear science community and generated commitments of the Mexican physicists with the AEC.

Biography and Atomic Technoscientific Development in Postwar France

Matthew Adamson McDaniel College, Budapest,
HUNGARY

This paper considers the role of biography in the writing of the history of the physical sciences in the postwar, and in particular the history of technoscientific institutions. It focuses on radiochemist Bertrand Goldschmidt, who played an important role in determining the nature of the Commissariat à l'Energie Atomique's development despite the fact that he was not a policy maker. Rather, as a radiochemist who chanced to specialize in the chemistry of plutonium, he discovered several scientific and non-scientific means to encourage its production in France, and thus influence the general military orientation of the French nuclear program. Goldschmidt was a prolific memoirist and participant-historian, and a look at his writings reveals a noticeably supple view of the postwar nuclear world, despite the narrowness of his technical specialty and the nationalist orientation of the CEA. A similarly broad view is exhibited in the writings and interviews of Goldschmidt's fellow CEA chemist, Jules Guéron. However, for several reasons, Guéron's interests did not influence the CEA's development as did Goldschmidt's, and in fact Guéron left the CEA to become Euratom's first director of general research. This paper suggests that biographical studies incorporating oral histories alongside institutional archives can present a means for framing the development of postwar technoscientific institutions, and are interesting stories in and of themselves.

Bruno Touschek and the Birth of Electron-Position Collisions after World War II

Giulia Pancheri (1) (1) INFN (Istituto Nazionale di Fisica Nucleare),
Luisa Bonolis (2) Frascati National Laboratories,
(2) AIF History of Physics Group,
ITALY

Bruno Touschek, born in Vienna in 1921, graduated in physics in 1946 in Göttingen. Among his mentors there were leading scientists of pre-war physics, with whom he collaborated in maintaining alive scientific research during the war. In participating to the reconstruction of physics in Europe, he performed a crucial role in the development of post-war theoretical physics in Italy since mid 1950s. The experience established in participating with R.Wideröe to the building of the first European betatron in Hamburg during the war, and in collaborating to the designing and construction of a synchrotron in Glasgow during the late 1940s, as well as his deep knowledge of Electrodynamics, culminated in his proposal to construct a small storage ring for electrons and positrons. AdA, the first matter-antimatter collider built in 1960 in Frascati National Laboratories near Rome, showed that electron-positron colliders could compete with traditional proton machines, proved the feasibility of a new physics and opened the way to higher energy and luminosity. The road to matter-antimatter collisions started in pre-war ravaged Germany, culminated on November 11th, 1974, when the discovery of the J/Psi was simultaneously announced by B.Richter and S.Ting. It was confirmed three days later by ADONE, the Frascati Italian accelerator, and signalled the beginning of a new era in particle physics which eventually led to some of the most important discoveries of the Standard model. Archival material and documents, some of which were published only very recently, will be used to outline the road which led Touschek to propose the construction of AdA and, immediately after, ADONE. Touschek's subsequent work on infrared radiative corrections as needed to extract meaningful physics from high energy electron experiments and his contribution to educate a generation of theoretical physicists to the importance and technical proficiency in resumming light quanta, will be also described.

Who Discovered Quarks?

Martin Counihan University of Southampton,
UNITED KINGDOM

Quarks are fundamental to our present-day understanding of the microcosm and macrocosm. The devising of the quark model, its experimental confirmation, and its eventual integration into the "Standard Model" of elementary particles was one of the outstanding achievements of 20th-century physics.
It is surprising, therefore, that confusion has arisen about how quarks were actually "discovered", i.e. how experimental evidence led the scientific community to accept the real existence of quarks. A myth has emerged that the existence of quarks became accepted after 1968 primarily as a result of the deep inelastic electron-proton experiments at Stanford Linear Accelerator Center (SLAC) in California. This view was bolstered by the award of the Nobel Prize in 1990 to Friedman, Kendall and Taylor. The "SLAC myth" has been perpetuated in textbooks of physics, in Wikipedia, and elsewhere. However, the contemporary literature shows that the existence of quarks was widely accepted well before 1968, mainly because of data from hadron-hadron scattering experiments using bubble chambers at Brookhaven (New York) and CERN (Geneva). The continuing harvest of such data into the early 1970s rendered the quark model practically unassailable. The SLAC data, while providing valuable complementary evidence, was of secondary importance for establishing quarks in the minds of most scientists at the time.
Suggestions are made about how the "SLAC myth" arose. Philosophical, political and nationalistic factors were surely involved. No doubt there was a desire for SLAC to publicly justify its costs and to distinguish its findings from what had already been revealed elsewhere by the bubble-chamber technique. When a major scientific development has to be conveyed to the public in just a couple of sentences, oversimplification is hard to avoid and a misleading myth may easily be generated.

S34 Crossing Borders in Modern Physics

Coordinated by **Massimiliano Badino (Max Planck Institute for the History of Science, Germany)**
Chaired by **Massimiliano Badino (Max Planck Institute for the History of Science, Germany)**

The proposed symposium focuses upon examples of border-crossing in late nineteenth – early twentieth century physics. The deep revolutions that shook the foundations of classical physics in this period are the perfect place to look for episodes of cross-fertilization between different domains as well as cases of re-allocation and re-organization of the cognitive resources.
Recently, the concept of border has become a widely used historiographical tool. Indeed, historians of science have increasingly focused upon the local conditions of the production of knowledge and the importance of elucidating the emergence of scientific results on the basis of local resources. Another notable example of this tendency is the wave of disciplinary studies that aim at underscoring the process of self-definition of a discipline as a separate entity from other cognate fields of research.
On the other hand, science is famously a universal enterprise. Thus the analysis of what happens within the border must be pursued in parallel with the investigation of the rich and multifaceted process of dissemination and circulation of knowledge. For this reason, historians have developed a number of conceptual tools aiming at describing how local knowledge and technology progressively lose their specific characters and become universally shared. Notable examples are Susan Star's notion of 'boundary object' or Peter Galison's description of 'trading zones'.
In the dialectics between locality and border-crossing, the 'borders' must be understood in the broadest sense. There is the obvious meaning of geographical borders that are crossed by people or objects embodying specific skills or expertises. However one must not forget the disciplinary borders which divide actors belonging to different disciplinary backgrounds as well as subcommunities of experts which share the same fundamental platform. Finally, there are epistemic borders related to different ways of knowledge access, most notably theoretical and experimental approaches to the natural world.

From Identity to Indistinguishability

Enric Pérez Canals Universitat de Barcelona, SPAIN

It is widely accepted that the papers by Bose in 1924 and by Einstein in 1924-1925 definitely opened the path to the quantum concept of 'indistinguishability.' Since then, distinction in physics between 'identity' and 'indistinguishability' of particles has come to be required.
However, even before the rise of quantum physics, Maxwell, Boltzmann and Gibbs, among others, had to tackle the difficulties and paradoxes that appear when counting identical particles. Later, after Sackur's and Tetrode's first quantum derivation of the canonical partition function of an ideal gas, much confusion arose around its dependence on the number of molecules in the system. Many other physicists, such as Planck, Lorentz or Schrödinger took part in those debates. In 1921, Ehrenfest and Trkal devoted a whole paper to this subject. Clearly, in the days before Bose's seminal work, embroiling and misunderstanding were commonplace.
In considering the emergence of the distinction between 'identical' and 'indistinguishable' particles, we will go through the so-called statistical route to quantum mechanics. The first developments in statistical mechanics became immediately confused and entangled with the irruption of quantum physics. In the first quarter of the twentieth century the mutual influence between both disciplines was profuse.
We will pay special attention to the story of the so-called 'Gibbs Paradox.' We will argue that what is now often known by this name in some textbooks of statistical mechanics did not exist as such in those foundational days.

Gas-Radiation Analogies and the Mutation of Migrant Ideas

Daniela Monaldi York University, Toronto, CANADA

Historians of statistics have recognized the power of analogies as vehicles for the migration of statistical ideas across different disciplines during the nineteenth century. Likewise, the diffusion of statistical methods within physics in the early part of the twentieth century was driven by analogies between different physical systems. This paper examines the different kinds of analogies that were formulated between material gas and electromagnetic radiation, from the early quantum theory to the inception of quantum field theory, seeking to throw light on the resulting mutations of formal and physical models.

Transfer and Transformation of Physical Knowledge: A Crucial Case in the History of Superconductivity

Gianmarco Ieluzzi Department of General Chemistry and Organic Chemistry,
Luigi Cerruti University of Turin,
ITALY

The recent history of superconductivity is an interesting case of movement of scientific knowledge and technological innovation. In a landscape dominated by scientific experimental activism and theoretical curiosity of Bernd Matthias , who brought to the attention of the scientific community type A3B intermetallic compounds (with A = B = Nb and Sn, Si, Al), superconducting materials with critical temperature of 23 K, stands the important discovery of the Swiss A. Müller and G. Bednorz. Indeed in 1986 at the IBM in Rüschlikon they found that mixed oxides perovskitic were superconductors at 35 K. Their inspired idea came from reading an article written by the French C. Michel, B. Raveau and L-Er-Rakho on the resistivity presented by the oxide of metallic BaLaCu perovskitic structure at high temperatures. In about a year the discovery of the phenomenon of superconductivity in compounds Y1Ba2Cu3O7 at 98 K by Americans C.W. Chu and M.-K. Wu was also extraordinary because it made sufficient cooling with cheaper liquid nitrogen. The outlined cognitive situation, for our retrospective view, has several points of interest: first, Bednorz and Müller were not well know specialists in the field of superconductivity, secondly, the phenomena present in the mixed oxide was not provided by the BCS theory, thirdly in small workshops like Rüschlikon, laboratories that were not created as centers of excellence, became instead places to discover. Another remarkable feature is the progressive increase in the importance of chemical sciences and materials acquired in the field of superconductivity, at the expense of the centrality of physics. Additionally, it came to creating research teams composed of scientists from various disciplinary training, united by the same research purposes and witnesses of the cognitive complexity of work in progress and needs of science and technology working together. In this light it is understandable that the reality of extended labs has been cut and has taken more and more space. This network (extended labs) connected in fact the research laboratories, as research groups consisting of scientists from different disciplinary fields, with the economy, politics in the service of scientific development and economic development. The general framework in which this work was presented was well defined by the work of H. Nowotny and U. Felt (After the Breakthrough,Cambridge: Cambridge University Press, 1997) and J. Matricon and G. Waysand (The Cold Wars. A history of superconductivity, New Brunswick: Rutgers University Press, 2003 translated by the French La guerre du froid: Une historie de la supraconductivité, Paris: Editions du Seuil, 1994).

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Optics at the Crossroads: the Case of Optical Dispersion at the Turn of 20th Century

Marta Jordi Taltavull Max Planck Institute for History of Science,
GERMANY
University of Barcelona,
SPAIN

The aim of the talk is to analyze the exchange of knowledge among different domains -theoretical and experimental practises, various disciplinary areas- in the development of optical dispersion between late XIX and beginning of the XX century.
Optical dispersion is a physical phenomenon in which light splits in different colors when it passes through a medium. It played historically a prominent role in developing classical theories of optical phenomena in the XIX century. In the 1900s and 1910s, precise empirical results intertwined with the accepted theoretical account led to internal tensions within the classical framework, and also with the emerging quantum theory. These tensions were not solved until 1921, when the first quantum theory of optical dispersion paved the way towards the origin of matrix mechanics.
In this talk I will focus on the long-standing process of framing an adequate experiment for measuring optical dispersion, from 1872 to 1901. This process, together with contemporary theoretical insights, was essential for assimilating a very accurate classical physical picture of optical dispersion in the 1900s. The discovery of anomalous dispersion and the new theoretical explanations of the phenomenon developed in the 1870s required more precision in the measurements and larger variety of conditions. Interferometer was already widely used for precise optical measurements, but there was no experimental setup fulfilling all new requirements.
Eventually, such suitable experimental setup resulted from a sharing of ideas among astronomy, chemistry and optics in the 1890s, in relation to the search for an explanation of certain anomalous effects in the spectrum of sunlight. On the grounds of the new theoretical insights of optical dispersion and by trying to reproduce chemical conditions of the stars on earth, they developed a precise method, including the interferometer, for measuring the phenomenon under required conditions.

Across the Disciplinary Divide: Otto Sackur from Physical Chemistry to Quantum Physics and Back

Massimiliano Badino Max-Planck-Institut für Wissenschaftsgeschichte, GERMANY

Otto Sackur (1880-1914) was educated in Breslau under the thoughtful guide of Richard Abegg and, from the outset, showed a strong inclination to combine different theoretical approaches. An analysis of his lectures at the University of Breslau, starting from 1906, reveals a leaning toward theoretical thermodynamics, statistical mechanics and other highly formalized theories that was uncommon among the physical chemists. Thus, it comes as no surprise that, in 1912, he was one of the very first scholars to apply the new and exotic quantum hypothesis to a long-standing problem of physical chemistry: the measure of the chemical constants. The result, famously, was the Sackur-Tetrode equation, an expression for the entropy of a monoatomic gas in which the entropy constant was formulated in terms of Boltzmann's and Planck's constants.
This equation was of extraordinary importance for the application of quantum theory to the gas. For it relied upon a procedure of quantization of the phase space that generalized the classical approach, though the corresponding counting of the elementary states led to results inconsistent with the Boltzmannian statistical mechanics. The solution of these issues would require the introduction of a new statistics (Bose-Einstein statistics) that can be explained only in quantum mechanics.
But Sackur's work was important for physical chemistry as well. By his bold papers he showed that the physical chemist should not be afraid of using abstract concepts stemming from seemingly distant disciplines because the study of the properties of matter calls for an interdisciplinary approach. This paper will tell the story of Sackur's contributions to the development of quantum physics and physical chemistry.

"None of them know what it is worth doing". Quantum Theory in Cambridge

Jaume Navarro Max Planck Institute for the History of Science, GERMANY

The development of quantum physics and early quantum mechanics is a story that skips Cambridge and the British world. The first main English actor, Paul A. M. Dirac, appears on the quantum stage only in the second half of the decade of the 1920's. In the background, people like James Jeans, Ralph H. Fowler and Charles G. Darwin play only secondary roles in the grand narrative of quantum physics. However, these and other characters are instrumental to understand how the theory came and took roots in Cambridge. In a recent paper I have discussed the way in which C.G. Darwin understood and spread the new quantum mechanics as characteristic of a wrangler of the last generation (Stud. Hist. Phil. Mod. Phys., 2009).
Here, I want to contribute to the early history of quantum physics in Cambridge by paying attention to the pedagogical side of this story. In particular, I want to concentrate on two books written by a relatively unknown Cambridge don, George Birtwistle (1877-1929). This senior wrangler (1899) was fellow and teacher of mathematics at Pembroke College and lectured on quantum physics and quantum mechanics between 1924 and 1929, producing two books that compile his lectures. These two books reflect a number of interesting aspects: first, they help us understand one way a generation trained in the old wrangler tradition could understand and teach quantum theory; second, they characterise the contents that non-specialists in Cambridge received about the new physics; and third, they embody the tensions experienced by teachers and students of the quantum theory in a time when this was developing at high speed.

S35 Transfer and Transformation of Knowledge in the Modern Physical Sciences and Technologies

Coordinated by **Shaul Katzir (Max Planck Institute for the History of Science, Germany)**
Christian Joas (Max Planck Institute for the History of Science, Germany)
Chaired by **Christian Joas (Max Planck Institute for the History of Science, Germany)**
Shaul Katzir (Max Planck Institute for the History of Science, Germany)

It is well known that scientists and engineers often use knowledge that was developed in one field to solve problems in another. Going beyond this general truth, in this symposium we will explore in detail how, in several physical and engineering sciences, particular concepts, mathematical and experimental methods, theories, and practical and engineering "know-how" were transferred from one context of inquiry to another. The participants in this symposium focus on the detailed techniques and tools involved in transfers of knowledge from one realm of inquiry/practice to another. We mean to illuminate the ways in which intentions are sometimes transformed into unexpected and unintended consequences with far-reaching implications that shift research practices and even the shape of accepted knowledge. While such transformations more often affect the fields to which knowledge was 'transferred,' powerful shifts may occur through repercussion in the original field. Especially when concepts and techniques are transferred from one realm of inquiry to another, a specific approach or a technical trick may be taken up and spread but have an essentially different role and theoretical status, as was the case, for example, with the transfer of methods from high-energy physics into solid-state physics. On the other hand, we know from various studies that individuals working at the boundaries between two fields may act as transmitters of knowledge. The members of this panel also explore how figures who straddled the boundaries between physics and engineering employed scientific theories and know-how in technology and how efforts to improve technical devices led not only to engineering innovations but also to new physics. Finally, we study how particular novel computational methods and instruments may represent points of technical knowledge transfer and exchange, and thus provide impetus for wider alterations in the contours of knowledge shared between groups of investigators.

From the Phenomena to Useful Instruments and from Them to Other Phenomena

Shaul Katzir Max Planck Institute for the History of Science, GERMANY

The technological challenges posed by World War I led the major participating countries to mobilize scientists and engineers in new institutions designed to answer some of these challenges. Historians have examined the processes that led to the establishment these agencies, and the different contemporary views on the potential of science to achieve immediate technological needs. Yet, probably since the contribution of scientists to technological projects has since been so common, the question what enabled the contribution of scientists, as scientists, to technology is seldom examined. As I show in this talk, one thing that scientists bring along is knowledge of specific natural phenomena and their manipulation that is unknown beyond the circles of scientists; sometimes this knowledge is even restricted to the research of a small field or to the users of a particular method.
The detection of submarines, a major priority of the Entente powers, provides a good example for how the knowledge of piezoelectricity, which was almost exclusive to physicists, led to the application of the effect in what was later called the sonar. Moreover, the two physicists that independently applied the effect (in different ways), Rutherford and Langevin, had dealt with the effect previously. I trace the relation of both back to the use of a device designed by Pierre and Jacques Curie (the discoverers of piezoelectricity) in radioactivity research. Although Rutherford employed the device in a different way from the Curies, in applying the effect he was restricted by the possibilities of the particular device. Langevin employed his more thorough knowledge of piezoelectricity to design a piezoelectric oscillator suited for the technological needs. The oscillator, however, opened a few questions unexamined before. The technological research demanded an immediate study of some of these questions. Other questions led, after the war, to the discovery of the sharp electro-mechanical resonance of crystals, a hitherto unknown phenomenon, with interesting implications to science and technology.

Understanding Quantum Systems and Getting Numbers Out

Edward Jurkowitz Fritz-Haber-Institut der Max-Planck-Gesellschaft/ Max Planck Institute for History of Science, GERMANY

This paper presents an example of how knowledge transfer may occur through the transmission of methods and techniques. Examining how theorists used specific computational techniques both within the context of the old quantum theory and in the new quantum mechanics, and how those changed with the advent of new computing devices, I trace how computational approaches may play important roles in knowledge transfer. Studying John Clarke Slater's and Douglas Hartree's researches on atomic and molecular wavefunctions and the quantum-mechanical properties of solid-state systems during the 1920s and 1930s, the paper indicates that they acted as conduits for knowledge transfer between the physics community and related engineering and chemistry communities. Locating these researchers within the institutional contexts at MIT and Cambridge/Manchester, respectively, the paper highlights how their engagement with computational problems and with specific computing machines, analog and digital, played a central role in their physics, and simultaneously made them into cross-roads of intellectual-technical exchange.

Adding a few Drops of Science in the Cooking Pot

Jean Matricon Université Paris 7 Denis Diderot,
FRANCE

Although it had been suspected since the nineteenth century, the close connection between cooking and the physico-chemistry of food got a large development during the last thirty years and culminates now with the spectacular preparations of some restaurants using new materials and sophisticated techniques directly issued from scientific laboratories.
On one side, the chemical properties of edible molecules can be used to understand the transformations which take place during a cooking process, like boiling, roasting, frying and then to improve the efficiency and the quality of the process…On the other side, one can make new recipes either by using classical products but new techniques or by introducing new substances which enable the creation of original dishes.
The physical domains of thermodynamics, phase transitions, bubbles, emulsions as well as the chemical knowledge on macromolecules, polymers, pH effects, oxidation and reduction and many other physical and chemical properties are now parts of the new art of cooking called molecular gastronomy.
Did it improve the qualities of food? It certainly increased the pleasure of cooking for the happy few who enjoy this approach.
In the same time it became the theme of international seminars and a recognized branch of the food industry.this will be analysed during the talk.

Interacting Fields—The Transfer of Knowledge Between High-Energy and Condensed-Matter Physics

Christian Joas Theory Department,
Fritz Haber Institute of the Max Planck Society, and
Max Planck Institute for the History of Science,
GERMANY

High-energy and condensed-matter physics are often presented as largely disconnected fields of research, sharing little more than their conceptual basis—quantum mechanics. I will show that, to the contrary, the history of the two fields is largely intertwined. The dynamics of institutionalization of both sub-disciplines of physics was markedly different in scale and pace. Yet, their common intellectual foundation, at first in quantum mechanics and later in quantum field theory, along with similarities in key technical challenges (e.g., the many-body nature of their objects of study), enabled numerous transfers of knowledge across disciplinary boundaries throughout the 20th century. I will trace the dynamics of interactions and the mechanisms of knowledge transfer involved, as well as the far-reaching heuristic and ontological consequences for both fields. While my focus will be on formal-theoretical knowledge, the role of technology and experimentation will also be discussed.
After the advent of quantum mechanics, nuclear physics only slowly became established as a discipline in the 1930s and 1940s, and solid-state physics even later. Early on, many physicists devoted attention to problems stemming from, in hindsight, both fields. This changed considerably during the 1930s. During World War II, interest in problems related to nuclear physics grew further, and only few people kept working on problems related to solid-state physics. After the War, major new ideas were developed in nuclear and particle physics (e.g., quantum electrodynamics), whereas solid-state physics witnessed a relative standstill, only overcome in the 1950s: Key concepts and methods (collective excitations, diagrammatic perturbation theory, charge renormalization) of modern condensed-matter physics emerged from a transfer of quantum field theoretic methods which had their origins in nuclear and particle physics. This interaction with nuclear and particle physics fundamentally reshaped solid-state 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 particle physics. Also today, interactions between condensed-matter and particle physics are frequent.

NMR in Biochemistry. Many Failures Add up to Success?

Carsten Reinhardt Institute for Science and Technology Studies,
University of Bielefeld,
GERMANY

Nuclear Magnetic Resonance spectroscopy (NMR) has been, and continues to be, one of the most widely-spread research techniques in the physical and life sciences after 1945, including medicine. Nevertheless, and especially in biochemistry, there is no basis to account for a linear "success story". Although NMR had been used for decades in biochemistry and molecular biology, it had for a long time not been able to contribute substantially to the solving of scientific problems in these areas. To the contrary, much of the early history of NMR in biochemistry is arguably a history of "failures", judged by the contemporary expectations of success or failure of a research technique. In my talk, I will inquire into the epistemological and the social processes that made the continuation of an unsuccessful research technique possible, maybe even inevitable. This includes the special epistemological outlook of a community of scientists that paid attention to the development of methods as a scientific objective in its own right, and the pathways of a science-funding policy focusing on means, and not ends, and combining industrial with scientific goals. The talk will analyze some examples of the practices of biochemical and biomedical research using NMR during the period from the 1950s to the 1970s, focusing on developments in the United States.

Transfer of Knowledge from Chemistry to Superconductivity: A First Century of Failures and Successes

Georges Waysand Observatoire de la Côte d'Azur,
UMR Galilée, Laboratoire Souterrain Bas Bruit de Rustrel Pays d'Apt,
Université de Nice Sophia Antipolis,
FRANCE

The first century of superconductivity and its chaotic relations with chemistry offers a good case study for knowledge transfer at three majors milestones.
1- The discovery of Superconductivity itself in 1911 was the unexpected result of the quest for the electric behavior of pure metals at very low temperature. This phenomenon attracted the attention of physicists in the 1920s even before a clear conception of electrons in metal was elaborated. Indeed, chemistry notions were called for help, "super currents carried by close molecular chains" (Einstein), "atoms in superconducting contacts" (Kamerlingh Onnes) and other naïve geometrical images of chemical links, these initial ideas led nowhere.
2-The birth of quantum chemistry with the computation of the hydrogen molecular bond by Heitler and London, and their subsequent work on the benzene molecule in magnetic field offered this time a fruitful explanation of the perfect diamagnetism of superconductors just discovered by Meissner and Ochsenfeld. "A superconductor is like a big diamagnetic atom" will pronounce Fritz London in 1935. However, only after WWII during which physicists were busy elsewhere the perfect diamagnetism will be recognized as the essential feature of a superconductor.
3-With the observation that isotope mass (by definition a non chemical feature) influences the superconducting critical temperature, the interaction of electrons with the ion lattice was recognized and open the path to the microscopic theory of superconductivity. It seemed that the interaction with chemistry was over, but it is no more the case nowadays since the synthesis of superconducting perovskites and the search for electron pairing other than electron-phonon interaction, the chemists are now major actors in the field.
These three majors phases will be analyzed with respect to the evolution of each discipline and the social context.

Particle Physics as a Field Science: the Emergence of Astroparticle Physics

Bernard Revaz Département de Physique Nucléaire et Corpusculaire,
Université de Genève,
SWITZERLAND

Since the end of the cold war, the scientific activities aimed at studying the particles of the cosmos have seen a vigorous expansion. This expansion has been accompanied by a rapprochement of various, originally largely disconnected, areas of specialty (gravitational wave, cosmic rays, high energy gamma rays, dark matter, neutrinos) into a field called astroparticle physics with clear disciplinary ambitions. The underlying process of unification, which results from the convergence of self defined, internal motivations and the direct involvement of the funding agencies, will be described. Although the dynamic process of definition of the boundaries of the field is not achieved, astroparticle physics is stabilizing around two main lines of research: first, the study of the limits of particle physics beyond the standard model based on the study of particles accelerated by (natural) cosmic processes and secondly, the opening of the observational window of astronomy and astrophysics to the highest energy gamma photons, new particles such as neutrinos and gravitational waves.
Not without reminiscence with the migration of atomic scientists towards biology after WWII, the scientific community supporting the emergence of astroparticle physics finds its roots in a migration, occurring in the 1990s, of physicists trained in accelerator particle physics labs towards new topics of research in relation with astrophysics, astronomy, and cosmology. As a consequence, astroparticle physics is both in rupture with the parent field of cosmic ray research and in opposition with organizational models ruling astronomy and astrophysics. This migration results in a circulation of new methodologies (statistical methods) and technologies (particle physics detectors and electronics) from high energy particle physics into astronomy and astrophysics. By crossing the borders of well established, historical fields, these objects are at the heart of legitimacy conflicts. On the basis of two cases, I will illustrate these and show how they can be related to different representations of the cosmic phenomena.
The experimental devices developed in the frame of astroparticle physics research are deployed in the natural space and, hence, point to the idea that astroparticle physics is a redeployment of accelerator particle physics technologies outside the confined environment of the laboratory. This redeployment is characterized by an extensive use of the different spaces available in our physical environment, particularly the most extreme ones, such as submarine abysses, deserts, high mountains, outer space, Poles, and deep caves. This redeployment introduces a new line of tension in the research on the astrophysical objects: whereas optical astronomy tends to make nature transparent to the observation by locating observatories in high altitude and by developing image correction softwares, astroparticle physics takes advantage of the thickness of the natural spaces, transforming them into detectors, targets, or shields, and turning thereby nature into a laboratory proxy. By embedding sensing elements deep in the natural media and in such a variety of locations, this new field of research, not surprisingly, becomes more and more involved in environmental sciences and risk prevention. We will discuss the idea that a new form of reductionism, characterized by the prevalence of the methods and technologies of particle physics across a broad range of field sciences, may emerge in conjunction with astroparticle physics.

S36 Internationalism of Physics during the 1920s and 1930s: Formation of a European Research Net and its Impact in the Development and Dissemination of the European Scientific Culture

Coordinated by **Luisa Bonolis (Università degli Studi di Genova, Italy)**
Matteo Leone (Università degli Studi di Genova, Italy)
Nadia Robotti (Università degli Studi di Genova, Italy)
Chaired by **Martha Cecilia Bustamante (Université Paris 7, France)**
Francesco Guerra (University of Rome, Italy)

The traditional international character of physics, as well as the development of strong international ties between European research groups since the beginning of the 1920s, represented a natural background both for the collaboration between physicists of different countries, and for the training of the new generations who were encouraged to spend some time abroad in the most advanced laboratories or to work with prominent theoretical research groups in Europe. This trend, which became a well established practice in the 1930s, more and more assumed the character of a great European research net.
While a few details on single personalities and-or experiences in France, Germany, Italy, and United Kingdom have been outlined before, a comprehensive framework for an overall mapping of European physicists' visits abroad and related collaborations during the 1920s and 1930s has never been presented so far. In this perspective, the purpose of this symposium is to review the state of the art of the studies on the development of physics in Europe as regards the relationship between mobility of physicists and theoretical/experimental developments of contemporary physics. The main focus will be on the emergence
of international ties among European research groups, and the nature of scientific internationalism prevailing during the period of interest with a special attention to the exchange of knowledge and competences between different scientific cultures, the development of scientific ideas, research styles, instrumental practices and collaborations of extraordinary character. A special emphasis will be given on the personal, institutional and/or political factors prompting young physicists, also from the United States and other extra-European countries, to spend some time in Europe to train themselves abroad, and how the actual effects of their mobility upon both the institutions of origin and the host institutions, became a most vital root of the explosive development of physical sciences in those years.

Fellowships Programs in the 1930s Italian Physics: a Survey

Matteo Leone (1) (1) Department of Physics,
Francesco Guerra (2) University of Genova,
(2) Department of Physics,
University of Rome,
ITALY

Since the second half of the 1920s, through the 1930s, a large number of young Italian physicists spent period of works in the best European laboratories or in close contact with the most notable theoretical research centers abroad. At the same time, a number of European and American physicists came to Italy to work within the Italian laboratories and institutes of physics, e.g. at the Universities of Rome and Florence. This intense program of exchanges, that enabled the young scientists to complete their formation by learning novel experimental techniques and by studying the most promising theoretical issues, was made possible by fellowships granted by Italian institutions (the CNR, Italian National Council of Research, the Fondazione Volta, the Ministero dell'Educazione Nazionale) and foreign ones (the Rockefeller Foundation). A detailed examination of the archival documents preserved by the Archivio Centrale dello Stato, in Rome, by the Amaldi Archives at the Sapienza University of Rome, and at other archival repositories, provides a global overview of this pattern of exchanges that, in turn, might form the basis for future analysis on the specific impacts that these fellowships programs had upon the actual developments of the research and education in physics within the Italian universities.

Unraveling the Nature of Cosmic Rays. Bruno Rossi and the Spread and Developments of Experimental Practices and Scientific Collaborations in Cosmic-ray Physics before World War II

Luisa Bonolis AIF History of Physics Group,
ITALY

During the late 1920s and beginning of 1930s, particularly in connection with the birth of Enrico Fermi's and Bruno Rossi's research groups in Rome and Florence, strong relationships established between Italy and other European countries such as Germany, Great Britain and France, as well as with some physicists of the U.S. scientific community. The case of Rossi, a leading personality in the study of cosmic rays and the pioneer of this research field in Italy, is particularly exemplar in this sense. His research activity started in coincidence with the appearance of the Geiger-Müller counter and particularly with its use in Bothe and Kolhörster's crucial experiment testing the nature of cosmic rays. In embracing the idea of the corpuscular nature of the "Hohenstrahlung", Rossi set up an electronic coincidence circuit which became a fundamental tool for the development and spread of coincidence methods in cosmic-ray and nuclear physics. In working at the very frontiers of research, Rossi had a main role in unraveling some important features regarding the interaction between cosmic rays and matter during the 1930s. His work was held in high esteem by relevant scientists of the time. His friendship with Fermi, Bothe, Blackett, Heisenberg, Bethe, was instrumental for the exchange of knowledge about experimental practices and for theoretical discussions, as well as in attracting the interest of physicists such as Arthur Compton and Louis Leprince-Ringuet on the problem of cosmic rays. The ties established during the period 1930-1938 became of vital importance when Rossi was obliged to leave Italy after the enactment of fascist racial laws in 1938. The solidarity of many members of the international scientific community gave him the courage to begin a new life in a new world, and provided him with the means for continuing in the U.S. his relevant research -and teaching- activity.

"If a lot of radium would be sufficient to make important discoveries, ..." - Vienna as a Node in the Network of European Atomic Research Centres

Silke Fengler Institut fuer Zeitgeschichte,
University of Vienna,
AUSTRIA

In 1926 the Rockefeller Foundation prepared a list of the most eminent centres of physics in Europe – unlike the big laboratories in Cambridge, London or Paris, the Institute for Radium Research in Vienna (Austria) was not mentioned as a place to send young scholars to in order to receive a thorough education in modern physics. Nonetheless, a considerable number of scholars, both from European countries and overseas, spent some time in Vienna to receive training in instrumental and experimental practices in the field of radioactivity and early atomic research.
My working hypothesis is that it was not so much the outstanding instumental equipment, nor a notable theoretical training, but rather the availability of strong radioactive resources that attracted these scholars to Vienna; doors were open for young Austrian physicists in other European laboratories by the same token.
In my paper I focus on the one hand on the strategies employed by Austrian radioactivists to maintain a position in the network of European research laboratories which was dominated since the early 20th century by the French (M. Curie) and English (E. Rutherford) schools. In order to gain access to radioactive ore, they had to (re-)create their own networks with the international radium industry, other scientists and politicians. On the other hand I will turn my attention to the scholars visiting the Institute for Radium Research in the 1920s and early 1930s: which countries did they come from, what kind of earlier training had they received in order to fit into the local research context? What did these scholars learn in Vienna, and what kind of impact did their study stay have on their further career abroad? Furthermore, I will analyze how access to raw materials affected cognitive developments in radioactive research and in the emerging field of atomic physics in Vienna.

Physicist' Role in the «Rebirth of a Scientific Movement» and also in the Dissemination of Scientific Culture in Portugal during the Inter-War Period

Augusto J. S. Fitas (1,2) (1) CEHFCi – Centro de Estudos de História e Filosofia da Ciência,
Emília Vaz Gomes (1) (2) Universidade de Évora,
Fátima Nunes (1,2) PORTUGAL
J. P. Príncipe (1,2)

The advent of Republic in 1910 brought important higher education reforms in Portugal. In spite of strong political and financial difficulties in the next two decades, Portuguese universities supported graduation studies of young physics teachers abroad. However these relevant initiatives, Portuguese republican government was not successful in creating a national institution able to promote and funding the organization of scientific research. Only in 1929 the government was able to set up this kind of institution, the "National Board of Education" [Junta de Educação Nacional], with the aim of funding research centres in the universities, as well as of providing grants for students to continue their studies at advanced level both at home and abroad. In the thirties an important group of young researchers went on to study in universities and laboratories of European advanced scientific countries, where some of them got their PhD degree. In Chemistry, Mathematics and Physics the school more demanded was Paris University. During this period Curie's laboratory received an important group of Portuguese students. After four years stay abroad, having established important international scientific links, back at home, some of these young scientists played an important role in their universities promoting a rebirth of a scientific movement. This lasted till the end of the Second World War, when a good number of them were dismissed from their positions because of their active opposition to Salazar's regime. Arriving home having experienced living in cities with intense political activity, some of these young scientists demonstrated a strong political commitment against the dictatorship regime and supported important activity in scientific associations and cultural organizations. The study of the scientific, cultural and political activity of this group is the purpose of this communication.

Alexandre Proca or the Internationalism of Physics during the Twenties and Thirties

Martha Cecilia Bustamante Equipe REHSEIS-SPHERE,
Université Paris 7,
FRANCE

Alexandre Proca (1897-1955) is one of the prominent figures of physics in France between the two wars. He has been a key player in efforts to give to the theoretical physics research a prominent place in the country. In France, as shown by historical studies, physics research was at that time largely dominated by the experimental tradition. Proca also occupies a place in the history of quantum field theory. Author of one of the first doctoral thesis in relativistic quantum theory in France, he proposed the equations that bear his name, Proca equations, which describe particles of spin 1.
From Bucharest to Paris, from engineering sciences to theoretical physics, from theoretical work to the activity of organizing research, Proca followed a singular trajectory whose strongest meaning appears in the light of his "internationalism" (linguistic, intellectual and geographical), but especially in the light of the general scientific internationalism that develops at that time. This is what we intend to show in our presentation.
Proca illustrated in the hard political, intellectual and scientific French context in the thirties and very concretely in the specific context of Parisian world of research. It is marked by great figures (Paul Langevin, Marie Curie, Jean Perrin, Emile Borel ...) and by the emergence of the new Institut Henri Poincaré. Deriving from internationalist projects of the Rockefeller Foundation, the Institute H. Poincare, where Proca conducts his activities is devoted to the development of theoretical physics. We will consider these facts to better understand Proca's trajectory and, more general, the ways in which scientific internationalism materializes at European level and in the inter-war period.

S37 Beyond the Molecular Vision: Unromantic Perspectives on the History of Biophysics

Coordinated by **Pedro Ruiz-Castell (Universitat de València, Spain)**
Chaired by **Mathias Grote (University of Exeter, UK)**

For almost two decades now, the mid-twentieth century formation of "biophysics" has loomed large in revisionist histories of molecular biology, allowing historians to implode the earlier, discipline-oriented and DNA-centric historiography. Rather than a science wrought in the 1930s and 1940s by the Rockefeller Foundation and invading nuclear physicists, the picture that emerged is one of a paradigmatic if heterogeneous cold war science, mushrooming in a cultural climate shaped by an ideology of basic science, atomic scare, and massively increases in the public support for science. And yet, this revised picture remained deeply informed, historiographically, by the received narratives, themes and assumptions along which the genealogy of molecular biology has been conceived. In fact, the story of biophysics remains a gene-centric one, and there prevails a strong focus on elite academic research institutions and on the diffusion and migration of physical instrumentation and techniques. These biases arguably have not appeared particularly problematic, and neither have apparently unproblematic framings such as 'physics' and 'biology', or indeed, the dimension of the 'molecular' itself.
The proposed session attempts to problematize precisely these narrative frames and categories. The aim of all papers in this session would be to demonstrate the potential of disengaging biophysical history from the disciplinary histories of molecular biology, physics, and biomedical 'hybrids' and specialties. The principal shift of perspective we hope to provoke is towards the vast domains of the scientific and industrial analysis of materials – organic and otherwise. It is these domains, we contend, that afford fresh perspectives on the mid-century transformations of biological science. Our papers, dealing with topics such as the material composition of membranes, electron microscopy and X-ray crystallography, show how academic, disciplinary (and ontological) classifications such as physics and biology were largely alien and historically irrelevant to advances in biophysical knowing. Studying materials such as textile fibers, metals, semi-synthetics or plastics was ontologically indiscriminate. And enrolling these spheres of scientific activity into the picture has significant implications for the history of biological science. The appropriation and diffusion of physical instrumentation for biological purposes, for example, looks slightly different through this lens: rather than academic 'biology' (reluctantly) being transformed by academic 'physics', there emerges a landscape populated by a more complex set of actors, pursuing tasks that cannot easily be subsumed under the disciplinary transformation model: engineers, metallurgists, industrial chemists, hospital physicists, etc. Likewise, bringing to the fore the material dimension – essentially, the study of economically useful things – effectively allows to complicate conceptions of the 'molecular' and its historical imports. Rather than biology's irresistible destiny, from the perspective of materials, the penetration into the molecular dimensions of life will appear as one element only of the far less romantic but large-scale scientific penetration of structures, processes and physical properties of worldly things that shaped modernity. Together, all papers in this session thus share the goal of demonstrating how we can, and should, re-envision the history of the biological sciences in the twentieth century along less molecular, less disciplinary and less elitist/academic lines.

Ersatz-Objects: Knowing Cellular Surfaces, 1920-1940

Max Stadler Max-Planck-Institute for the History of Science, Berlin, GERMANY

A great deal of what there has been written about the life sciences and their metamorphoses in the twentieth century revolved around, in the words of one historian, biology's 'continuous borrowing' from physics. Typically, these narratives also centred on a select number of themes, landmark events and (academic) scenes: in the interwar period, in particular: Cambridge and progressive, leftist biochemists, migrating instruments, or model-organisms; and typically, they revolved around entities of ever diminishing size - genes, proteins and molecules. The cell, for one, is largely absent from these accounts or made its appearance as a holistic, somewhat anachronistic aberration. This paper presents an account of the genesis of the iconic 'bimolecular-layer' model of the cell-membrane that challenges these framings of life science between the wars. It does so by re-embedding its development in a world of practical knowledge production about useful things, processes and materials beyond the academic, biological laboratories. Neither anachronistic nor emphatically biological, this vast world ranged from surface chemistry to the analysis of semi-synthetics and fibres to studies of soaps, emulsions and foams. In my paper, I show how, during the interwar period, knowing the cell – devising models of cellular behaviour such as the bi-molecular layer one – was inseparably intertwined with the scientific knowing of this man-made, material world. Disciplinary (and ontological) classifications such as physics and biology were largely alien to these domains and, as I shall argue, they open up new, less molecular and disciplinary perspectives on the advances of biological knowing in the period.

Seeing the Invisible: the Introduction of Electron Microscopy in Great Britain

Pedro Ruiz-Castell Departament d'Història de la Ciència i Documentació, Universitat de València SPAIN

During the twentieth century, life sciences experienced notable progress thanks to the development of new and improved instruments coming from the field of physics. Traditional historical accounts have built a coherent history of how these instruments were appropriated by life scientists and revolutionized biomedical work. But the development and introduction of some of these techniques such as electron microscopy in countries like Great Britain, was far from unproblematic. In fact, life scientists originally proved very reluctant to incorporate this new technique into their research. The interest in electron microscopy may be seen indeed as a consequence of a more general concern in the scientific and industrial analysis of materials. All in all, considerations of the potential uses and applications of the new technique finally secured the development and consolidation of electron microscopy, promoted by a new community of scientists engaged in the study of both organic and inorganic structures.

Surfaces of Action: Cells and Membranes in Electrochemistry and the Life Sciences

Mathias Grote ESRC Centre for Genomics in Society (Egenis),
University of Exeter,
UNITED KINGDOM

Max Planck Institute for the History of Science, Berlin

In addition to fundamental units of life, the term "cell" has designated technical apparatuses such as fuel and galvanic cells since the 19th century. This paper shows that such technologies, based on electrical effects of chemical reactions taking place in containers, had an impact on the concept of the biological cell that reaches far beyond the terminological basis. It focuses on the controversy about oxidative phosphorylation in bioenergetics (ca. 1961-1977). In this scientific conflict, an intermingling of technological culture, concepts as well as practices of physical chemistry and biological research can be observed on two levels. First, Peter Mitchell explained the chemiosmotic hypothesis of energy generation by representing cellular membrane processes in analogy to fuel cells. Second, in the associated experimental scrutiny of membranes, material cell models were devised that were able to reassemble spatialized molecular processes in vitro. Cells were thus modeled both on paper and in the test tube not as visualized morphological structures, but as compartments able to perform work.
The story of cells and membranes in bioenergetics points out the stake that theory and practices of physical chemistry had in molecularizing life. Scientific endeavours from this realm model the cell as a "topology of molecular action", involving concepts of spaces, surfaces and movements. Epitomizing an engineer's vision of the organism, these experimental approaches and ideas have influenced diverse fields of today`s life sciences. As topical as this perspective might appear, it also reveals a surprisingly romantic trait of the 20th century life sciences : Analogies of living and energetic phenomena should equally be understood in light of the age-old associative complex of "vital fire" or "fire without flames" that Gaston Bachelard has sketched in the "Psychoanalysis of Fire".

S38 Circulations in the Neurosciences

Coordinated by **Jean-Gaël Barbara (Université Pierre & Marie Curie, Paris, France)**
Chaired by **Jean-Gaël Barbara (Université Pierre & Marie Curie, Paris, France)**

Focusing on the neurosciences, the session will investigate how instruments weave social circulations - and how, vice versa, such circulations participate at the formation of scientific knowledge in this domain. The neurosciences are generally regarded to be a research area highly dependent on technological innovation, if not driven by it. Typically, a new approach – such as a staining method, electronic amplification, or measurement technology – spread rapidly across the scientific community and was quickly implemented at various places; and yet, many of such instruments and methods remained embedded in specific local cultures. Entire "schools" coalesced around the development or refinement of investigative technologies and were consolidated by sophisticated training regimes in particular forms of instrumentation.
But how does instrumentation generate new investigative approaches, emerging from previous knowledge? Along which chains of material articulation do technological innovations travel and how do they orchestrate the emergence of new research arenas in between established disciplinary fields? How can distant research areas far away from an original field benefit from a technological innovation? And how do instruments frame the identification and characterization of scientific objects?
On basis of a series of case studies, the session will analyse the contexts in which particular research programmes evolved and how technical expertise travelled while constantly adapting to progressively changing problems. On a more local level, the mediation between instrumentation and concept formation will be studied in the construction of scientific objects. The guiding question here is whether instrumentation encompasses primarily material instruments, or should also be extended to include biological materials, concept formation and non-material procedures in the social process of knowledge building. The examination of the many relations between instrumentation and knowledge will help to understand the dynamics of disciplinary networks, their evolution and interaction at both, a theoretical and material level.

Mutation Carriers: US Laboratories Led by Spaniards in the Early 80s

Enrique Wulff Barreiro (1) (1) Consejo Superior de Investigaciones Científicas,
Emilia Currás (2) (2) Universidad Autónoma de Madrid,
SPAIN

The history of the initial protocols to transfer viral genetic products inducing tumors was greatly facilitated by the availability of continuous cell line of highly contact-inhibited cells (NIH/3T3). During the 70s the teachings of those involved in this research reached some of the recent arrived in the US Spanish oncologists. And in the early 80s significant Spanish biologists arrived in the Columbia university develop laborious techniques for the detection of oncogenes, involving the gene cloning of regions where are aberrations, sequencing and identification of structural genes in the affected loci and then determination of their role in cancer. After the initial observation that a significant proportion of the tumors scoring positive in the fibroblasts used - the NIH 3T3 cells - and that the genes responsible belonged to the ras family, Isabel Guerrero isolated the two main murine genes responsible for the phenotype, N-ras, in results presented in 1984. The following year she sequenced the complete coding region of N-ras, and suggested evidence for the spectrum of activated mutations in different mouse strains and by different agents. A number of methodical factors affect this historical series of performances. Concept symbols derived from the display of the graphical distribution along time of the concurrent performances, reveal the successive shifts features of their authors from the Columbia University to the Cold Spring Harbor Lab and the Kaplan Cancer Center.

Circulations of Invertebrate Animal Models in Neuroscience at Play in Interdisciplinary Research

François Clarac CNRS, P3M,
FRANCE

Neuroscience was established around the 1960s. In this new field of research, invertebrate preparations were of great value for understanding the organisation of the neurone. The paper will provide a analysis of how these animal preparations were exchanged between laboratories and provided solid grounds for the circulations of neuroscientific concepts.
Just before and after the WWII, the squid axon was used for the study of nerve conduction in parallel by A.L. Hodgin (1914-1998) and A.F. Huxley (1917-) from Cambridge and K.S. Cole and H.J. Curtis in Woods-Hole.
The visceral (abdominal) ganglion of the mollusc Aplysia was studied by A. Arvanitaki (1901-1983) near Toulon, Paris and New-York.
The stomatogastric preparation from rock-lobsters was discovered by D. Maynard (1929-1973) and represents the best known neural network.
The analysis of the flight of the criquet was developed by D. Wilson (1933-1970) when he was working in the laboratory of T.Weis-Fogh (1932-1975).
The results obtained by these preparations were one of the cornerstone of neuroscience in explaining the basic neuronal functionning, the intrinsic neuronal properties the synaptic activations and their different properties in inducing complex networks.
We want to show how different laboratories in Europe or in America adopted these models and how they favoured the circulations of new concepts in the different disciplines of neuroscience.

Commitments and Scientific Ideas of J.-M. Lahy on Psychotechnics and USSR

Isabelle Gouarné Cultures et sociétés urbaines (CSU, Paris 8 – CNRS) and
Centre nantais de sociologie (CENS, Université de Nantes),
FRANCE

I will analyse the intellectual and political life of J.-M. Lahy (1872-1943). In the early 1920s, he joins the movement "Russie nouvelle". His commitments to USSR develop between the two wars, when the relations between the communist world and Western intellectuals are not yet stabilised. This study asks the relations between political commitments and intellectual practices of French academics. How the commitments of Communist scientists can be in part explained by the evolutions at stake in their disciplines, by their place in the academic world or their intellectual education. Two lines of analysis are presented. First, I will show how the philosovietism of Lahy is part of his scientific project aiming a novel program against Taylorism. Second, I will study how in the 1930s French intellectuals take over the Soviet Marxist discourse on science.

The Rockefeller Fellows and the Transnational Circulations of Neurosciences (1930-1960)

Ludovic Tournès Professor of history, University of Paris-Ouest Nanterre La défense,
FRANCE

That American philanthropic foundations played a great rôle in the funding of science from the beginning of the 20th Century onwards is well known.However, most studies have focused on the funding of important institutions, in order to assess the « American » influence on different national scientific scenes. This paper adopts a different perspective : it focuses on
fellowships, which has been overlooked by most historians of philanthropy,and uses them as a way to analyse the transnational circulation of researchers in neuroscience at the time of their emergence (1920s-1950s).
In this perspective, the Rockefeller foundation is not considered as a vector of diffusion of American science, but as a turntable in the transnational circulation of men, knowledge and practices, from United States to Europe, Europe to the US and Europe to Europe. After having presented an international panorama of the Rockefeller fellowships in the field of neuroscience, the paper focuses on the French case in order to present a detailed analysis of the role of the Rockefeller both in the institutionalisation of neuroscience (neurosurgery, neurophysiology, neurobiology) and in the inclusion of French researchers within a transnational network of neuroscientists from the 1930s onwards.

Circulations in the Revival of French Neuroscience after Second World War. Part 1 - First Generation Scientists

Jean-Gaël Barbara CNRS, Université Pierre et Marie Curie and
Université Diderot, Paris,
FRANCE

The revival of French neuroscience after WWII was conditioned by the will of young fellows and their idea of science radically different from that of their masters, where international collaborations and exchanges were central to their work. This appears in a striking manner for those scientists born around 1900, and it is also significant of their students, born in the 1920s, who are the real actors of the birth of French neuroscience.
In this presentation, the first generation will be analysed. It includes Alfred Fessard, Louis Bugnard, René Wurmser and Henri Laugier, the first three being Rockefeller fellows. We shall show how their initial careers, the beneficial funds from the Rockefeller foundation to visit foreign laboratories, and their network enabled them to develop a collaborative idea of science at an international level. This was also pivotal when they allowed French scientists to escape France during WWII and when they organised the visits of younger colleagues just after WWII in foreign countries, thereby making the renewal of French physiology possible.

Circulations in the Revival of French Neuroscience after Second World War. Part 2 - Second Generation Scientists

Claude Debru Professor of Philosophy of Science,
École normale supérieure, Paris,
FRANCE

The revival of French neuroscience after WWII was conditioned by the will of young fellows and their idea of science which was rather different from that of some of their influential their masters. International collaborations and exchanges became central to their work. This appears in a striking manner for those scientists born around 1900, and it is also significant of their students born in the 1920s, who are the real actors of the birth of French neuroscience after WWII.
In this presentation, the second generation will be analysed. It includes Yves Laporte, Pierre Buser, Michel Jouvet, Antoine Rémond, Robert Naquet, Henri Gastaut and Henri Korn. We will describe the circulations of techniques, instruments, concepts and theories between France, United-Kingdom and the United-States, but also Eastern countries, in which these scientists participated in the 1950s and 1960s.

S39 Representations of Science and Technology in the European Daily Press

Coordinated by **Ana Simões (University of Lisbon, Portugal)**
Faidra Papanelopoulou (University of Athens, Greece)
Chaired by **Ana Simões (University of Lisbon, Portugal)**
Faidra Papanelopoulou (University of Athens, Greece)

Despite the renewed interest in the role of the mass media in communicating science and technology to non-specialized audiences, historians of science have paid scant attention to the daily press as an object of research per se. Although the fields of media studies and cultural history have long recognized that newspapers are crucial in the making of public opinion, in the history of science we are just beginning to establish the nature of newspaper coverage and account for its importance. Recent studies have shown that like periodicals, the daily press can be equally seen as a particularly suggestive source for the public images of science and technology and the public perception of their role in society. Moreover, the extent to which science and technology are topics that permeate the entire newspaper and are not limited to specific columns dealing with 'science popularization', is indicative of the important role science and technology played in the formation of modern societies. To what extent can newspapers be seen as privileged media for the examination of the cultural meanings of science and technology in different local settings? How do the main political, social and cultural features of a period influence the public discourse about science and technology, and how in turn do discussions about science and technology in the public sphere transform the ideological, social and cultural formations of each historical period? This session aims to bridge various perspectives on the role of the daily press in the circulation of news concerning science and technology and their cultural and political underpinnings in different European countries during the 20th century.

Science is Feuilleton and Technology is Business? On Orders, Genres and Topics in German Quality Newspapers, 1895-1943

Arne Schirrmacher Max Planck Institute for the History of Science, Berlin, GERMANY

News on science and technology increased in many German newspapers in 1895 rather coincidentally when a law on Sunday rest made it necessary to have pre-produced pages on Mondays. Special pages (or parts thereof) and sections then flourished and became widespread in leading German newspapers.
I will discuss among others the Berliner Tageblatt (1872-1939) and the Frankfurter Zeitung (1845-1943) in order to explain how in the German case scientific and technological innovation was communicated by the press and also how scientist used this means for creating a calculated representation of their work in a wider national cultural context.
The Berliner Tageblatt was in 1895 the first German newspaper with a technical review supplement ("Technische Rundschau") for which a special technical editorial office was established; it was at the same time the longest running supplement until 1935, a circumstance that allows to analyze the changes in the presentation of technology (and some science) from the 19th to the 20th century and thus from Kaiserreich culture to Weimar Republic.
The Frankfurter Zeitung had a particularly rich technical supplement ("Das technische Blatt") from 1919 to 1943, whereas the paper was already well-known for its "scientific feuilleton" in the main part.
The talk will present select examples of different genres of communicating science and technology and will try to exhibit the changing orders thereof within the world of knowledge (re-)produced in newspapers during an era where print media were the main mass medium.

Test-tubes, Computers and Black-Holes. 30 Years of Science and Technology in Newspapers

Rui Brito Fonseca CIES/ ISCTE - IUL, Lisbon University, PORTUGAL

This presentation aims to discuss the public understanding of science and technology, namely, it aims to question 30 years of science and technology, in Portuguese newspapers.
Taking Science and Technology published in national newspapers has representative and source of the whole science and technology media coverage, this presentation goal it is to build a landscape of Portuguese science and technology media coverage, between 1976 and 2005.
It seems clear that for scientific activity to be understood, the communication of science plays a central role. The representation of science by the mass media possesses, thus autonomy before the scientific activity playing, relatively to this, different social functions.
Starting with the approval of the first Portuguese democratic Constitution, this paper analyses science and technology newspaper coverage, in Portugal. This has been a period of major changes in Portugal, namely in science and technology. In 1976, Portugal had almost no investments in science and technology and science and technology weren't an important issue. Are science and technology noticeable now? Does science sells newspapers? Are science and technology popular issues? Which issues are more relevant?
Based on, a quantitative and qualitative, analysis of thousands of newspaper articles published in four major national, daily and paid Portuguese newspapers, this presentation develops a portrait of what has been the media coverage of science and technology, and discusses trends and transitions, between 1976 and 2005.
This discussion it is a chapter of a wider research that aims to discuss and characterize the presence of science and technology in the Portuguese newspapers.

Epidemics in the News: Health and Hygiene as Seen by the Press in Periods of Crisis

Maria Antónia Pires de Almeida CIUHCT – Centre for the History and Philosophy of Science and Technology,
Faculty of Science and Technology,
New Lisbon University,
PORTUGAL

As part of a larger project focused on producing a History of the Popularization of Science and Technology in Portugal, my aim is to find out how scientific knowledge reached the common people, 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. In times of health crisis, newspapers are particularly important sources to access the type of information and advice given to the public and the sanitation measures taken by the authorities.
In this paper there is an intention to compare several epidemics which scourged the world during the nineteenth and twentieth centuries, by analyzing their impact in Portugal and in the Portuguese newspapers. Oporto was particularly affected by the cholera morbus epidemic in 1855, the bubonic plague in 1899, the 1918 Spanish flu and later in the 1980s the AIDS epidemic. Currently the swine flu is in the news and there are prevention measures being encouraged and enforced everywhere, but the main issue is always the same for nearly two centuries: hygiene. Teaching people how to prevent disease by explaining hygienic procedures has been a constant concern in the press and other more recent media in periods of health crisis. News on the subject reveals the state of the art of the medical science in each of the stated periods. It also reveals the importance given by health authorities and journalists to the publication of the most recent discoveries and the most adequate hygiene procedures to prevent the spread of the epidemics. This is an important subject that can contribute to the debate on the dissemination of science and technology.

(Re)Presenting Science: Archaeology and Portuguese Daily Press(ing)

Ana Cristina Martins IICT - Tropical Research Institute, Lisbon,
PORTUGAL

During the second half of the 19th century, Portuguese archaeology was scarcely represented in national daily press, comparing to the number of articles dealing with news coming from other countries, informing about archaeological discoveries in Greece, Egypt, and ancient Mesopotamia, etc, as they invoked the Old Testament and the basis of European culture.
However, by the second decade of the 20th century, things seemed quite different. Two of the most relevant Portuguese archaeologists, Mendes Corrêa (1888-1960) and Manuel Heleno (1894-1970), profoundly committed with the new political agenda Estado Novo ('New State'), began to influence archaeological (re)presentations in daily press accordingly to their scientific interests and ideological purposes.
We will therefore analyze several Portuguese daily publications in order to list geographies, chronologies and archaeological cultures mainly (e)presented, disclosing the inherent scientific praxis and national agendas, and the role played by those two archaeologists in all this process, as well as by published articles on a particularly idea of Portuguese ancestry and ancestors .

Comparing the Public Perceptions of Science and Technology in the Greek and the Portuguese Daily Press, 1908-1910

Ana Carneiro (1) (1) Centro Interuniversitário de História das Ciências e da Tecnologia –CIUHCT,
Maria Paula Diogo (1) University of Lisbon- New University of Lisbon,
Ana Simões (1) PORTUGAL
Isabel Zilhao (1) (2) Department of Philosophy and History of Science,
Eirini Mergoupi-Savaidou (2) University of Athens,
Faidra Papanelopoulou (2) GREECE
Spyros Tzokas (2)

In this paper we present the results of a comparative study of the public perceptions of science and technology stemming from the Greek and the Portuguese generalist press in the period from 1908 to 1910. Our work is based on a common bottom-up approach offering a complete survey of all news published in two different newspapers in each country: the Greek newspapers selected for their wide circulation since at the period under examination newspapers had no clear political orientation - Skrip (Athens, 1893) and Embros (Athens, 1896), and the Portuguese newspapers chosen on the basis of broad ideological scope and different geographical locations - Diário de Notícias (Lisbon, 1865), and Diário dos Açores (Azores, 1870).
In view of the importance of this historical period for both Greece and Portugal, we interpret the multifaceted discourse used by journalists when accounting for science and technology in their articles. From the wide range of articles studied, we have discerned the following broad themes: the introduction and cultural appropriation of new technologies, 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. We offer some conclusions which explore the contrasts and similarities of treatment of the common topics identified.

S40 Cold War Science and Technology in the Arctic

Coordinated by **Matthias Heymann (Aarhus University, Denmark)**
Chaired by **Matthias Heymann (Aarhus University, Denmark)**

In the post-war period scientific exploration of the polar areas became a strategically important element in American and Soviet defense policy. Greenland, the Arctic Sea and Arctic regions in Canada, the Soviet Union and Scandinavia, which due to harsh climates remained marginal areas in most of their history, suddenly became a focus of Cold War politics and science. Scientific ideas, techniques, practices and interests were circulated into a new region and in new domains and at the same shaped and reshaped by new challenges and findings. Particularly geophysical fields like meteorology, geology, seismology, oceanography, but also nuclear technology and other fields profited greatly from military interest in the Arctic.
In recent years, the interest in Cold War Arctic science has increased considerably, but many questions are still open and deserve to be investigated. Comprehensive surveys of Cold War science in the Arctic are lacking. Problems of particular historical interest include the question of a distortion of the sciences by military engagement, the relation of scientific internationalization and military classification of research results or the shift from military predominance in research planning to the emerging environmental interests in Arctic regions in the later Cold War period. The symposium aims at presenting new international research efforts and discussing new contributions to and open research questions of Cold War Arctic science and technology.

Secretive Geologies. Rivalry and Cooperation in the Geological Investigation of Greenland, 1946-1958

Christopher Jacob Ries Dept. of Science Studies,
Aarhus University,
DENMARK

Between 1946 and 1958, Greenland geology was generally explored in three largely independent institutional contexts, each covering their region of the island, following their own agenda.
To the North, the U.S. Geological Survey investigated and mapped the topography and geology of large areas of northern Greenland as part of U.S. Cold War military projects, the outcome of which was initially confidential, and therefore relatively unknown.
South of this, Danish efforts were mainly concentrated on the Eastern and Western parts of the island. To the east the Danish geologist Lauge Koch carried out large-scale investigations on behalf of the Danish Greenland Administration with crews of international specialists, and no Danish geologists involved. To the west Danish geologists were running the Danish Greenland Geological Survey with its own international cooperative network. Directly reflecting deep hostilities within the Danish geo-scientific community, there was very little cooperation and exchange between the two Danish operations. This project seeks to identify important actors within each of these independent operations and sketch out the different agendas that guided their work. Further, it seeks to identify patterns of scientific cooperation or competition between the three operations, as they were shaped by the general climate of politically motivated secrecy that governed Greenland geology during the Cold War.

Confidentiality vs. Publicity: Emerging Tensions in Military-Science Collaborations during the Cold War

Kristian Hvidtfelt Nielsen Dept. of Science Studies,
Aarhus University,
DENMARK

One important tension involved in the military patronage of scientific research is that of confidentiality vs. publicity. While most military operations are based on controlling flows of information, it is commonly agreed that science needs open publishing, unrestrained communication among peers across national borders and public understanding of science to flourish. With the spread of extensive military-science collaborations during the Cold War, the balancing of military needs and scientific ambitions became critical, not the least when it came to public understanding of science and science policy issues. Combing contributions from Cold War studies and the history of recent science, this paper aims to explore the tension between confidentiality vs. publicity. With a particular emphasis on scientific activities in Greenland during the International Geophysical Year of 1957-58 (IGY), the paper also provides a few examples of how military bodies and scientific organizations in practice managed the tension.

Eternal Ice in the Cold War. EGIG I and German Polar Traditions

Christian Kehrt Deutsches Museum, Munich,
Rachel Carson Center für Umwelt und Geschichte, Munich,
GERMANY

I want to present my project on German polar research in the Cold War in spatial and environmental perspectives and talk about the first expedition in the Arctic after the Second World War. EGIG I in 1959 was an international cooperation between scientists from France, Germany, Austria and Switzerland. I want to focus on glaciological research of measuring the movement and size of the arctic ice shield and raise the question in what sense these efforts go back to the Wegener Expedition in 1929. At least German polar research on the one hand does not seem to fit into the picture of a “typical Cold War Science” that was heavily influenced by military interests. On the other hand the German mission takes place in the same environment, the same places and the same time as American research efforts. Is it a special case or even a “Sonderweg” of Cold War history or do we have to rethink the general narratives, in order to understand the German case, which of course was another Cold War story?

The Cold War Roots of Ice Core Drilling

Aant Elzinga Department of Philosophy, Linguistics and Theory of Science,
University of Gothenburg,
SWEDEN

The presentation takes its point of departure in the International Geophysical Year that was influenced by the Cold War context. In the Arctic this coincided with the conflict between the US and USSR, whence scientific research had a strong political dimension. The connection with military agendas and technological development was also evident. The case
of ice and snow studies in this context is taken up, indicating how glaciology was given a boost. Ice core drilling in Greenland in particular laid a groundwork for later studies that nowadays are associated with gaining an understanding of global climate change. The paper probes several aspects of this history.

Militarizing the Arctic in Cold War North America. The Contrasting Cases of Canada and the United States

Ronald E. Doel Department of History,
Kristine C. Harper Florida State University,
USA

As the cold war began, military planners at the Pentagon began to see the Arctic in national security terms. They realized that the U.S. understood little about the Arctic environment, even as Strategic Air Command bombers were flying above this frozen landscape; they began planning for the possibility that the emerging cold war with the Soviet Union could become a hot war in this region. In the U.S., military interest in the Arctic led to major new research institutes and greatly enhanced funding for the physical environmental sciences. The far-less-researched situation in Canada, however, seems different: while Ottawa shared Washington's concerns over cold war conflicts in the far north, Canadian officials and researchers saw the Arctic more as a region for potential habitation and resource exploitation—leading to a distinct research approach involving the environmental sciences. The origins and implications of these contrasting visions are the focus of this paper.

Polar Research and the Endings of the Cold War

Stian Bones Senior Research Fellow,
Department of History and Religous Studies,
University of Tromsø,
NORWAY

Throughout the Cold War, the scientific efforts would serve many political interests. It is not difficult to find examples where science was attached to a political strategy – both in the East and in the West – which focused on power-oriented manouvering. This also holds to be true for the activities of the Norwegian Polar Institute (NPI). For decades it seemed to be somekind of a leith motive for the NPI not to let any of the Great Powers, and especially not the Soviet Union, get such advantages at Svalbard or in any other strategically important areas, that it loosened up or threatened Norway's sovereign rights. But this is not the whole story. Another strategy was also always evident in polar research, the one that was oriented towards true international cooperation, and this strategy will be described in Bones' presentation. On the basis of the rich source material from the NPI, Bones will analyse the role that NPI and polar research played towards the end of the Cold War. Polar scientists from several countries - Canada, Denmark, Norway - invited partners in the Soviet Union to a closer cooperation, and when Gorbatsjov took seat in the Kremlin in 1985, this also laid a new foundation for polar research throughout the whole Arctic region.

S41 Technological Innovations, Humanitarian Networking, and Politics in the Red Cross International Movement: the Case of the Spanish Red Cross, 1864-1950s

Coordinated by **Jon Arrizabalaga (Institució Milà i Fontanals, CSIC, Barcelona, Spain)**

Chaired by **Jon Arrizabalaga (Institució Milà i Fontanals, CSIC, Barcelona, Spain)**

The debates and activities in which the international movement of the Red Cross (the ICRC and the national societies of the RC) was involved from its foundation in 1863 to the post-WWII years provide us with a splendid observatory to analyse how a wide international network of humanitarian actors made expert knowledge about technological innovations circulate and be implemented, as well as these actors' interplays with political agencies. In this context, the meaning of technological innovation covers not only the new medical devices and equipment, but also innovative measures with regard to war medicine logistics and to mobilisation of solidarity towards war victims.
This symposium proposal is intended to explore this issue through the interventions of the Spanish Red Cross that was founded in 1864, in a number of military conflicts where its humanitarian activities were deployed, including the Second Carlist War (1872-1876), the Rif War (1921-1926), the Spanish Civil War (1936-1939), and the Second World War (1939-1945).

Scientific Communication and Technological Innovation in the Early Spanish Red Cross, 1863-1876

Juan Carlos García Reyes Institució Milà i Fontanals,
Jon Arrizabalaga CSIC, Barcelona,
SPAIN

The early years of the international movement of the Red Cross (founded in 1863) coincided with an age of great technological changes in war medicine that derived from the transformation of medical science and from the acceleration of communication systems. The organisational peculiarities of the International Association for Relief of Wounded Soldiers in Campaign (the ICRC and the national committees of the Red Cross), the confluence of physicians from different national societies of this association in a variety of professional conferences and journals on a international scale, and the construction of a shared practical knowledge that was properly tested in the Franco-Prussian War (1870-1871), provided us the essential keys to understand the technological innovations put on by the Spanish Red Cross during its baptism of fire on the occasion of the Second Carlist War (1872-1876).

The Spanish Red Cross, the Repatriation of Soldiers from the Cuban, Philippine and African Wars, and the Development of Medical Science in Spain

María-Isabel Porras-Gallo Medical School,
University of Castile-La Mancha,
SPAIN

The creation of the Red Cross in 1863 must be understood as one of the private international initiatives developed from the middle of the 19th century, which were parallels to the acknowledgement of the need to establish some international measures to preserve health and to deal with health problems and the subsequent development of International Health Conferences.
As we know, J. Henri Dunant founded the International Red Cross with the aim of providing neutral care to wounded and unattended soldiers of any country in wartime, but the initial limited function of this agency gradually expanded to cover many aspects of health, as well as the role of providing emergency relief to citizens in times of disasters. In fact, the Spanish Red Cross carried out a remarkable task of health care during the latter half of the 19th and the early 20th centuries. From 1896 to 1900 it took charge of the repatriation of the Spanish soldiers who had fought in Cuba and the Philippines, and between 1901 and 1927 of those resulting from the war in Africa.
The main aim of this paper is to study the role played by the Spanish Red Cross in the transmission and development of the medical science in Spain, making use of the case study of Spanish soldiers from Cuba, Philippines and Africa wars. We shall analyse the different activities of the Red Cross to deal with soldiers and their evolution over the period under consideration as well as their possible impact when dealing with civilian problems such as polio.

No Place for Humanitarianism: the Failed Intervention of the International Committee of the Red Cross (ICRC) in the Rif War, 1921-1926

Francisco Javier Martínez Antonio CCHS, CSIC, Madrid,
SPAIN

John F. Hutchinson has shown how ICRC's ideas of humanitarianism in armed conflicts up to the IWW were systematically distorted by the actual practice of national Red Cross societies, which rallied to support their respective Army medical services and to take care exclusively of their own diseased or injured comrades. At least, the ICRC was convinced of the need and allowed to intervene in a number of international conflicts, even if its "medical" activities usually limited themselves to coordinate the neutral distribution of aid provided by those non-involved Red Cross societies, to inspect the behaviour of belligerents at war and to check the condition of prisoners in concentration camps and jails.
However, in the case of the Rif War, a harsh conflict which involved Spain and France against a popular uprising against their Protectorates in northern Morocco, the ICRC doubted first if it should play any role at all and was later given almost no chance of displaying its usual tasks. These facts were due to a number of factors which will be analysed here while describing the ICRC's failed attempt at sending a medical mission to the Rif.

S42 Atomic Energy in the Public Sphere

Coordinated by **Alfredo Menéndez-Navarro (University of Granada, Spain)**
Chaired by **Alfredo Menéndez-Navarro (University of Granada, Spain)**

In this symposium we will try to delve into public perceptions of atomic energy in Spain and Italy from the mid 1940s to the late 1980s. To this aim we will first explore the Spanish Official Newsreel NO-DO, which was the main source of visual information for Spaniards up to the late 1960s, when it was supplanted by Spanish Television. The symbiosis between NO-DO production and the new State born after the Civil War therefore makes it a fundamental point of analysis for understanding Spanish culture under Franco, including science and technology. NO-DO became crucial for providing Spanish society with new cultural meanings of science, scientists and technology as well as forming public attitudes toward atomic power.
Second we will explore the Spanish Atomic Forum and its activities during the late 1960s and 1970s. The main purpose of the Forum was to promote the use of nuclear energy by representing the interests of this multi-faceted industrial sector, headed by the most important electric companies in Spain. We will analyze how this organization somehow relieved the Franco government efforts in order to legitimate the electric energy supply based on nuclear production.
We will focus on the Spanish nuclear lobby concerns about public image, and the subsequent information campaigns launched during the 1970s linked to the rising antinuclear movement demonstrations.
Finally, we will explore the relations between nuclear power and public opinion in Italy. Since its very beginning, nuclear power was well accepted by a bipartisan group of supporter among the political parties. Working on the historical archives of ENEL, the research reconstruct the shifting in the public opinion attitude, a shifting that bring Italy to reject all the nuclear plants on her territory. This happened through a popular referendum in 1987.

Atoms for a Spanish Peace: Education trough Propaganda

Javier Ordóñez Max Planck Institut for the History of SciencE, GERMANY

After John Ktrige's articles (2006, 2008) about the program "Atoms for Peace" launched by the United States during the Cold War, it has become quite clear that it would be desirable to complete his research with a more detailed analysis on the repercussion that initiative had in the countries interested in the development of industries related to atomic energy.
In this paper I would like to present the case of Spain under Franco's dictatorship in the specific period from 1955-1965 regarding two aspects: the use that Franco Rule made of atomic physics, in first place, in order to present itself as a political system interested on technological innovation and, in second place, in order to give the appearance that it strove to improve science studies in primary and secondary Education. I would like to point out, that the current investigation could complement and give a wider vision on A. Menendez specific research in the field of medicine.
The documentary basis for this work focuses on the analysis of documents from several archives of the Spanish Public Administration, the documents used by the curators of the different exhibitions on atomic energy that took place during that period, and on the analysis of the Spanish press. All this documentation allow us to say that Franco's Government pretended to be a progressive system open to the world.

The Development of a Public Idea of the Atomic Energy in the Francoism (1945-64 Period): the Role of the Official Newsreel NO-DO.

Felipe E. Ramírez Martínez Universidad Autonoma de Madrid, SPAIN

The NODO, the official newsreel of the Francoism, was during twenty five years a monopoly of information in the mass media. One of the most unexplored and yet unravelled aspects relate with the central role that NODO had in the broadcasting of scientific news and technical advances. The scientific point view offered by NODO definitely contributed to elaborate a common view in the Spaniard public for that period of time.
Particularly relevant to study in deep is the public image spread from the Franco´s regime regarding the atomic energy, an official vision that underwent strategic changes according to Franco´s domestic and foreign policies. Over the years, the official vision of "the atomic affair" moved from a terribly dangerous weapon towards the hopes for health and the promise of an unlimited energy resource. The NODO launched through nearly two hundreds news along twenty years, and became the media in charge of broadcasting to Spaniards both the fear and the hopes.
Moreover, the Francoism aware of the power of the atomic energy, employed it as an instrument representing to the Spaniards the fragile equilibrium in the world of that period, as well as a matter of the anti-communism propaganda. The Spanish atomic endeavour was one of the outstanding manifestations of the Spanish-nationalism spirit and importantly, a rationale to justify the political regime to the citizens.

Legitimating Nuclear Energy in Spain: the Role of Spanish Atomic Forum (1962-1979)

Luis Sánchez Vázquez Instituto de la Paz y los Conflictos,
Universidad de Granada,
SPAIN

The Spanish Atomic Forum is the association for the nuclear energy industry in Spain. Its main purpose is to promote the use of nuclear energy by representing the interests of this multi-faceted industrial sector, headed by the most important electric companies in Spain.
In this communication we analyze how this organization somehow relieved the Franco government efforts in order to legitimate the electric energy supply based on nuclear fission.
We will focus on the Spanish nuclear lobby concerns about public image, and the subsequent information campaigns launched during the seventies linked to the rising antinuclear movement demonstrations. In so doing, we will illuminate the ways in which the Spanish nuclear lobby perceived and reacted to the rising of ecologist movements in Spain.
The paper is based on analysis of the rich material published by the Spanish Atomic Forum during the period 1962-1979, taking as starting point the set up of the Forum and finishing with the Three Mile Island accident.

Public Opinion Strikes back: the Italian Referendum on Nuclear Energy

Matteo Gerlini University of Florence,
Angelo Baracca ITALY

In its very beginning, nuclear power in Italy was well accepted by a bipartisan group of supporter among the political parties. Working on the historical archives of ENEL, the research reconstruct the shifting in the public opinion toward an antinuclear attitude, a shifting that bring Italian state to reject all the nuclear plants on her territory. This happened through, only case in the world, a popular referendum.
The paper investigate on the historical context for such public opinion stance, moving from the Italian Communist Party congress in which an anti-nuclear motion was presented and got almost 50 %. Two weeks later the congress the Chernobyl accident happened. It raised a deep impression and a wide worry for the behaviour of the “Chernobyl cloud”, and the public debate and polemic revived. Local and national manifestations (Rome, 10 May) proliferated. In July the gathering of firms for a national referendum began. In October, after a huge manifestation at Montalto di Castro, the Craxi government decided the stop to the yard, and called for a big Conference on Energy, which was held in February 1987 without any important result.
The execution of the referendum, on 8-9 November 1987 stems from this background. By one side, the growing proposal of Italian nuclear complex, by other side the bipartisan public opinion and political representative opposing to power plant. It is well known that in the referendum almost 80 % of the votes were against nuclear. The legitimate question is: did this result univocally manifest the will of shut down every nuclear power activity?

SS01 Gender Standards in Drugs History: Crossing Boundaries

Coordinated by **Toine Pieters (VU-Medical Centre / University of Amsterdam, Netherlands)**
María J. Santesmases (Instituto de Filosofía - CSIC, Spain)
Chaired by **María J. Santesmases (Instituto de Filosofía - CSIC, Spain)**

Hormonal Contraception, Gender and Society in the Spanish Seventies

Teresa Ortiz Universidad de Granada,
Agata Ignaciuk SPAIN
Eugenia Gil García

Social studies focusing on women's health, women's history and/or medicine for women not always are elaborated using gender as a category of analysis. In the last twenty years in Spain, many scholars have made important contributions on contraception focusing on demographic, political or ethical aspects, but few of them have discussed their results from a gender perspective. These studies usually do not include woman's medical, scientific, social and religious definitions; the role of women as doctors, health administrators, scientific researchers, and/or health activists; the contribution of women's movements and social movements to the improvement of women's life conditions; the relations between sanitary and women's movements, the construction of collective gender identities, the experience of real women in accessing and using oral contraceptives and so on.
In Spain, during the last years of the Franco dictatorship and the democratic transition (1970-1982) there was a widespread movement towards the legalisation of contraception, prohibited since 1941. In this paper we want to look at the discourses surrounding the legalization of the pill as represented in the press, and at the role played by the feminist movement and the medical professionals in this debate. For this purpose we analyse, on the one hand, the information on the hormonal contraceptives that was published in the Spanish general press, feminine magazines and different kinds of feminists' publications during the 1970s, as well as in the main gynaecology handbooks used in Spanish faculties of medicine during this period. On the other hand, we will use oral interviews with health professionals and feminist activists.

The Gendering of Immunocontraceptives

Jessika van Kammen Academic Medical Center (AMC) Amsterdam,
THE NETHERLANDS

In the 1970s, a brand new approach to fertility regulation emerged: immunocontraception. The immunological mechanism of action would cause temporal infertility by provoking antibodies against substances necessary to human reproduction, such as certain hormones and surfaces molecules of the sperm and the ovum. In the 1990's about ten percent of the public funding available for research on new contraceptives was spent on anti-fertility vaccines. The research was coordinated by the World Health Organization (WHO), the National Institute of Immunology in India, the Population Council and the American National Institute for Child Health and Development/ National Institutes of Health (NICHD/NIH), which sponsored a consortium of university based research groups in the US.
Unlike in the case of hormonal methods, in the initial years research lines on target substances in both women and men were developed. The new technology was aimed at "everybody", conveniently allowing for the versatility of the emerging technology. The biomedical scientists' indetermination of the envisioned users included their sex. Why then most work was done to develop a vaccine to be used by women? I will argue that the lack of research into male immunological methods does not follow from male physiology, nor was the biomedical scientists' reiteration of these possibilities simply meant to please policy makers and funding agencies. Instead, I will show the material, institutional and political factors that determined the researchers room for manoeuvre.
The unequal distribution of sex in reproductive matters has been remarkable persistent over time and in different contexts. But these recurrent patterns do not simply unfold along a historical trajectory under their own momentum. Rather they are reproduced and remade in situations which could have been otherwise.

Gendered Moods in Women's Magazines and Drug Advertising in the Netherlands, 1950-1990

Toine Pieters VU-Medical Centre & University of Amsterdam,
Stephen Snelder THE NETHERLANDS
Frans J. Meijman

The gender identification of products has created gendered markets for most commodities in the twentieth century. This is also true for therapeutic drugs. Gender typing and metaphors have been a powerful strategy in marketing drugs. Advertisements for sex hormones and psychotropics have been shown to be more gender biased than advertisements for other categories of drugs. For advertisers it is rather challenging to produce familiar and at the same time alluring drug related gender portrayals. In order to tap into changing gender roles in society and changing notions and ideas about coping with health problems advertisers use among other sources of information, women's magazines. Women´s magazines offer a gender specific source for changing public definitions and perceptions of illness and health. In our paper presentation we will focus on the circulation of ideas and notions on gender typing and responsive health behaviour regarding depression, anxiety and sleeplessness between drug advertisements and Women's magazines within the Dutch context. Our guiding research question has been: How do changes in the representation of gendered moods and responsive health behaviour in woman's magazines relate to changes in gender typing and metaphors in drug advertisements for psychotropics? Thus, we will show that there is indeed mutual interference between these rather different sources of information as part of a process of supply and demand. Furthermore, we will point out phase differences regarding changes in the representation of gendered moods. Finally, we will discuss the development of standard repertoires of identifying and naming gendered moods in drug advertising as compared to women's magazines.

(Un-)Safe Dose Levels. Scientific-Feminist Coalitions and Contradictions in Germany in the 1950s and 60s

Heiko Stoff Department for the History of Science and Pharmacy,
Technical University of Braunschweig (Brunswick),
GERMANY

The main focus of this speech will be on analyzing the different and varying agendas for policies of zero tolerance of chemicals invading the gendered human body.
The debate about estrogens as carcinogenic substances is usually situated in the 1960s and associated with a feminist critique of hormonal contraceptives.
But in the last years it has been shown by historians of science (Gaudillière, Ratmoko, Stoff amongst others), that already in the 1940s sex steroids like estrogens were suspected of arousing cancer or stimulate existing cancer. While the German biochemist Adolf Butenandt, who cooperated with Schering AG, the world market leader for sex steroids, was eager to clear sex hormones of this suspicion he as well played a major role in institutionalizing commissions for food additives in the 1950s. Butenandt thereby was deeply influenced by Hermann Druckrey's concept of cumulative dose and cancer development, which raised the question if there indeed exists anything like a safe dose-level. Butenandt's tolerant view of estrogens was contradicted by his fundamental rejection of food colors, bleaching agents and preservatives. Druckrey and Butenandt thereby tried to enforce strict regulations for food additives as an European norm in the mid-1950s.
This policy made by scientists was supported by women's and housewife's organisations as main actors of consumer resistance in Germany. In 1956 the forty-six female members of the Bundestag pleaded for a tightening of the German Food Law. This non-party political movement led by scientists and organized women gained its discursive power through the intriguing trope of poisoned food, a poisoning of the individual and collective body. The coalition against chemical substances in food was abandoned when it came to post-menopausal therapy or hormonal contraception in the 1960s. Different from England there was no ongoing debate about sex hormones and tumors in West Germany, where Butenandt's verdict was still valid. Whereas feminists continued the struggle of the consumer organizations in fundamentally questioning the acceptability of either natural or synthetic estrogens, most gynaecologists and biochemists advocated a preferably low-dose use of estrogens.

Gender Sensitivity regarding Drug Development, Administration and Surveillance – What can We Learn from the Dialogue between History of Pharmacy and Recent Pharmacoepidemiology?

Ljiljana Verner (1) (1) Medizinische Hochschule Hannover,
Bettina Wahrig (2) (2) Technische Universitaet Braunschweig,
GERMANY

The authors of this contribution have been teaching the subject of gender differences regarding drugs in a both historical and epidemiological perspective to students of different disciplines (pharmacy, biology, psychology, history) for three years. We have noticed that a perspective on the three classical research domains of Gender Studies in Science, namely
- Gender in Science
- Science of Gender
- Gender of Science

can be valuable tools to make students more sensitive to the task of reflecting their own present and future position within experimental sciences or humanities respectively. Students learn to understand that the way a culture values old or young age, men or women, position at work or in the family, etc. has an influence on the way drugs are developed, bought, prescribed, provided by health services, and monitored. But we want to know more: Does this dialogue also include a research perspective?
In the first part of our presentation, we would like to compare historical explanatory models for the differences between male and female bodies with advanced modern medicine's perspectives (e.g. the bio-psycho-social model). We will also contrast the critical tools of Gender Studies in Science (named above) with the policy perspective of "Gender Mainstreaming". In the second part of our presentation, we will analyse one example from modern trends in drug monitoring and again compare the historical and the pharmacoepidemiological perspective in Gender Studies.
This is an experiment, whose working hypothesis is that it will work, but we do not yet know the result.

SS02 International Association for Science and Cultural Diversity (IASCUD)

Coordinated by Karine Chemla (REHSEIS-SPHERE, CNRS, France)
Chaired by Mike Osborne (Oregon State University, USA)

Mathematical Cultures in 13th Century China —A view from Diagrams

Karine Chemla CNRS (UMR 7219, REHSEIS—SPHERE), FRANCE

The talk intends to highlight the cultural diversity in the mathematical practices to which Chinese mathematical sources of the 13th century bear witness. The point will be made on the basis of how diagrams were drawn, how they were inserted in texts, and how they were used.

Circulation of Knowledge as Reflected in the Indian Travel Accounts to Europe in the Late 18th and 19th Centuries

S. Irfan Habib National University of Educational Planning and Administration (NUEPA), New Delhi, INDIA

This paper will deal with the insights available in the travel writings of some travellers from India to Europe during the late 18th and 19th centuries. Most of them were primarily curious about the West and its culture; however they made some serious observations about the scientific and technological developments in Europe. They produced knowledge about Europe in India and about India in Europe. Most of these travellers "accompanied Englishmen back to their native land, in one or other capacity, as munshis, envoys, or gentlemen of leisure". It is possible that quite a few travellers were encouraged by the British to cross the seas to see for themselves 'the wonders of wilayat and the superiority of Western culture and technology. For example, one of the travellers Mirza Abu Talib assured his reader in his travel account "that by reading this account of the state of the arts and sciences in Europe, he will considerably add to the stock of his own knowledge". Another traveller Karim Khan elaborated that the European scientists had viewed a number of heavenly bodies with the aid of a telescope and discovered a number of new facts. Karim Khan also dealt with the various aspects of the British industrial revolution as he was there in the mid-nineteenth century when the British capital was undergoing radical technical and industrial transformation. These travelogues were the early attempts to help expose India to the rapid scientific and technical advancements in Europe.

Intercultural Encounter and the Construction of Modern Science: India and Europe, 16th-20th Centuries

Kapil Raj Centre Alexandre Koyré,
Ecole des Hautes Etudes en Sciences Sociales, Paris,
FRANCE

The relationship between modern science and the rest of the world has been viewed either as one of diffusion from Europe or in terms of an irenic contribution of more-or-less well-defined civilisational spaces to the "common kitty" of knowledge we call science. This talk will focus on the crucial role of circulation, intercultural encounter and interaction in the making of much of what goes under the name of "modern science". It will thus question the idea of science as being peculiar to this or that so-called civilisation or culture and will instead raise a set of new issues that this circulatory perspective raises.

Qi-Transformation and the Steam Engine: Visualizing the Body in Chinese Medicine in the Nineteenth Century

Sean Hsiang-lin Lei Institute of Modern History,
Academia Sinica,
TAIWAN

Tang Zhonghai (1851-1908), the widely-acclaimed first proponent of medical eclecticism in the late Qing period, invented the famous formula: "Western medicine is good at anatomy; Chinese medicine is good at qihua (Qi Transformation)." While it is well-known that Tang coined the concept of qihua and thereby created a long-lasting dichotomy between Chinese and Western medicine, it is little known that Tang's conception of qihua was built upon and therefore heavily influenced by a newly imported technology from the West, namely the steam engine. Based on this important discovery, this paper traces three interconnected processes, the introduction of steam and the steam engine into China, the invention of qihua, which served as the crucial tool for both boundary-drawing and communicating between two medicines, and the related transformation of the body in Chinese medicine.

Cultural Hybrids and Transmission of Knowledge: The Case of the Philosophy of Quantum Mechanics in Japan, 1925-1940

Kenji Ito The Graduate University for Advanced Studies, JAPAN

This paper criticizes certain approaches to cultural aspects of non-Western science and examines, as an example, how Japanese physicists and other intellectuals reacted to philosophical issues of quantum mechanics.
In the English language scholarship, there exists a tendency to consider non-Western science as interesting only when presented as different from the West in a cultural-essentialist way. One symptom of such tendency is to seek essentially different cultural traits in non-Western science. In studies of science in East Asia, thus, often readers expect to see influence of Eastern thoughts and feel deeply disappointed if they find none.
One conceptual basis of this tendency is the notion of national culture, an assumption that one could reasonably talk about the culture of one country. In reality, cultural resources available in a given context very often have trajectories across national boundaries. Careful microscopic studies should reveal global nature of the cultural context.
The issue of quantum philosophy in Japan, in particular, tends to raise an expectation that exotic Oriental thoughts, such as Taoism, had something to do with it. This paper shows that the cultural context in which philosophy of quantum mechanics was understood and debated in Japan was a hybrid of various cultural traditions, most of which originated from Europe. The few ideas of Asian origins did not take any important place in the debate.
What makes this case interesting and worthwhile is the way how various cultural resources were combined and historically situated. Such inner workings of the historical process can be considered unique in each country, but such uniqueness cannot be reduced to the country's cultural heritage; they are contingent on social and political situations in a given time. Omitting such complexity and jumping on shallowly appealing but simplistic description would prevent understanding of what really happened.

Gender Diversity in Science

Abha Sur Massachusetts Institute of Technology, USA

Gender is embedded in an ensemble of relations of class, caste, race, ethnicity, and nationality among others. An understanding of diversity in science must therefore include a larger social matrix representing the interaction and intersection of different dimensions of social inequality. Instead of addressing questions of class, colonialism, gender, and race separately, as has been the practice in the history of science, there is a need to develop models that reveal their interconnectedness. I will draw upon professional experiences of women scientists of different races, ethnicities, and nationalities working in the United States to suggest that women's different locations on the social matrix influence their acquisition of tacit knowledge in their chosen scientific disciplines. I will argue that socialization into the scientific community, essential for acquiring tacit knowledge, is mediated by informal knowledge—experience obtained outside formal avenues of learning. This, in turn, affects the ways in which knowledge circulates between different actors or groups of actors.

SS03 Scientific Correspondence

Coordinated by Federica Favino (University of Rome La Sapienza, Italy)
Chaired by Federica Favino (University of Rome La Sapienza, Italy)

Circulation of Science through Letters; Circulation of Letters through Web-Technologies. The "Eastways of Science" Project

Federica Favino University of Rome La Sapienza,
ITALY

Correspondences are one of the most important sources for a science historian: they shed light upon the origins of new scientific theories; they are a privileged point of view to understand the debates of an age of censorship; last but not least correspondences are necessary instruments to understand that extraordinary phenomenon that was the ideal super-national academy of the 17th century European "scientists".
These are some of the reasons why the letter-exchanges kept by the «heroes» of modern science still offer material for monumental edition plans. Anyway, if we consider the scientific correspondences as the main source for mapping boundaries, extension, density, population and roadways of the actual "Republic of sciences", the editions on-paper - even if philologically peerless - are widely insufficient to manage the huge mass of information inferred from letters. Eastways of Science is one of the many projects that nowadays exploit the web-technologies to edit, manage and study such documents. It is a research project co-financed by European Commission, hosted by the University of Rome La Sapienza and technologically implemented by the Rinascimento Digitale Foundation-Institute and Museum for the History of Science of Florence. It aims at creating an electronic database that would work as a common repository of letters of scientific-historical interest; a register of the men, women, lecturers, practitioners, patrons, institutions, things etc. involved in such a "Republic" (especially as to Middle-East Europe) in the second half of the 17th Century; a «dynamic» database able to reconstruct the networks of scientific relations that crossed early modern Europe - that is the scientific information flows - making them visible on a geographic map. It focuses on the Academy of the Cimento correspondence, and on its intersections with the epistolaries by Johannes Hevelius and Giovanni Alfonso Borelli.
This paper aims at explaining and discussing methodologies, ends and temporary results of the project.

Men of Science, Men of Letters. Scientific Correspondences of the "Accademia delle Scienze" among the "Archivi del Novecento"

Nicoletta Valente Accademia Nazionale dei XL, Rome,
ITALY

Many of the outstanding figure of XIXth and XXth Century Italian science left their papers to the Accademia delle Science or dei XL, which they belonged to. Therefore, in the Roman site of the Academy - founded in 1782 with political and cultural aims - lie one of the most huge patromonies concerning the italian scientific culture: letter exchanges by Stanislao Cannizzaro, Emanuele Paternò, Arturo Miolati, Enrico Bompiani and many others. For more than ten yeas, the Academy has been cataloguing, filing and editing on the web these precious documents. The strategic tool of this long-lasting enterprise has been the software GEA (Gestione Elettronica Archivi - Electronic Archival Management - http://www.baicr.it/site/it-IT/Gli_Strumenti/Software/GEA), a software especially suitable to describe, manage and consulte data-bases of different kinds. Many other archives of contemporary cultural italian institution share this tool, and thanks to it, they partecipate in the same integrated platform Archivi del Novecento (Archival of the XXth Century). This paper aims at describing this project, its ends and its metodologies, and to present this network as an important resource for the history of science.

Epistolary Writing and the Discipline of Discourse in Early Modern Medicine

Massimo Rinaldi Dipartimento di Storia,
Università di Padova,
ITALY

During the early modern age, European scientific communities start using epistolarity as a tool for disseminating ideas and practices, seeing it as endowed with vigorous argumentative and equally strong persuasive qualities. This phenomenon still needs to be studied within the perspective of the growingly wide affirmation of epistolary communication in the literary and erudite discourses of the time and the complex theoretical framework which was setting shared norms and standards for the genre.
In this paper I intend to survey the collections of letters published by the best known medical writers of the late sixteenth and early seventeenth centuries (including Konrad Gessner, Pietro Andrea Mattioli, Johannes Crato, Thomas Bartholin, Vittor Trincavelli and Thomas Erastus). I aim to verify whether the disciplining of medical discourse also passes through a redefinition of epistolary writing – its structure, rhetorical order, model-making devices – comparable to what was being proposed in those same decades in the field of general literature by the great theoreticians of the genre, namely Stefano Guazzo and Emanuele Tesauro.

Negotiating Medical Authority in Early Modern Physicians' Epistolary Networks

Michael Stolberg Institut für Geschichte der Medizin,
Universität Würzburg,
GERMANY

In 16th- and 17th-century medicine letter writing played a crucial role. Numerous physicians participated in extensive epistolary networks. Their letters covered a wide range of topics, from new theories and empirical findings to political and confessional controversy, from the challenges and rewards of medical practice to domestic affairs. They were much more than a means of communication, however. In the absence of scientific periodicals, epistolary networks constituted the principal public sphere in which the success or failure of new books and ideas was decided upon and in which some authors rose to the position of an authority while others remained controversial or were marginalized. In their letters, early modern physicians could exchange their opinions and criticism of individual authors and books much more quickly, widely and openly than in books. This paper will draw on a sample of more than thousand manuscript letters written, for the most part, by physicians – some famous, some hardly known – in the German speaking areas between 1530 and 1650. The letters are taken from a data base which is at the core of a 15-year project on "Early modern physicians' letters" started in early 2009 at the Institute for the History of Medicine in Würzburg under the auspices the Bayerische Akademie der Wissenschaften which will ultimately provide access to many thousands early modern physicians' letters via OPAC. As the paper will show, a thorough analysis of such letters offers unique insights into processes involved in the creation of new medical authorities and into the relative importance of criteria such as originality, learning and style, association with established authorities or intraprofessional and moral conduct which prompted the appreciation or rejection of an author and his work.

Verba Volant, Scripta Manent: the Importance of Correspondence in Early Modern Medical Diagnosis

Annarita Franza University of Pisa,
ITALY

The aim of my talk is to underline the importance of correspondence between physicians in Early Modern medical diagnosis. The paper studied the correspondence between Romolo Spezioli, personal physician of Queen Christina in Rome and the famous Italian scientist Marcello Malpighi. The research examines the serial of letter that is kept in Archiginnasio Library and in University Library in Boulogne. The collection of the letters, unpublished and unstudied, offers a unique example of medical correspondence full of details about the description of diseases and therapy in XVII Century and it represents an important source of reconstruction of the epistemological approach to catarrhal diseases in Early Modern medicine.

Antonio Vallisneri's Network and the Structure of Naturalistic Knowledge in Early 18th-Century Europe

Ivano Dal Prete Yale University,
USA

Antonio Vallisneri (1661-1730) was an outstanding protagonist of early 18th-century European medicine and natural history. His correspondence, in particular, has proved an essential tool in the investigation of the still little known Italian scientific culture of this age. In this paper we will shift the focus from exchanges between the best-known intellectuals and international contacts within the European "Republic of Letters" – the mainstream approach in current historiography – to the regional and local networks of Vallisneri's correspondence. We argue that, far from being passive receivers of notions and practices, local naturalists and amateurs were an essential element of the structure of naturalistic knowledge in early modern Europe, and fully contributed to its construction. With particular reference to the on-line inventory and edition of Vallisneri's correspondence, we will also explore the pivotal role of web-based editions for this and future researches.

The Zoological Collections of the Museu de Lisboa and the Networks of Scientific Correspondence and Exchange (1858-1898)

Catarina Madruga Zoology and Anthropology,
Museu Nacional de História Natural da Universidade de Lisboa,
PORTUGAL

In 1858, the royal zoological collections hosted in Lisbon became part of the Polytechnic School [Escola Politécnica de Lisboa 1837-1911] to be of assistance to the classes in Zoology. The previous «Museu de Lisboa» at the Royal Academy of Sciences was now to be organized following proper scientific and up-to-date knowledge. José Vicente Barbosa du Bocage [1823-1907] as the head professor in Zoology became the Director and first organizer of the "Zoological Section of the Museum of Lisbon". Under his direction the royal collections became a museum designed as part of the exchange network of specimens and the scientific knowledge within.

To discover, collect and send home to Europe natural objects and images of the new world was a comprehensive task held by many naturalists whether with an academic, military or religious background. Nevertheless, the understanding of the knowledge held in all the thousands of specimens being brought to European collections and exchanged between European societies, academies and universities was now being completed inside the collections storage rooms.

In this paper we analyse the correspondence of Barbosa du Bocage to his foreign peers aiming to contribute for a clearer picture of the importance of the network established between private collections, universities and museums in the construction of new knowledge in the study of nature at the second half of the nineteenth century.

We argue that some influential authors were organizing knowledge about nature from inside the museum's walls and that the way the trade of specimens inside Europe was made is of major importance for the production and reproduction of knowledge. We hope that analysing the relationships established between these authors (their institutions and nations) and other professors, collectors, patrons, diplomats, naturalists and taxidermists may be helpful in the study of scientific knowledge production.

Scientific Correspondence in the Belle Epoque: Henri Poincaré and Friends

Scott Walter University of Nancy 2, and
Henri Poincaré Archives (CNRS, UMR 7117),
FRANCE

The pursuit of exact science during the Belle Epoque is known to us essentially from published sources: articles in professional journals, textbooks, and obituaries. More recently, unpublished sources, and in particular, collections of scientific correspondence, have shown us a quite different picture of this activity, one in which the personality of individual scientists expresses itself more freely. My paper compares the received image of Poincaré's mathematical physics with one formed on the basis of his correspondence with physicists, mathematicians, and astronomers. Two sets of exchanges are revealing in this respect. One is Poincaré's correspondence with the Swedish astronomer Anders Lindstedt, from 1883 to 1885, concerning the convergence of certain trigonometric series employed in celestial mechanics. The other is with a young French experimental physicist, Victor Crémieu, whose test of the validity of Maxwell-Lorentz electrodynamics Poincaré supervised in 1901 and 1902. These exchanges shaped Poincaré's views, respectively, of the three-body problem, and of the principle of relativity.

The Epistolar Correspondences between Brioschi and Cremona and Betti and Genocchi

Nicla Palladino University of Salerno,
ITALY

In the 50s of nineteenth-century, there was the necessity to organize new structures in the borning Italian State: the Unification of Italy marked a turning point not only in the political life of the Country, but also in the organization and content of university education and scientific research. More expecially, a group of mathematicians helped to build the foundation for the renewal and development of Italian mathematics that took place in the following decades. This group included, among others, Francesco Brioschi, Enrico Betti, Angelo Genocchi and Luigi cremona.
The Unification of Italy had positive effects on Italy's cultural climate, expanding and improving scientific relationships among scholars. Italy achieved a leading position in Europe, particularly in the field of math¬ematical sciences. I want to present here the epistolar corrispondence between Brioschi and Cremona and Betti and Genocchi, covering the period from the mid to late 19th century, provide greater insight into scientific developments and political-institutional arrangements that took place at the time of the formation of the new unified Italian state.
The letters between Brioschi and Cremona are numerous and show that Brioschi was the most complex character among the four. He assumed several institutional nominations, was member of the "Consiglio Superiore della Pubblica Istruzione" and director of the Politecnico in Milano. He was a prominent character in the construction and organization of the new unified Italian state.
The letters between Genocchi and Betti show the importance of Genocchi who practiced the profession of full-time researcher. He studied in several fields of research: analysis, theory of the numbers, but in their corrispondence, Betti and Genocchi talk about also mathematical education, pseudospherical surfaces, non-euclidean geometries.
I want also to remember that Brioschi and Betti studied the "explicit solutions" of the fifth-degree general algebraic equations by means of the elliptic functions.

Scientific Correspondences on the Web: Challenges and Opportunities

Christine Blondel Centre Alexandre-Koyré,
CNRS, Paris,
FRANCE

The edition of scientific correspondences on the web offers new opportunities but also new challenges. One of the major opportunities is the possibility to build a virtual workspace around any document. Access may be given to the fac simile of a manuscript, to full-text search including mathematical expressions, to online publications alluded to within the text, to collections of instruments, etc. Documents of different natures and origins, accessible either through hyperlinks, through the same platform as the document, or through open-source tools, may be requested to shed light on a specific point. When enough correspondences of the same period will be available online, it will be possible to cross subcorpuses of two correspondents and set up networks analysis. Another major opportunity is the open character of online corpuses. Including new letters, to be unearthed sooner or later, to an online correspondence no longer requires the edition of a supplementary volume to a printed edition. Critical edition becomes a continuous and open process. Moreover, in a next future, critical edition may stand as a collective adventure through online collaborative platforms. These very opportunities imply challenges. First of all, there is no reference model as for printed academic editions where rules have been gradually established for around a century. How to reference a continuous edition? At the same time editors may incline to address the larger potential audience to the detriment of erudition. Or is a new erudition on the way? As for the openness in time, it could be an illusion since academic research is more and more based on short-term funding whereas these projects require high labor costs, long-term funding and a sustained follow-up to tackle the dizzying rate at which web technologies are evolving. I will go through these questions which arose during my work on the online edition of Ampère correspondence on the website "Ampère et l'histoire de l'électricité".

Circulation of Knowledge in the 17th Century Dutch Republic. Analysing Correspondence in a Webbased Collaboratory

Henk Wals Huygens Institute,
Royal Netherlands Academy of Arts and Sciences,
THE NETHERLANDS

During the last decades historians of science have increasingly become aware of the Dutch Republic played in the "scientific revolution" of the 17th century. Intellectuals from all over Europe visited the Low Countries and ideas of Dutch-based scholars were disseminated abroad. However, it is still unclear how this knowledge circulated, how ideas were appropriated and transformed in to scholarly themes. Until the publication of the first scientific journals in the 1660.s, letters were by far the most direct and important means of communication between intellectuals. Using web based tools to analyze and to visualize the 17th century intellectual networks and their themes of interest, a multidisciplinary collaboratory of historians of science, linguists and humanities-computer scientists is studying the circulation of knowledge in international context around a machine readable corpus of ca. 20.000 letters of Dutch scholars of the 17th Century. We analyze quantitative and qualitative information to answer questions regarding the geographical and intellectual spread of this information. Who introduced who? What is an introduction letter; can we distinguish specific politeness formula or rhetorical structures? Can we distinguish certain circles, what sort of scholars made part of them, and where were they geographically located? How can we distinguish emerging themes and debates in these social and intellectual networks over time and space?
In my paper I will give a short overview and discuss some preliminary results of the project.

SS04 Science, Astronomy and Instruments from the Middle Ages to the 17th Century

Coordinated by the Conference program committe

Chaired by Carles Puig-Pla (Universitat Politècnica de Catalunya, Spain)
Roser Puig (Universitat de Barcelona, Spain)

Buildings as Instruments in the Mediterranean Context

Mònica Rius (1) (1) Universitat de Barcelona,
Roser Puig (1) (2) Universitat Politècnica de Catalunya,
Maria Rosa Massa (2) SPAIN

Textual sources and architectonic evidences in both Muslim and Christian Mediterranean societies provide us many references of meridian-lines housed by civil and religious buildings and used to cast astronomical data. The first known of them was the Fakhri sextant by al-Khujandi. It was constructed in Rayy, Iran, in 10CE to measure the obliquity of the ecliptic. A second one was the giant sextant of Samarqand in 15CE. During the 17CE and 18CE meridian-lines were traced inside the European cathedrals of Florence, Bologna, Rome and Paris and served to determine the longitude of the solar year through precise and continuous measurements of the position of the Sun. Several direct references of the 17th century like Mengoli's and Cassini's works have promoted this study. A later reference should perhaps be added to them, a description quoted by Al-Asfi al-Andalusi, in a Maghrebi manuscript of 17CE, of an odd architectonic device to show the exact moment of the spring equinox with a lightening solar effect. The aim of the paper which is still a work in progress is to explore social, political and scientific connections between all these particular traditions of instruments and their textual sources. These analyses can provide new insights in the view of scientific circulation in the Mediterranean context.

The Description and Use of the Astrolabe in Medieval Hebrew

Josefina Rodriguez Arribas The Frankel Institute for Advanced Judaic Studies,
University of Michigan,
USA

This paper is part of a work in progress on the cultural values of the astrolabe in Jewish cultures. My presentation is concerned with the genre of the instrument-book in medieval Hebrew and specifically with the first treatises written in Hebrew describing and explaining the astrolabe. As far as we know, Abraham ibn Ezra (12th c.) was the first Hebrew writer dealing with this subject and implementing the language of the Bible and the rabbis for conveying and explaining the parts and uses of this instrument (so far described in Greek, Syriac, Arabic, and Latin, never in Hebrew). Although the reading of these treatises, as a rule, displays a heavy and wearisome language, it is indisputable that they are the first texts to make Hebrew a language capable of scientific expression (and eventually, research).
Our first purpose is to analyze the early emergence of technical Hebrew in the three treatises that Ibn Ezra devoted to the astrolabe. The second objective will be the synoptic analysis of the three treatises in order to find out why Ibn Ezra devoted several different texts to the same subject in a brief period of time (Mantua 1146, 1st version; Verona 1146, 2nd version; and Béziers 1148, 3rd version). This analysis could let us guess something about the level of scientific knowledge in the Italian and French Jewish communities intended in each particular treatise. Finally, we would like to investigate the specific types of astrolabe that Ibn Ezra could use in the different countries where he lived until 1148 (the date of the last treatise) and, specifically, what kinds of astrolabe are referred to in his treatises.

The Reception in the Western Area of a Same Method for Two Medieval Astrological Practices

Montse Díaz-Fajardo Universidad de Barcelona,
SPAIN

Medieval Arabic astrologers used three fundamental practices in order to cast a horoscope: the determination of the celestial houses, the prorogation and the projection of rays.
A horoscope is a representation of the celestial sphere in a specific moment and for a given latitude. The equator and the ecliptic are maximum circles of the celestial sphere; the ascendant of the horoscope depends on the horizon of the locality.
In the computation of the three mentioned practices intervened one or several of these circles. Likely, this fact helped to the establishment of a relation between those practices, even though they had different aims and an independent development with their own methods.
My study is devoted to the connection between the prorogation and the projection of rays and to the dissemination of a common method for both techniques in the Islamic West.
The equatorial method was the link between the two techniques. Up to now, we knew about it that it was the standard calculation for the projection of rays since the first half of the 9th century. However, in the East in the second half of the 10th century, the equatorial method was also used for the prorogation. This common method is found in a book dedicated to the prince of Aleppo Sayf al-Dawla (945-967) "The Introduction to the Craft of Astrology" of al-Qabisi (Alcabitius). In the Mediterranean Western Area, the popularity of al-Qabisi's book was such that its Latin translation was still being printed in 1521. The common method was also used by a Moroccan astrologer of the first half of the 15th century: in the Middle Ages, authors used to copy passages of other sources but, in this case, the use of several technical terms denotes that the defining text was written by a Western astrologer.

The Artisans of 'Plus Ultra': Pilots, Cartographers, and Cosmographers in the House of Trade in Seville during Sixteenth Century

Antonio Sánchez Martínez Centro de Ciencias Humanas y Sociales, Madrid,
Consejo Superior de Investigaciones Científicas,
SPAIN

In the context of the growing historiographical interest that is causing the world of Iberian science, especially among non-Spanish authors, during the Early Modern period after the Discovery of America, in this paper the author shows how it carried out the grand project of institutionalization of cosmography throughout the sixteenth century, from the Catholic Monarchs to Philip II. Through the inner workings of the House of Trade, the Indian Council, and the Academy of Mathematics this paper highlights how the Universal Monarchy and its conqueror slogan 'Plus Ultra' tried to encircle the Atlantic world first, and dominate the New World after by means of the Cosmography, an essential science for the maintenance of the overseas Empire.
The aim of this paper is demonstrates how the institutionalization of cosmography and navigation ended with the slogan Non Terrae Plus Ultra, and led to the emergence of imperial heading Plus Ultra helped by the navigation of a Mare Tenebrosum (the Atlantic Ocean), and the delineation of the contours of a new world that began beyond the Columns of Hercules. This process was made possible by the establishment in Seville of the House of Trade in 1503 and the creation of scientific offices such as Pilot Major, master of making nautical charts or cosmographer. The ship appears on the cover of the Regimiento de navegación (1606) by Andres Garcia de Céspedes across the pillars of the hero of Greek mythology highlights the Baconian premise of man's dominion over nature, the knowledge gained through the conquest of the West Indies, and also the wishes of the Spanish Monarchy by taking advantage of the usefulness of scientific knowledge by joining the nautical experience and cosmographical theory.

From Denmark to Italy: Franciscus Patricius' Reception and Criticism of Tycho Brahe's Geo-heliocentric Planetary System – and the Repercussions

Matjaz Vesel Institute of Philosophy,
Scientific Research Centre of the Slovenian Academy of Sciences and Arts,
SLOVENIA

In 1588 Tycho Brahe published a book on the comet of 1577 De mundi aetherei recentioribus phaenomenis, which contained the first published account of his new geo-heliocentric planetary system, with all the planets revolving around the sun and the sun in turn revolving around the stationary earth. In the Tychonic system the orbits of Mars and the sun intersected, which was made possible by replacing the traditional solid, real spheres with the fluid heavens, in which the spheres are nothing more than geometrical boundaries. A few copies of the printed book were sent to leading astronomers throughout Europe, some were offered for sale at the Frankfurt book fair, but most copies were stored unbound.
Three years later in Ferrara (1591) the first note on the Tychonic system appeared in a published book. Franzicus Patricius briefly described it in his Nova de universis philosophia at the end of his overview of the history of astronomical systems, which according to him were all based on the same assumption: the stars and planets are attached to the heavenly spheres sicut nodi in tabula, that is to say, to solid, real spheres. The result of this presupposition of all astronomy, including Tycho Brahe's, were according to Patricius numerous astronomical "deliraments and monstruosities", which in the end produced "a whole new Chaos".
In this paper I want to investigate how it happened that Patricius completely overlooked one of the crucial achievements of Tycho Brahe's book (did he read it at all?), secondly, what he proposed in order to save the universe from astronomical Chaos, and thirdly, how astronomers (Brahe, Kepler) responded to his criticism of Brahe in particular and astronomy in general, as well as to his proposed solution of the "problem".

The Battle of the Astronomers. Johann Adam Schall von Bell and Ferdinand Verbiest at the Court of the Celestial Emperors

Stefano Salvia University of Pisa,
ITALY

My talk will focus on the two most outstanding figures among the Jesuit missionaries in 17th-century China: Johann Adam Schall von Bell (1591-1666) and Ferdinand Verbiest (1623-1688). In 1619 von Bell reached Macao, bringing some telescopes along and translating European mathematical, astronomical, and optical works from Latin to Chinese.
Von Bell aimed at introducing the telescope into Chinese astronomy, traditionally based on naked-eye observation and calculation. In 1634 he started a correspondence with the last Ming Emperor, Chongzhen (1611-1644), describing the many useful applications of the telescope.
With the advent of the Qing dynasty, von Bell became counsellor of the new Emperor, Shunzhi (1638-1661), as well as Head of the Mathematical Board and Director of the Imperial Observatory. Verbiest was called in 1660 to assist von Bell in his project of reforming the Chinese traditional calendar.
The political situation changed dramatically in 1661, with the Empire ruled by four regents who were hostile to the Jesuits, as much of the Chinese mathematicians at the Observatory. What followed was not just a conspiracy against the Jesuits, but a sort of "Kulturkampf" raised by the most conservative side of the Manchu regime, which regarded the Europeans and their increasing authority as a threat for the Empire.
I want to discuss the famous contest between the Chinese astronomer Yang Guangxian (1597-1669) and the Jesuit mathematicians, which lasted from 1664 to 1669. Behind the scenes of a public competition to compare the merits of European and Chinese astronomy, a dangerous game was played at court, which involved science, technology, philosophy, power, credit, patronage, personal rivalry, and luck.
The contest was finally won by Verbiest, who succeeded to von Bell as Head of the Mathematical Board and became a close friend of the new Emperor, Kangxi (1654-1722), teaching him geometry, philosophy, and music. He translated Euclid into Chinese and in 1673 he rebuilt the Observatory according to the European standards.

The Theory of Space and the Rejection of the Vacuum in Descartes' Early Work

Giurgea Madalina University of Bucharest
ROMANIA

The issue of the rejection of the vacuum in Descartes' thought has been an important subject of debate among scholars of early modern thought. This has happened not only because the obvious difficulties in interpreting Descartes' theory of space as it was presented in his early treatise, Le monde, but also because such an interpretation bears upon a large number of vexing problems of Cartesian philosophy, like the nature of bodies, causality, the problem of action and the role of God.
In this paper, I aim to examine closely the Cartesian concepts of space, body and vacuum and to investigate the possibilities of explaining these concepts in view of the theory of matter and the laws of physics. Therefore, I will conduct a historical examination of the important views in 16th and 17th centuries regarding these specific issues on the base Descartes' correspondence with Mersenne, Beeckman, Fromondus and Arnauld. I will sum up the two main interpretations given to Descartes' conception of matter, namely the corpuscularian and the atomistic approaches and I will build up a case for rejecting the second. The rejection of the atomist approach is made possible by two assumptions. Firstly, in the early period of his work Descartes has the same idea about space, namely as being identical with the matter which occupies it, as he argues in Principles. Secondly, if we give attention to his explanations for the rejection of the void we could observe that his argumentation is bases on a certain theory of bodies and also of space which could be sketched form the ideas presented in his fabula of the world. I will take into consideration significant reconstructions developed by Daniel Garber and Richard Arthur concerning this problem and I am inclined to accept Daniel Garber's view about the rejection of void having an insufficient argumentation in the Treatise on Light. Nevertheless, I strongly believe that it is more appropriate for Descartes' works to consider his point of view as a first step in the further development of his physic.

SS05 Natural History and Medicine from the 16th to the 19th Century

Coordinated by the Conference program committe

Chaired by Alfons Zarzoso (Museu d'Història de la Medicina de Catalunya / CEHIC, UAB, Spain)
Àlvar Martínez-Vidal (Universitat de València, Spain)
Josep Maria Camarasa (SCHCT, Barcelona, Spain)

Medical Humanism in Late Renaissance Italy: Girolamo Mercuriale's Suggestion of the Rise of "New Diseases"

Maria Kavvadia Dept. of History and Civilization (HEC),
European University Institute (EUI), Florence,
ITALY

Due to the rich content of Girolamo Mercuriale's De arte gymnastica (Venice, 1569), drawing from other than purely medical sources (textual as well as material), the task of designating the medical nature of the book in its full spectrum suggests at the same time the mapping of the boundaries of sixteenth century medicine as well as the book's "scientificity", as the product of a sixteenth century "rational and learned" physician. Mercuriale's diagnosis of "new diseases" and his prognosis of "future" diseases surprisingly (or not) direct the "modern" readers (medical men and others) of the book back to antiquity to find the proper method of medical treatment for all the "modern" scourges. In this framework, aspects of the ancient past are reconstructed in "medical" images and they are examined through textual and material (antiquarian objects, remaining, etc.) sources which are interpreted in "modern" terms so as to demonstrate the timeless medical value of the ancient, "traditional", "indigenous" culture. In the De arte gymnastica aspects of the ancient Greek and Roman culture are being medicalized by Mercuriale with the aim to form a "modern" medical art: the "art of gymnastics". In this medical discourse on health, disease and treatment Mercuriale raises issues regarding the limits and the credibility of the contemporary corpus of medical knowledge, its format and content, the focus of contemporary medical practice, as well as the nature and the effects of practices of contemporary lifestyle, having two "scientific" criteria: the notion of a healthy human body acknowledged as the actor of everyday life and culture, and the opinion that medicine can be benefited from other fields of knowledge too. How is the scientific nature of this medical book to be designated and which is its content?

Amato Lusitano and his Pilgrimages through Europe. His Contribution for the Development of European Medicine in the Sixteenth Century

Isilda Teixeira Rodrigues Centro de Estudos de História e Filosofia da Ciência,
Universidade de Trás-os-Montes e Alto Douro-UTAD, Vila Real,
PORTUGAL

This study covers a remarkable period in European history - the Renaissance, and has as main objective to analyse the contribution of the Portuguese doctor, Amato Lusitano (1511-1568) for the development of European medicine in the sixteenth century.
Amato Lusitano was born in Castelo Branco, with the name of João Rodrigues. He was only 14 when he went to Salamanca to study medicine. After graduation, he returned to Portugal but soon after he began a long pilgrimage through the North and South of Europe. His dedication to medicine, and moreover the greed of new knowledge, led him for long trips through Portugal, Spain, France, Netherlands, Italy and Turkey. Amato perfectly mastered eight languages, including Spanish, Portuguese, Latin, Greek, Arabic and Hebrew. In possession of such remarkable advantages, he was able to freely transfer to any city or country where he would find favorable conditions for the exercise of his profession.
Amato Lusitano is one of the major references of European medicine of his time. It was worthy of the title page picture on the book of some of his colleagues. His service was ordered by personalities as diverse and distinct as the Pope, the King of Poland, the city-state of Raguza, or the Grand Turkish of the Ottoman Empire.
We found that his views and interpretations, although influenced by the philosophical and scientific thinking in at the time, are remarkable, both in content and in form, showing a knowledge of the empirical analysis and synthesized by a thought that often exceeds the mental structures of that time. His third book, the Seven Centuries of Medicinal Cures, which was the subject of our analysis, is a collection of valuable observations of Surgery and Medicine, collected throughout his wanderings through Europe.
This work was first published in 1580 in Leon and was reissued, complete or fragmentary, at least 57 times. This number of editions shows the influence that the Centuries had for several years, from various academic groups, including doctors and medical students of the many universities in Europe.

Giovanni Borelli (1608-79) on Animal Movement

Jarmo Pulkkinen University of Oulu,
FINLAND

Although Giovanni 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. 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).

Wandering Exotica. The Illustrations in Nieremberg's Historia Naturae (1635)

José Ramón Marcaida López Instituto de Historia,
Centro de Ciencias Humanas y Sociales,
Consejo Superior de Investigaciones Científicas,
SPAIN

Juan Eusebio Nieremberg's Historia Naturae (1635) constitutes a rare contribution to natural history and natural philosophy coming from Spain during the first half of the seventeenth century. Featuring a theologically oriented approach to nature, mainly focused on the curious and the rare, the book is particularly noteworthy for the way it makes use of the materials (texts and illustrations) gathered by Francisco Hernández during his expedition to the New World in the 1570s.
The story of these materials is well known among scholars, specially in relation to the Roman edition of Hernandez's texts and illustrations produced by the Accademia dei Lincei. Nieremberg's treatment of these materials, however, has not received as much attention, despite some significant work being done on the American flora featured in his book.
The purpose of this paper is to focus on the visual content of Historia Naturae. By examining several woodcuts of fauna and flora, our aim is to gain further insight into the mechanisms involved in the production and distribution of images representing unknown subjects such as New World animals and plants. The issues we want to address are: How were these images produced? How did they circulate? Which was their epistemic value? How did they compare to textual accounts?

Doing Science in the Mission Field. The Doctor of the Danish-Halle Mission in Tranquebar, South India, ca. 1730-1766

Niklas Thode Jensen European University Institute, Florence,
ITALY

From their arrival in Tranquebar at the beginning of the eighteenth century, the missionaries of the protestant Danish-Halle mission were engaging with many different kinds of knowledge present in Tamil society and with the local natural environment. This paper will focus on the activities in the field of natural history or science, especially medicine, botany and chemistry, from the time of the arrival of the first mission doctor around 1730. The establishment of the office of mission doctor appears to be a decisive moment for the development of the later famous connection between the Mission and scientific enquiry. As a case study, the office of the mission doctor presents a window into the multiple practical difficulties behind the 'transmission' of knowledge from the colonial 'periphery' to the scientific 'centre's' of Europe. These problems of lacking facilities, of 'trading' knowledge with local experts and of reorganizing local knowledge into recognizable European conceptual forms, make the process of doing science in the colonies look more like a translation than a transmission. What came out of it was something new, not just a transmission of existing local objects, texts or practices. In this way, the new scientific knowledge about Indian nature was not just collected locally in the colonial mission field; it was constructed in a global process of negotiation between the practices of local experts, the interests of the scientific 'centers' of Europe and the very tangible realities of colonial life.

Commemorating the 250th Anniversary of the Royal College of Surgery of Barcelona

Núria Pérez-Pérez Centre d'Estudis d'Història de la Ciència (CEHIC) UAB and
Observatori de la Comunicació Científica (OCC) UPF,
SPAIN

Taking the Royal College of Barcelona (1760 -1843) as a case study, this communication shows the development of the modern surgery in Spain initiated by Bourbon Monarchy founding a new kind of institutions by means of its academic activities of diffusion of science.
Founded 250 years ago, in 1760, the Royal College of Surgery of Barcelona was the second college of surgery created in Spain. The new college was erected near the old Hospital of Santa Creu. Learning human bodily structure by performing hands-on dissections in the anatomical theatre has become a fundamental element of modern medical education.
Antoni Gimbernat from Madrid worked with tenacity improving the quality of the royal colleges in Spain but before that he was professor of the Anatomy in the College of Barcelona and the most famous Spanish surgeon with international recognition.
Gimbernat favoured the study of natural sciences, the new chemistry of Lavoisier and the experimental physics in the academic programs of surgery. As a result of that, the academic program developed in the new colleges of surgery was different from the traditional formal education for surgeons. The new physician-surgeons trained there not only were interested in therapeutics but also wanted to know as much as possible about the bodies' anatomy and physiology, being as they were in competition with its pathology.
According to the study of a very relevant set of documents preserved in the library, the so-called "Juntas Literarias", we have notice about the main subjects debated in these clinical sessions about the concept of human being and diseases in relation to the development of the new experimental sciences. These documents evidenced that chemistry and experimental physics were considered crucial tools to understand the unexplained processes that happened in the human body in a medico-surgical context.

Key words: Enlightenment, medical sciences, Royal College of Surgery of Barcelona, Gimbernat.

The Young Scientific Audience in Late Enlightenment Spain: the Children's Magazine (1798-1800)

Elena Serrano CEHIC (Centre d'Història de la Ciència),
Universitat Autònoma de Barcelona,
SPAIN

From 1798-1800, one of the most praised and successful printers in Madrid, the Sancha family, published the first periodical for Spanish children. It was an unusual success, first, because new licenses for periodicals had been forbidden by the Government since 1791 (in an attempt to halt French-revolutionary contagiousness) and second, because as many as thirty years after its publication, nothing like this was ever printed in Spain again.
The aim of the Children's Magazine or General Principles of Moral, Sciences and Arts Adapted to Primary Age Intelligence, is made explicit from the very title. The authors, the Canga-Argüelles brothers, who were well-known in enlightened circles for their translations of Greek poetry, stated in the preface that scientific novelties were not properly communicated to Spanish children. Germany had Campe (the author of a best-selling adaptation of Robinson Crusoe in dialogue format), Shummel and Weitz; France had "children's friend", Berquin, and above all, Jauffret, whose periodical Courrier des Enfants, was their inspiration.
As has been successfully shown by J. Secord, Fyfe, Shteir, Benzaque, Topham, and many others scholars, children's publications enable us to examine the social, moral, religious and cultural values associated to the sciences in a particular community. The Children's Magazine contains scientific knowledge and moral tales. It also deals with cultural practices like going to a museum or attending public lectures on chemistry; instructions for examining minerals or reading Buffon's Historie Natural; and a boy that writes to his female cousin about chemistry and botany. The aim of my paper is to study what the authors of Children's Magazine considered to be the proper way of communicating science to boys and girls.

Circulation as Translation of Books: the Case Ardinghelli in the 18th Century Naples

Corinna Guerra Seminario di storia della scienza,
University of Bari,
ITALY

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. Most of Italian scholars probably learned that by the first and only Italian translation published in Naples in 1756.
In fact in the 18th Naples there was a brilliant young woman, whose name was Mariangela Ardinghelli (1728-1825), who 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 and we know that all foreigners in the Kingdom of Naples want to meet her. She was in contact with numerous academies and in her salon lively conversations, of Newtonian inspiration, took place.
So Ardinghelli had a central role in the circulations of many scientific books in Italy through her translations; with her notes added to the text she also fit the theory to her local context converting, e. g., all English weights and measurements into their Neapolitan equivalents.
Ardinghelli is also linked, in the history of the circulation of ideas and techniques, to the 18th century fashion for electricity: she was the addressee of the Abbé Nollet's first Lettres sur l'electricité (1753) and for the whole life she informed him about scientific news from Naples.
The purpose of this paper is to reveal Ardinghelli's peculiarities and her role in circulation, reception and appropriation of scientific theories in the Kingdom of Naples (i.e. Southern Italy), through an analysis of her writings and of those (both coeval and later) who wrote on her, using Latin, Italian, French and English sources.

Correcting Lazzaro Spallanzani. The Antoni Martí Franquès Contribution to the Knowledge of Sexual Reproduction of Plants (18th Century)

Pasqual Bernat Centre d'Estudis d'Història de la Ciència,
Universitat Autònoma de Barcelona,
SPAIN

Lazzaro Spallanzani (1729-1799) in Expériences pour servir l'histoire de la génération des animaux et des plantes (1786), concludes that some plants, including hemp, could reproduce without fertilization. Antoni Martí Franquès (1750-1832), a Catalan naturalist, repeated the Spallanzani's experiments with hemp, concluding that the Italian scientist was wrong. According Martí, Spallanzani had not been sufficiently rigorous and careful in its testing. He did not realize the presence of male or hermaphrodite flowers at the female plants. Martí found that in hemp, like in all superior plants, the intervention of both sexes is needed for successful reproduction. At that time, experiments on plant sexuality was crucial to get to pronounce definitively among the three alternatives surrounding the mechanism of the generation: ovist theory (pre-existence of germs in the egg), animalculist theory (pre-existence of germs sperm) or epigenesis (meeting-with-fertilization of two principles contained respectively in the egg and the sperm). In this paper Martí's method will be shown and, also, we will explain how he got his conclusions.

Orchid Hybrids and the Rediscovery of Gregor Mendel's Genetics

Romualdas Sviedrys Polytechnic Institute of New York University,
USA

Josef Ritter von Rawicz Warszewicz (1812-1866) achieved the rare distinction of surviving almost nine years in the tropical jungles of Central and South America, and the frigid Andes, and discovered almost three hundred new species of orchids. He was particularly good at finding orchids in temperate zones at heights of up to three thousand meters. He was helped in this endeavor by Alexander von Humboldt and his discoveries were send to eight botanical gardens in Europe, in addition to shipments to London to be auctioned. It was in Britain where many orchid hybrids were produced that led to a rediscovery of Mendel's work in genetics by members of the Horticultural Society.

'Turning poor devils inside out': Manners in Dispute in Mid-Victorian Natural History

Raf De Bont Research Unit of Cultural History,
KULeuven,
BELGIUM
Department for the History and Philosophy of Science,
Cambridge University,
UNITED KINGDOM

Historians of science have always been interested in controversies and 'conflicting knowledge claims'. Far less, however, have they studied the behavioral rules that structure scientific debates. Some attention has been given to the gentlemanly 'manners in dispute' in early modern Europe(Shapin and Shaffer, 1984), but later periods have only been scantily researched in this regard.
My paper will focus on the changing behavioral rules that structured the discussions of naturalists in mid-Victorian England. The years between roughly 1850 and 1890 seem to be pivotal for several reasons. It was a period of scientific professionalization and popularization, which also witnessed the rise of new scientific forums and institutions. The limited literature that touches upon the topic seems to suggest that these developments strongly influenced the ways in which scientists discussed with each other. Thackray (2003) noted how the president of the London Geological Society stressed in the late 1820s that his institution stimulated 'conversations' rather than 'discussions' - or even worse: 'debates'. By the 1870s, however, the chief editor of a prominent scientific weekly like Nature would explicitly stimulate his authors to engage in vigorous controversies (Barton, 2004).
My paper will explore whether these examples are representative for a general change of tone in mid-Victorian science and, if so, what its implications were. Firstly, it will look at explicit comments on scientific etiquette made by contemporaries (such as Charles Darwin, Thomas Huxley and Norman Lockyer). Secondly, it will analyze the organizational changes that scientific discussions (both in live and published form) underwent - from the establishment of 'parliamentary-style' benches in scientific societies to the introduction of 'discussion sections' in periodicals. Finally, it will study how these changes in behavioral rules went together with an epistemological shift, or how differing manners of dispute reflected different ways of thinking about knowledge itself.

Social Evolutionism: from a Naturalism to Another

Emmanuel D'Hombres Laboratoire SPHERE UMR 7219,
Université Catholique de Lyon,
FRANCE

Social (or cultural) evolutionism is a theory claiming that there is one single line of development for all human societies, and that such a development is gradual and progressive. As one can assume that all societies do not evolve at the same rhythm, or that some are older than others, it follows an important corollary, that is the past historical forms of most advanced societies (societies of Western Europe) are similar to existing forms of less advanced societies (called primitive societies). This proposal has obvious methodological significance, because it justifies the procedure consisting in supplying the deficiencies of archeology and ancient history by ethnographic data about "savage" populations, and vice versa. This procedure, named "comparative method" since the early nineteenth century, is actually used in the historical and anthropological literature since the late seventeenth century, at least. Such a use testifies the pervasiveness of evolutionary pattern in the minds of scholars since the Classical Age. But it does not prejudge the identity of implicit naturalistic model underlying the representation of social evolution, nor the broader issue which relates to evolutionism.
One will seek to identify the change of problematization affecting the social evolutionism in the nineteenth century (rational justification of the spontaneous negative judgment on cultural otherness vs. explanation of cultural similarities between remote societies, geographically or historically speaking). Then one will analyze the theoretical and epistemological implications of the substitution, subsequent to the recent and growing triumph of embryology based on epigenesis, of the technical and scholarly reference to embryogenesis, to the traditional and mundane reference of the successive ages of individual life, in the role of pattern of cultural evolution.

SS06 Science and Technology in the 18th and 19th Centuries

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Newton's Quest for a Mathematical-Demonstrative Optics

Steffen Ducheyne Centre for Logic and Philosophy of Science,
Ghent University (UGent),
BELGIUM

In this talk, I take up and develop the suggestion made by the late I. Bernard Cohen, Casper Hakfoort and Alan E. Shapiro that Newton's methodological ideal of "deducing causes from phenomena", on which we have elaborated on in the preceding chapters, was not equally attainable in the study of optical phenomena. If this suggestion is correct, then in the apex of Newton's optical researches, The Opticks, which in fact contained a set of interrelated theories on optical phenomena, Newton failed to rigidly deduce these theories in the sense he had done in the Principia.
By contrasting Newton's methodology in the Principia with the way in which theoretical conclusions are established in The Opticks, I shall be able to explain why Newton was less successful to accommodate optical phenomena according to his own methodological desiderata of deducing causes from phenomena. After having commented briefly upon Newton's methodology in the Principia, I will review the kinds of trouble that Newton ran into when trying to methodize optics in a Principia-Style fashion. My focal point will be Newton's arguments for the thesis that white light consists of rays differently 'refrangible'. Special attention will be paid to Newton's presumed application of Rule II of the regulae philosophandi in establishing that part of his optical theory. It is shown that Rule II licenses the identification of instances of causes of the same kind which have been shown to be true and sufficient to explain their phenomena. Thus, on the basis of Rule II we identify two instances of causal parameters of the same kind, which have separately been derived from phenomena. The disanalogy involved is thus that in the experimentum crucis (and its related sections in The Opticks) we use an argument for uniformity to establish a single causal claim, while Rule II licences the identification of similar causal parameters which were independently established and were deduced from phenomena by systematic dependencies.
In the Principia there are systematic dependencies, derived from the laws of motion, between causes and effects. Given the absence of systematic dependencies, Newton could offer only sufficient causes in The Opticks. Moreover, by means of what I call 'macro-micro inference tickets' (i.e. Props. LXX-LVI, Book I), Newton was able to license conclusions about the inverse-square centripetal forces of each of the individual micro-particles that constitute a macroscopic body from the overall inverse-square centripetal force exerted by that body – in this way, Newton was thus able to back up transductive inferences about the particles constituting a macroscopic body. In The Opticks none of the above was at hand. Newton clearly wanted to do more than to simply establish the phenomenological laws regulating optical phenomena: he also wanted to provide a solid physical account of optical phenomena. However, given the empirical and methodological problems Newton later encountered when methodizing optics in a Principia-style, it turned out that establishing non-hypothetical physical interpretations of optical phenomena was quite a difficult matter.
It is the aim of this talk to pinpoint the dynamics between method and 'phenomena' in Newton's optical research.

The Correlation Between Scientific Knowledges and Technological Innovations at the Beginning of the Industrial Revolution (1713-1800)

Fabio Zanin Liceo "Brocchi"-Bassano del Grappa (VI),
ITALY

Technological innovations are among the crucial factors at the origins of the Industrial Revolution in Great Britain around 1750. Some historians have recognized the causal nexus between new scientific knowledges, in fields such as physics and chemistry, and technological innovations (see: J. Mokyr, The Enlightened Economy, 2009). However, a precise evaluation of the impact of the spread of scientific knowledges on technological development hasn't been tested, yet .I will suggest a method to quantify the scientific knowledge encorporated in technology. Therefore, I will apply an evaluation model based on Cavalli Sforza's theory of cultural evolution (Genes, populations, and languages, 1996) to four different fields of industrial production (1. spinning and weaving of cotton, 2. bleaching and colour fixing, 3. fusion and moulding of iron, 4. application of Watt's steam machine to pumping processes in coal mines), concerning the period 1713 (2nd edition of Newton's Principia mathematica)-1800 (expiration of the patento of Watt's steam machine).
According to the theory of cultural evolution, culture is a complex mechanism, in which peculiar unities of cultural information (ideas) spread like the unities of biological information (genes). Ideas pass from one person to another by the language, and whenever they are trasmitted they undergo changes; sometimes they go adrift (isolation) or they migrate. The application of an evaluation model based on such a theory to the research concernig the geographical spread of technological innovations will make it possible, in my opinion, to answer to the question how precisely the way scientific knowledges spread was correlated to the success of those innovations at the beginnig of the Industrial Revolution.

The Role of Cavalier Tours in Circulation of Technologies and Technical Methods

Milada Sekyrková Charles University in Prague
CZECH REP.

The Cavalier tours represent a significant way in which new technologies and knowledge on inventions and also new construction methods came from England and Western Europe into Central and Eastern Europe, in particular during the time of the Industrial Revolution.
The aristocrats were visiting industrial regions, historic sites etc. and the acquired knowledge applied at home after their return. The ways varied: either they brought specialists from abroad, who delivered then their experience to the local residents, or they supported the local talented people by sending them abroad to gain knowledge there.
The Schwarzenbergs and Sternbergs can serve as examples.

The Stethoscope – Presentation of a Medical Innovation and its Impact on its Circulation

Maria Winter Institute of the History, Philosophy and Ethics of Medicine,
Ulm University,
GERMANY

Laennec's "De l'Auscultation Médiate" (1819) has been criticized even by its translator, John Forbes, for being "written in a diffuse and verbose style by no means commendable in a work of science". The modern reader would wholeheartedly agree, especially since the book also seems to indiscriminately mingle case reports, pathogeneses, diagnostics, post-mortem analyses, physiology and numerous other elements including anecdotes from the author's life. Only a very small proportion is dedicated to the stethoscope and its use.
It is interesting to observe that in fact Laennec's contemporaries perceived the work above all as a treatise on anatomical pathology and not so much as a handbook for a new means of diagnosis.
For his first English translation, Forbes consequently rearranged and considerably shortened the book, "restoring" it to "what I humbly conceive it ought always to have been".
The most common criticism was, however, the sheer length of the work; two volumes of 470 and 472 pages. Soon concise versions, even tiny "pocket versions" and overviews in tabular form, came out. Their great variety seems to suggest a considerable demand.
But not all objections were based on presentation. The new method of diagnosis was criticized "because its whole hue and character is foreign, and opposed to all our habits and associations. " It was considered too complicated to learn, too mechanical and against the old art of hippocratical medicine.
But this all didn't stop the stethoscope from becoming inevitable within only a few decades.
On the basis of books, press and journal reports, the paper seeks to examine how far the way of presentation chosen by Laennec served as inhibitor or promoter to the international success of his invention, with special focus on France, Britain and Germany.

The Role of Photochemical Processes on the Development of Colour Printing in the XIX Century Cartography

Maria Estela Jardim (1) (1) Faculty of Sciences,
Isabel Marília Peres (2) (2) CCMM, Centro de Ciências Moleculares e Materiais,
Fernanda Madalena Costa (2) University of Lisbon,
PORTUGAL

During the decade 1860 -70, the French chemist Alphonse Poitevin (1819-1882) did research work on the photographic sensitizing properties of dichromate gelatine, which led to the development of several printing methods by photomechanical processes. This allowed significant advances in several scientific and technical fields such as cartography; production of printing maps was done with more precision and in an easier and economical way. The introduction of colour in the maps by photomechanical processes at that time led to remarkable changes in the cartographic photographic cameras and printing instruments produced by European makers.
The study of the chemical and physical principles of the most important photomechanical techniques used in the second half of the XIX century cartography will be presented, namely the three-colour photographic printing processes developed by Charles Eckstein in the Netherlands and José Julio Rodrigues (1843-1893) in Portugal. We also intend to relate their work with the photocolographic process (tricromy) developed in France by Louis Ducos du Hauron (1837-1920). In 1878, Ducos du Hauron presented at the Universal Exhibition of Paris his process of tricromy, but without obtaining any impression using photomechanical processes. At the same time Rodrigues researched and obtained coloured photomechanical prints. A parallel study of the optical, photographic and printing instruments specially designed for the XIX century cartography will be done.

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Designing Engineers: Engineering Literature and the Discourse of Design

Courtney Salvey University of Kent at Canterbury,
UNITED KINGDOM

Although the proliferation of technology and of engineering as a profession in early nineteenth-century Britain is so well-established as to need no comment, the parallel development of a 'literature of engineering' has been virtually ignored. There were technical treatises like John Bourne's 'A Treatise on the Steam Engine' (1853), histories like John Smeaton's 'A Narrative of the Building of the Eddystone Lighthouse' (1813), periodicals like 'The Engineer', textbooks like William Fairbairn's 'Useful Information for Engineers' (1856), Proceedings of the Institutions of Civil and Mechanical Engineers, autobiographies like those of Thomas Telford (1838) and James Nasmyth (1887), and biographies like Samuel Smiles's 'Life of George Stephenson' (1857). Like all literatures, the genre did not emerge in a vacuum, but interacted with rhetorics and discourses already circulating in nineteenth-century Britain. Tracing how this burgeoning genre disseminated engineering and its knowledge in British culture, my paper will ask how the genre shaped engineering and constructed engineers for various publics through its interaction with existing discourses. Because of the lack of critical or historical commentary, I will first discuss the emergence of the genre, identifying its characteristics and types along with who was writing, publishing, and reading it. Then I will discuss how this genre utilized the natural theological 'discourse of design' and how it returned to shape attitudes toward engineering and technology. Ultimately, I hope to show how the rhetoric used in circulating a specific knowledge set served to consolidate the position of its practitioners by authenticating—by blessing—that knowledge set.

Historical Photographic Developers and their Chemistry: the Lumière's Contribution

Sara Carvalho (1) (1) CCMM, Centro de Ciências Moleculares e Materiais,
Maria Estela Jardim (2) (2) Faculty of Sciences,
Fernanda Madalena Costa (1) University of Lisbon,
PORTUGAL

From the time of its invention in the 19th century, Photography was used as an important scientific tool as well as a document whose authenticity would promote the spread of scientific knowledge in society. However, the early photographic techniques were not easy to handle, and it was the discovery of the gelatin silver-bromide emulsion in 1871 by the British physician Richard Leach Maddox (1816-1902) that brought speed and convenience to the use of photography both in science and in other fields. Formation of the latent image was discussed throughout the century with different theories trying to understand the role of the emulsions and of the reducing agents in the development of the photographs. At first the gelatin silver bromide dry plates which came on the market were developed exclusively with pyro-ammonia developer which had been brought over from the collodion process. In Germany Momme Andresen (1857-1951) took part in the successful investigation of organic developers for the dry plates and patented several of these compounds. In France, Auguste (1862-1954) and Louis (1864-1948) Lumière, better known for the invention of cinema and the autochromes, did a lot of research on photographic methods since the middle of the 1880's.The Lumière brothers and the organic chemist Alphonse Seyewetz (1869-1940) conducted several experiments on this subject in the photochemical laboratory of their dry-plate factory at Lyon. They wrote a series of papers with their results in several prestigious scientific and photographic periodicals on the theory of developer substances, including the study of the role and structure requisites of the organic developers, among them the paramidophenol.
In this work we intend to trace-out the evolution of the different techniques and processes carried out by those researchers giving an emphasis on the chemical interpretation of the role of photographic developers.

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Moscow Society of Friends of Natural Sciences and Dissemination of Scientific and Technological Knowledge In The 19th Century Russia

Galina G. Krivosheina S.I. Vavilov Institute for the History of Science and Technology, Russian Academy of Sciences, Moscow
RUSSIA

The Society of Friends of Natural Sciences, Anthropology, and Ethnography (SFN) grew from a circle of naturalists, uniting professionals as well as amateurs, concentrated around A.P. Bogdanov, professor of zoology and director of the Zoological museum of the Moscow University. SFN was the first learned society that was organized according to the University statute of 1863 (later on societies of this type appeared in all Russian universities). It was aimed at advancement of natural sciences and popularization of scientific knowledge in Moscow school district.
SNF 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 SFN, were the four: All-Russia Ethnography Exhibition (1867), Polytechnic Exhibition (1872), dated for the 200th anniversary of Peter-the-Great, Moscow Anthropologic Exhibition (1879), and Geography Exhibition (1892). Less known are exhibitions on applied zoology, beekeeping et al. These undertakings of SFN were a success due to four basic principles, realized by the Society.
1. SFN attracted to the spade work as many people 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 exhibit.
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 connected with important scientific or cultural events (congresses, scientific conferences on the topic et c.).
4. Exhibited collections were to be used as a basis for new museums or museum collections, university or public, in Moscow (this was the case of Dashkov Museum of Ethnography, Museum of applied knowledge, better known as Polytechnic Museum, Museum of Anthropology of the Moscow University et al.).

The Diffusion of New Painting Materials in the 19th Century Portuguese Technical Courses: The Case of the Oporto Industrial School

Sónia Barros dos Santos CITAR - Research Center for Science and Technology in Art - School of the Arts, Portuguese Catholic University,
PORTUGAL

The 19th century was proficuous in the discovery and spreading of new painting materials and techniques throughout Europe namely the synthesis of new pigments and dyes. The industrial revolution combined with liberalist policies promoting the spreading of technical studies in Portugal led to the creation in 1852 of the Oporto Industrial School. The town of Oporto at that time led an important role in the industrial and commercial development of the country. There was a special concern in the training of highly skilled technicians that led to an acquisition of recently discovered painting materials common in countries like France, England or Germany but that were scarcely available in peripheral countries like Portugal.
This study will focus on the diffusion of new materials in this reference school through the analysis of the different acquisitions that were made until the end of the 19th century namely the ones regarding interaction with foreign suppliers. Although Portuguese painters were, in general, very conservative in their palette regarding the introduction of new pigments, at least until the early 1880s, the materials found in the Oporto Industrial School collection clearly demonstrates a concern in presenting their students the latest developments and innovations of this industry.

The Circulation of the Knowedge about Synthetic Colorings in the Company La España Industrial

Assumpta Dangla Museu de l'Estampació de Premià de Mar
Mònica Dòria SPAIN

The present communication is a study about the circulation of textile chemistry knowledge, in the moment of transition of the use of the natural colorings to the synthetic colorings for the textile printing. The company La España Industrial, the most important textile factory of Spain (1847-1980), incorporated progressively new synthetic colorings, which during the second half of the 19th century coexisted with natural colorings.
The discovery in England in 1856 of new synthetic colorings revolutionizes the production in the factories and they changed the forms of communication of the knowledge on the subject of chemistry applied to printing.
In the case of the natural colorings, the transmission of the knowledge was traditionally made under a great secrecy. With the discovery of the new synthetic colorings, the forms of communication changed them and new tools of communication of the formulation and application of the colorings were born.
The Museu de l'Estampació de Premià de Mar, a museum specialized in textile printing, preserves an extense collection of formularies and a documental archive of the company La España Industrial. In the collection, there are several witnesses of the incorporation of the new chemical knowledge.
In our journey, varying aspects of the period of the natural and synthetic colorings are revealed to La España Industrial. In first place, we present a collection of unedited formularies of the museum, witnesses of the progressive incorporation of the synthetic colorings and of the coexistence with natural colorings. We present, also, the catalogues of colorings edited by chemical industries that were used in the factory.
Other unedited documents are also discovered, like the correspondance that sustained the company with chemical companies, spanish and foreign scientists. In our route, we will reveal the main actors of the change in the factory that implanted the new discoveries, and the tools that they used for the transmission of this knowledge.

SS07 Institutions from the 18th to the 20th Centuries

Coordinated by the Conference program committe
Chaired by Antoni Roca-Rosell (Universitat Politècnica de Catalunya, Spain)

Efflorescence of the Natural Sciences and Medicine at the University of Vilnius at the End of the 18th and the Beginning of the 19th Centuries

Ramunas Kondratas Vilnius University,
LITHUANIA

The University of Vilnius, which was founded in 1579, is one of the oldest and most preeminent institutions of higher learning in Central and Eastern Europe. It was the center of education and the transmission of knowledge not only for Lithuania but for many neighboring countries and states as well. Among its professors and students were representatives from almost all European countries.
The natural sciences and medicine especially flourished at the end of the 18th and the beginning of the 19th centuries because of the many foreign scientists and physicians who came to Vilnius, especially from Poland, France, Germany, Austria, and Italy. They not only taught and practiced but also founded scientific societies and institutions – observatories, museums, botanical gardens, laboratories, clinics, and other medical institutes (some were the first of their kind in Europe).
They included such well known figures as the German naturalist Georg Forster (1754-1794), who accompanied James Cook on his second voyage to the Pacific; the German physician and one of the pioneers of social medicine and public health Johann Peter Frank (1745-1821) and his son Joseph Frank (1771-1842); the French physician August Becu (1777-1824); the German anatomist , zoologist and early evolutionist (student of Cuvier) Ludwig Bojanus (1776-1827); the Polish chemist and biologist Andrew Sniadecki (1768-1838) and many others.
This paper will analyze the conditions which made this efflorescence possible and the impact that it had on the evolution and dissemination of science in this part of Europe.

Intellectual and Political Activity of Baltic Universities in the Beginning of the 19th Century

Juozas Algimantas Krikstopaitis Lithuanian Research Institute of Culture,
LITHUANIA
Vice-President of Baltic Association of the History and Philosophy of Science

The 19th century began with an event which produced a scientific breakthrough – the discovery of Volta's Pile in 1800. Several scientists of Baltic countries entered at once into this new research area. They were primarily associated with the two leading universities of the Baltic region, namely, Vilnius and Dorpat universities. The most active scientist was T. Grotthuss, a German Balt who produced the first theory of electrolysis that had a major influence in determining the development of electrochemistry and electrodynamics during the first four decades of the 19th century. Such active reaction to a new discovery was possible because the Baltic scientists were in contact with the premier scientific centers of Western Europe.
Ever since the Russian annexation of the Baltic shoreline at the end of the 18th century, the Baltic countries differed in their cultural legacy from the Russian imperial system. In Catholic Lithuania, Vilnius University became a center of active political opposition. Napoleon's invasion of Russia in 1812 even raised hopes of independence. Later, in 1831, the academic community participated in an armed uprising that led to the closure of the Vilnius University in 1832.
In Lutheran Courland (Curonia), the faculty of Dorpat University was dominated by scientist of the Baltic Germans. They were the descendants of the Teutonic knights who had gained a foothold on the Baltic shores since the 13th century, and had always been oriented to the western traditions of intellectual life. They also staffed since the beginning of the 18th century the St. Petersburg Academy of Sciences. The German Balts remained to the Russian imperial government, and thus were not as wearisome to the officials of the Russian regime.

Academic Congresses and the Making of Academic Communities in the Russian Empire, the 1860s-1910s

Marina Loskutova St. Petersburg Branch of the Institute for the history of science and technology,
the Russian Academy of Sciences,
RUSSIAN

In the 19th century academic congresses, both national and international, became critical institutional means facilitating the traffic of knowledge. Since the 'Great Reforms' era scholars in the Russian empire set up two major periodic conventions – the Russian archaeological congresses and the congresses of Russian naturalists and physicians that served as important sites of academic socialisation and exchange of knowledge. In the early years of the 20th century they were supplemented by a few minor conferences on applied geology, meteorology and applied entomology. The paper examines changing institutional affiliation of congress members (both scholars presenting their papers and their audience) and their places of residence, as these transformations reflected the changing understanding of 'professional' and 'amateur' research, and the rise of professional middle-class strata in the provinces. It compares these processes across a number of disciplinary fields (life sciences, earth sciences, proto-social sciences), thus highlighting different roles played by university faculty, civil servants and professionals, major academic centres and provincial societies in structuring these fields of knowledge. Also the paper compares geographical configuration of emerging academic networks, exploring the impact of various regions and regional centres of research and education within the Russian empire. Finally, the paper examines the historical geography of congresses: it addresses the role of local field sites, leading local practitioners and provincial institutions in attracting the congresses to different urban locations, and considers the reception of congresses in local civic and intellectual context.

Physics at the University of Coimbra in the European Context in the Turning of the 19th to the 20th Century

Susana Boloto Universidade de Coimbra,
Décio R. Martins PORTUGAL

The scientific trips through Europe done by three Professors of the Faculty of Philosophy of the University of Coimbra , Matias de Carvalho Vasconcelos, Jacinto António de Sousa e António dos Santos Viegas, on the second half of the XIXth century were essential to allow an important development of the Physics Cabinet of the University of Coimbra. The connections established with the most important scientific European institutions and notable scientists allowed the creation of the Meteorological and Magnetic Observatory in Coimbra. The knowledge acquired by the Professors, as the perceptions of the new scientific development on Physics lead the improvement of experimental conditions and actualization of the programs of study, by a bigger interest to the experimental part in general, and giving a particular attention to areas such as electromagnetism, thermodynamics, meteorology and optics. Several modern scientific instruments of Physics were acquired to the most famous European instrument makers. This progress can be stated by the headlines of the thesis presented by António de Meireles Garrido in 1878, Mathematical Theory of wide spreading of the light in homogeny means or the one of Henrique Teixeira Bastos, in 1884, entitled Electrical Unites where we can find a references to the Electricity Congress of Paris in 1881, where António dos Santos Viegas was the Portuguese delegate. In 1892, Bernardo Ayres presented the dissertation with the headline The Atmospheric Circulation and the Weather forecast, focused mainly on meteorology. In May 1897 Alvaro da Silva Bastos, who took a degree on Natural Philosophy, presented the dissertation about The Cathodic Rays and the Rontgen X Rays. Yet in 1901, Anselmo Ferraz de Carvalho presented the thesis on Magneto optical - phenomenons, while Egas Pinto Bastos in 1908 submitted a dissertation on Electron´s Theory. Other theses on were submitted by several students in this period under Santos Viegas supervision.

A Stroboscopic Picture of European Science Attractive Institutions in the Thirties and Forties – Following Portuguese Grant Holders

Emília Vaz Gomes CEHFCi (Centro de Estudos de História e Filosofia da Ciência),
Augusto J.S. Fitas Universidade de Évora,
Fátima Nunes PORTUGAL

To understand the circulation of scientific knowledge and scientist in Europe in the 20th century is essential to identify the institutions that attracted foreign scientists to all kinds of training. To construct such broad picture would be compulsory to study the dissemination of scientific culture over Europe. To accomplish this, it would be necessary to assemble as many information as possible about specific institutions and scientist.
There are several analyses on the development of science in particular European institutions and in specific disciplines that referred the passage of foreign scientists at those places, as in Paris. However, this is not the main goal of those authors. Some work has been made on the history of Foundations where grants attributed can be studied, as an example, the Rockefeller Institution. The institutions that manage and promote national science were also studied and these played the principal role sending apprentices abroad. This is the case of the Spanish JAE, Junta de Ampliación de Estudios. Currently, we study the Portuguese scientific apprentices at Europe and pretend to contribute to picture the scientific attractive institutions in the thirties and forties. We intend to show that, through time, there were geographical changes on those institutions at a particular discipline. We want to underline several factors influencing the selection of destinations and how these factors conditioned the circulation of scientist. The success, renown and visibility of an institution or scientist act together as a factor, by far the unique. In the Portuguese case we can identify other factors on different levels: the country characteristics or constraints, the national institutions to where apprentices were connected and orientation of particular personages. However, besides all these factors we want to enhance the leading role of JEN (Portuguese Board of National Education) promoting scientific apprenticeships in Europe.

SS08 Physics in the 20th Century

Coordinated by the Conference program committe

Chaired by Albert Presas i Puig (Max Planck Institute for the History of Science, Germany)
Emma Sallent del Colombo (Universitat de Barcelona, Spain)

The Principle of Popularization of Energy

Nemrod Carrasco Nicola (1) (1) Seminari de Filosofia Política,
Enric Pérez Canals (2) Universitat de Barcelona,
(2) Departament de Física Fonamental,
Universitat de Barcelona,
SPAIN

We will examine the emergence of the principle of conservation of energy and its relation to the rise of science popularization.
On the one hand, the principle of conservation of energy is an uncommon example of widespread and simultaneous discovery. In fact, more than ten authors can be mentioned as discoverers or inventors of this fundamental principle, all during the middle of the 19th century. Although its genesis was closely related to research on the nature of heat, energy conservation did not arise to solve any one specific age-old problem, nor did it belong to any specific theory. However, once firmly established, it has grown to become one of the most unquestioned principles of science.
On the other hand, popular science publishing underwent a notable -if not a radical transformation in the second half of the 19th century. Not only did this consist of a quantitative increase in scientific content; there was a significant qualitative change as well. In the 20th century, especially after World War II, popularization experienced again a radical change. Today, mention in the media of new scientific advances is far from scarce. In all of this proliferation the concept of 'energy' plays a crucial role. Moreover, its use has grown beyond scientific spheres, and we can now find it even in the most varied contexts. 'Energy' has become a ubiquitous word.
Is 'energy' an especially well-suited concept for popularizing purposes? It has been stated that the concept of energy had already existed in the minds of some of the authors involved prior to its 'discovery'  as a metaphysical concept. Therefore, is this a case where society at large has come to influence technical and specialized research? Influences in both directions will be considered.

New Non-Classical

Peeter Müürsepp Tallinn University of Technology,
ESTONIA

The paper aadresses a possible shift in the classification of science into classical and non-classical. It has been accepted widely that Galilean-Newtonian mechanics is the basis and best example of classical science, while quantum mechanics and the theories of relativity play the same role at the non-classical side. Some methodologists (most notably Prigoginians) claim that in addition to the mentioned distinction one should speak about post-non-classical science. In the latter case Ilya Prigogine's conception (theory?) of self-organization has been taken as the model case. The third member in the classifying sequence, however, has failed to gain general recognition. It is obviously possible to drop the post-non-classical story as an overestimation of the influence of some relatively marginal approach to the scientific method. Another solution, however, is possible as well. As a matter of fact, one can view both the theories of relativity and quantum theory as classical and move the dividing line between two types of science closer to the present day in the history of science. Quantum mechanics is quite different from the classical one in several significant ways, i.e. indeterminism and the role of the observer, to name just some of the most influential ones. It may look as self-organizationists did not really do anything else but put a stronger stress on some aspects put forward by the grands of the non-classical approach already. However, it is the issue of irreversibility that may well turn the tables here. The Schrödinger equation is reversile. For Einstein time was just an illusion. It is Prigogine, who has been consistently claiming that irreversibility is an objective fact inherent in nature and not something that subjectively seems to us humans due to the limited character of our knowledge. It appears that we cannot get rid of irreversibility in principle.

Circulation of Ideas and Forming of Slovak Physics

Juraj Šebesta Department of Theoretical Physics and Physics Education,
Comenius University, Bratislava,
SLOVAKIA

Forming of Slovak physics is pregnant example for importance of ideas circulation. Before 1918 no university was on territory of modern Slovakia. After origin of Czechoslovakia Comenius University was established in Bratislava but without faculty of science. So who was interested in study of science he was forced to move out to Prague, Brno or foreign cities. Three young men were studying at Charles University in Prague in 1925-29 - Dionýz Ilkovi´c and Ján Fischer from Slovakia and Vilém Kunzl from Czech city Plzeň. The first one was appointed (1940) professor of technical physics in Bratislava´s technical university and after faculty of science was established in Bratislava he was appointed professor of physics also there. He founded undergraduate study for future physics teachers and future physicists, he started physical research. First his followers moved to Košice at the beginning of 1950´s to found second Slovak center of physics.
Owing to Ilkovic´s effort V. Kunzl was appointed professor of physics at Comenius University in 1947. In 1948-52 Kunzl founded four physics branches which are cultivated there up to now. So he is considered as founder of experimental physics at CU. Besides that, owing his effort Ján Fischer came in CU. In 1928-31 Fischer finished his PhD study at ETH Zürich under supervisor prof. G. Wentzel. J. Fischer completed here two papers which became foundation stones of quantum theory of interaction between radiation and matter. He is considered deservedly to be founder of Slovak theoretical physics. No doubt, D. Ilkovic, J. Fischer, and V. Kunzl became founders of Slovak physics owing to high-quality training at Charles University in Prague. Moreover, creating new branch of science and forming undergraduate training they used fairly all experience, methods, and ideas which they met in Prague. In 1950´s Czech theoreticians promoted to build up Slovak school in theory of elementary particles.
Development of physics in Slovakia was affected by Vienna university too (more details see in full text).

Cold Wave. Heike Kamerlingh Onnes's Laboratory as an International Centre for Low Temperature Research

Dirk van Delft Museum Boerhaave /
Leiden University,
THE NETHERLANDS

The Leiden cryogenic laboratory, founded by Heike Kamerlingh Onnes (1853-1926), offered world wide unique facilities to do low temperature physics. For that reason, it attracted lots of foreign researchers. From 1896 onwards, when Kamerlingh Onnes's place was characterized by Nature as a 'cryogenic model laboratory', one guest researcher after another made his way to Leiden.
The liquefaction of Helium by Kamerlingh Onnes in July 1908 gave a firm boost to this practice. At the First International Congres of Refrigeration, later that year in Paris, there was a huge interest in Kamerlingh Onnes's presentation of his low temperature apparatus and his cryogenic achievements. The Association Internationale du Froid, founded shortly after the Paris congress, offered research grants and subsidized the Leiden laboratory directly. The Belgium soda producer Ernest Solvay supported the 'labeur passioné' in Leiden after meeting Kamerlingh Onnes at the first Solvay Conference in Brussels in 1911.
Before 1908 mostly young researchers visited Leiden. Kamerlingh Onnes incorporated them in his research program. After the helium triumph, more often renown researchers made their way to Leiden to do research at temperatures lower than could be reached in their own laboratories. Madame Curie for example in 1911 took a train to Leiden, a radium source in her suitcase, to examine whether radioactivity was temperature dependent. Kamerlingh Onnes offered his guests a warm welcome and invited them to stay at his Leiden home.
The foreign contributions to Leiden physics can be traced in Kamerlingh Onnes's research journal Communications of the Physics Laboratory at the University of Leiden. At the time of his retirement 1924, researchers from abroad were involved in a quarter of the articles published in the Communications. Leiden experimental physics those days proved to be a truly cosmopolitan enterprise.

The Inventions of Jose Ruiz-Castizo: the Planimeter

Claudia Teresa Vela Urrego Universidad de La Rioja,
Mª Ángeles Martínez García SPAIN

The Spanish physicist-mathematician José Ruiz-Castizo (1857-1929) reached its highest academic position as a full professor, first at the University of Zaragoza (1896-1905) and later at the University of Madrid. He was also a teacher at several Technical Schools. He published diverse works in Spanish scientific journals and newspapers, and was the author of an unfinished textbook on Rational Mechanics.
As well as recognising his teaching and investigative achievements it would also be interesting to recognise his achievements as an inventor. He designed gears, a distributor for steam engines, and scientific instruments.
The focus of our study is the planimeter designed by Ruiz-Castizo in 1896. A planimeter is an instrument for mechanically measuring the area of a plane figure. The design of the 'Cartesian planimeter of tangential values' invented by Ruiz-Castizo was presented to the Spanish Royal Academy of Sciences. According to the report of this institution this instrument was not only as good as existing models of the time but in some aspects even better. The mathematical foundations of this planimeter were exposed in a sequence of five articles published by the author in the official journal of the Spanish civil engineers (Revista de Obras Públicas, 1896-1898).
Finally the instrument was made in Switzerland with the support of the Spanish Government, and was exhibited in the Scientific Instrument Exposition organized by the great Spanish inventor Leonardo Torres Quevedo on the occasion of the Congress of the Spanish Association for the Advancement of Science (Madrid, 1913). The planimeter was used in the mathematical laboratory of the Faculty of Sciences of the University of Madrid and also in all the provincial establishments of the National Institute of Geography.

Unsuccessful Transmission of Knowledge. An Example of the Astronomical Society of India

Rajinder Singh Physics Education, History and Philosophy of Science - Research Group,
Faculty V, Institute of Physics,
University of Oldenburg,
GERMANY

In India the first three decades of the 20th century are considered as a hall-mark in the history of physics. During this period three Indian physicists made their name on the international level. MN Saha gave the ionisation equation to explain the structure of the Sun (Saha-Eggert equation). SN Bose applied the concept of light quanta to derive Planck's law which lead to Bose-Einstein Statistics/Bose-Einstein Condensation. CV Raman (with his student KS Krishnan) discovered the Raman Effect and won the Nobel Prize in 1930.
Seen on the institutional level a number of scientific organisations were established on the model of the British System. A few to be mentioned are: Indian Science Congress Association, Indian Academy of Science and National Institute of Sciences (later to be named as Indian National Science Academy) were founded. However, the example of the Astronomical Society of India (ASI) shows that a transmission of knowledge was not always successful. The ASI was founded in 1910. It died its own death within a decade. The present paper explores the "unsuccessful" story in social, cultural and technological context.

Dayton C. Miller's Ether-Drift Experiments

Roberto Lalli Dipertimento di Fisica,
Università degli Studi di Milano,
ITALY

One of the most important case of circulation of a physical idea in first half of the XXth Century concerns the relativity theory.
Miller's experiments and their international reception are an example of how the circulation of relativity theory and some physicists changed the scientific research programmes.
Between 1902 and 1926, Miller made several ether-drift experiments similar to the well-known 1887 Michelson-Morley one. The 1920s Miller's experiments, 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 developed a theory of absolute motion of the Solar System and published it in 1933.
He thought that his results disproved the theory of relativity, but the most of international scientific community did not believe him and preferred a different explanation, as temperature variations, wrong data analysis, experimental errors, etc. After Miller's claims, the Michelson-Morley experiment was repeated many times from 1926 to 1930 by other experimenters with different instruments. All these experiments gave a null result.
In 1955, Shankland and his co-workers explained Miller's data as depending from temperature variations, in the context of the relativistic research program.
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)If there was a controversy inside American or European scientific communities;
3)The relation between Dayton C. Miller and other American or European physicists.
The themes I am willing to analyze are important in developing the history of relativity, in particular the history of the reception and circulation of relativity in the American scientific community.

The Approaches to the Lorentz Transformation Derivation Typological Structures Creation

Shcherbak O. ESHS
Savcuk W.

The analysis of the original issues to the Lorentz transformations derivation approaches witnesses that they had evolutional character which was connected with their applications to the different physical systems and mediums possibilities extensions. In this issue through the analysis of mathematical methods which were applied while deriving the Lorentz transformations four major directions which dominated in the first part of the XXth century are investigated. I have pointed out four founders of these directions:
- coordinate approach (V. Voight, G. Fitzgerald, J. Larmor, A. Poincaré, H. Lorentz, А. Einstein, I. Kordysch);
- group approach (H. Minkowski, A. Poincaré, V. Varicak);
- tensor approach Einstein, Ivanickaya),
-matrix approach. (H. Minkowski, A. Poincaré)
The main peculiarities of these approaches and their realizations through the examples of European scientists' works are shown.

Understanding Computer Simulation: the Case of the Atmospheric Sciences

Matthias Heymann Department of Science Studies,
Aarhus University,
DENMARK

In the second half of the twentieth century a mostly peaceful and silent revolution has changed scientific practice in many fields significantly: computer simulation. Some scholars refer to it as a large-scale transformation from science to e-science. A number of studies with a broad scope have acknowledged the notable impact of computer-based scientific practices on science in general. Detailed investigations of computer simulation practices and their epistemic impact remain the exception and mostly had a limited scope. Some researchers have considered computer modelling as a "third way in science", complementing theory building and observation. If this contention turns out to be substantive, it involves a shift of the very understanding of science rather than just an additional third approach to knowledge production, which complements theory and observation. The very criteria and standards of what may count as scientific evidence are subject to change.

In this paper I will describe some important features of computer simulation, such as the character of computer models and of important computational practices like model validation or sensitivity analysis referring to examples from the atmospheric sciences. In the second half of the twentieth century computers have become crucial instruments and computer simulation approaches core practices in fields like numerical weather forecasting, atmospheric pollution modeling and climate simulation. The paper will show that simulation approaches have common features but also differ considerably. Individual simulation approaches have "a life of their own" (Hacking) and require investigation on the micro-scale. To further the understanding of computational approaches and the transformation of science to e-science more micro-scale investigations will be needed.

SS09 Science and Technology in the 20th Century

Coordinated by **the Conference program committe**

Chaired by **Pedro Ruiz-Castell (Universitat de València, Spain)**
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Pasquale del Pezzo (Berlin 1859 - Naples 1936): "from the Local to the Global"

Emma Sallent Del Colombo Universitat de Barcelona,
SPAIN

Pasquale del Pezzo was born from a family of the highest nobility: the father Gaetano, duke of Cajanello, plenipotentiary minister of the Regno delle due Sicilie in Prussia, the mother Angelica Caracciolo from the princes of Torello.
Studied in Naples and obtained his degree in Law in (1880) and in Mathematics (1882). He taught Projective geometry till 1933 when he retired. Rector of the University in 1909-1911 and 1919-1921 and Mayor of Naples from 1914 to 1917. Married the Swedish writer Anne Charlotte Leffler (1849-1892), sister of the mathematician Gösta Mittag-Leffler (1846-1927). One of the members of the Neapolitan Intelligentsia, he was a frequent visitor of the ``salotto'' of the Italian philosopher Benedetto Croce (1866-1952).
His mathematical contributions are at the basis of the future classification of algebraic surfaces due to the Italian School, in particular to Guido Castelnuovo (1865-1952), Federigo Enriques (1871-1946) and Francesco Severi (1879-1961).
A work written in collaboration with Ciro Ciliberto which will be publish in the journal "La Matematica nella Società e nella Cultura" of Unione Matematica Italiana (UMI) enabled us to study in detail his mathematical contributions together with his social and private profile. We would like to make a step further and to analyze how his knowledge transits between different spheres and how this very local case study acquires a more global and trans-disciplinary dimension.

A "Science of Exportation"? The Role of Foreign Scholars in the Professionalisation of Spanish Prehistory (1900-1936)

José María Lanzarote Guiral Department of History,
European University Institute, Florence,
ITALY

History of Spanish Prehistory has been driven by two opposed currents. On the one hand, it has echoed the mainstream research done in the field of History of Science which stressed the (purposed) detachment of Spanish scientific community from Europe during the 19th century. Spanish science of that period is therefore characterised as peripheral, due in great measure to the passive role of Spanish scholars in the main scientific debates of that time, as the reception of Darwin's Theory of Evolution seems to suggest. On the other hand, the role of foreign scholars in the study of prehistory of Spanish soil has been some times considered an intrusion and sometimes has even been described as "scientific colonialism". This vision of things, which emanates from the legitimising histories of prehistory written at the beginning of the 20th century by the practitioners of the new discipline, has spilled over the recent historiography on the field, and deserves careful attention by historians of science. In the apparent contradiction of regarding foreign scholars as both the model to imitate and the concurrent to counteract, lies the tension of the desired internationalisation of Spanish Science done in a period of rise of national identities. Prehistory, placed as a discipline in between natural sciences and humanities, between anthropology and archaeology, seems to us an excellent stand point to tackle those unsettled questions. By looking at the role of foreign scholars in the professionalisation of Prehistory, we aim at surpassing this contradiction in terms, studying their interaction with Spanish scholars and their contribution to the developing of the discipline in the first decades of the 20th century

The Influences of Aristocracy upon the Development of Motoring in Austro-Hungarian Monarchy

Miloš Horejš National Technical Museum in Prague,
CZECH REP.

Aristocracy has often been perceived as a conservative element in society. Since the 18th century, however, many aristocrats had shown, that the aristocracy was not disincentive, but the motive force of technical progress. At the turn of the 20th century, their interest in technical innovations was manifested in the case of motoring. The aristocrats were not only interested in the new means of transport, but were engaged in founding numerous automobile associations throughout the monarchy. They played – with their vehicles – active role in WW1: the ranks of aristocrats swap the service from prestigious cavalry regiments to a car steering wheel. WW1 contributed to a massive spreading of automobiles in the following years.

Ways of doing Chemical Production at CUF, "Companhia União Fabril" (1909-1972)

Isabel Cruz CICTSUL (Interdisciplinary Center of Science, Technology and Society),
Lisbon University,
PORTUGAL

When, in 1906, the Portuguese chemical enterprise "Companhia União Fabril" has decided to establish its Barreiro works for a European-sized competitive production of phosphatic fertilizers, the use of Portuguese pyrites has been immediately selected as the S-source for the required sulphuric acid. Another important feature marks the chemical production at Barreiro that is, from 1909 to 1950 all the sulphuric acid produced was "chamber acid", obtained by the classical lead chamber process.
With the approach of the end of the II World War, there was a need to equate urgent technological reforms for the development of production of acid chemicals (sulphuric, hydrochloric, phosphoric), metals (cooper, lead, gold and silver) and fertilizers (phosphate and nitrogenous). Consequently, by the beginning of the 50's several important facts happened in CUF, but we stresses two among the others: the adoption of the contact technology and the implementation of organizational and structural reforms.
Progressing from the former industrial model where, with a simple structure, hierarchically makes a centralized command, CUF introduced a dynamic where the technical performance of its employees was not desirable, but also inevitable. In the industrial frame, several Study Centres were introduced, where engineers carried out the specialized technical work to production activities, and a Documentation Centre was also created.
The work which is being proposed, aims at understanding the process of CUF technology adoption between the beginning of sulphuric acid production (1909) and the erection of the first contact plant with fluidization technology (1972), not only in terms of the technologic consumption concept, always present, but also in terms of development of its own technological capacities (Barreiro, chemical production) related with the structures and dynamics established in the meantime.

Russia and Mongolia: Transfer of Scientific Knowledge in Political Context (1920s)

Tatiana Yusupova St. Petersburg Branch,
Institute for the History of Science and Technology,
Russian Academy of Sciences,
RUSSIA

Russian-Mongolian scientific contacts began in the middle of 1920s. It was impossible for Mongolia – just recently a feudal – theocratic country without any system of secular education, to start organizing of national scientific institutions without foreign support. Taking in consideration all historical and political factors, the first possible candidate for granting such a support was Russian Academy of Science (RAS).
The latter had the interest of its own in exploration of Mongolia for several reasons: further explorations in frontier regions; systematization of materials, previously having been collected during several Russians expeditions to Central Asia and then located in Academic institutes. Intentions of Russian scientists, interested in further explorations of Mongolia and support Mongolian Scientific Committee, coincided with the geopolitical situation in that region and striving of Soviet government for obtaining political authority there. That is why RAS' initiatives were supported by the government.
Russian-Mongolian scientific contacts were of various forms, such as: joint Russian-Mongolian expeditions and publications of collected data, support in establishing of national museum in Mongolia, exchange of scientific editions, formal visits of RAS officials to Mongolian Scientific Committee, training of young Mongolian specialists in Russia and so on. They developed from the gratuitous aid on the part of Russia to the bilateral parity relationship on the basis of various agreements and conventions in which both countries took part. Their format, content and intensity varied due to the international status of Mongolia, the condition of Russian-Mongolian relations, internal political situation in both countries. Today, according to many researchers, an ideological component left the academic interaction of both countries giving place to national interests.

German Science in Portugal 1933-45

Fernando Clara Faculdade de Ciências Sociais e Humanas,
Universidade Nova de Lisboa,
PORTUGAL

the bomb has persuaded historians that they must take some account of the role of science (Kuhn 1977: 132).

One will hardly find a moment in the History of Mankind which so incisively enlightens Bacon's famous aphorism *Scientia potentia est* as the period between 1933 (or 1939) and 1945 does. Sure enough, the fact that II World War was rather decided in a Physics laboratory than in battlefield forced a global (and, in a way, radical) change of perspective on Science. Kuhn's epigraph accounts for it. 'German Science' is, recognizably (and in both sides of the Atlantic) in the heart of this transformation.
The period in analysis raises several crucial questions which revolve mainly around the Science-Society-State triad. This particularity calls for an historical analysis that takes as its cornerstones the relations between: Science, Culture, State (Nation) and Society, Science and Nationalism or Science and Propaganda
The National-Socialist State takes advantage of Science, in an ideological and propagandistic manner and brings new nuances into the institutional relationship between Science, Society and State that had, at least since the end of the 18th century, appeared quite steady and balanced.
Science in National-Socialist Germany – and the term 'Science' should here be understood in the broadest sense of 'Wissenschaft', including both 'Naturwissenschaften' and 'Geisteswissenschaften' – has been the object of several studies. These have been mostly developed within a German historiographic framework and consequently, mainly concerned with demystifying internal structures and problematics. They therefore paid less attention to the circulation (and influence) of 'german science' outside Germany.
This paper will try to bring into focus the circulation of Science and Techonology between Portugal and Germany of that period, thus tentatively providing a wide and general picture of the persons and institutions involved in a complex - social, scientific, political - network of influence.

Thematic Maps and their Circulation during National Socialist Era

Petra Svatek Department of History,
University of Vienna,
AUSTRIA

The lecture will focus on the circulation on thematic maps developed in the Austrian part of the German Reich (called "Ostmark") during National Socialist Era with the prime aim of addressing the exchanges of maps between National Socialist authorities, scientific institutions and various scientists of different disciplines. After the National Socialist takeover in March 1938, in the "Ostmark" thematic maps were produced almost exclusively by scholars belonging to various research societies ("Working Group for Spatial Research" at Vienna University, "Southeast German Research Association", "Southeast European Society", "South-Eastern German Institute" of Graz etc.). Most of these maps played an important role for spatial planning as well as for the implementation of specific political projects and had therefore a large circulation between National Socialist authorities, regional planning authorities and scientific institutions.
One focus of the lecture will be on the question which institutions or scientists the map-circulation had initiated. The hypothesis is that it depended on the research institution as well as on the different research projects. For example scientists of the "Southeast German Research Association" produced ethnic distribution maps of South-Eastern Europe on behalf of the Ministry of Foreign Affairs. Members of this Ministry sent them to the general staff of army and air force and to the resettlement commandos of the "Volksdeutsche Mittelstelle" (Ethnic Germans Welfare Office). But sometimes the initiative came from scientists themselves, who submitted their maps to National Socialist authorities of their own accord. For example the Viennese geographer Hugo Hassinger (1877-1952, head of the "Working Group for Spatial Research" at Vienna University) maintained contact with the Research Troop ("Forschungsstaffel") of the Wehrmacht and submitted them a lot of thematic maps of Croatia, without having been constrained in any way to do so.

Human and Political Factors in Establishing Process of the Russian and Chinese Scientific Schools in the Field of Radio Electronics

Vassili M. Chesnov Russian Academy of Sciences,
RUSSIA

By the early forties of the last century a unique education system aimed at developing mathematic and engineering branches has been established in the USSR. Thus the new generation of scientists proved to be able to solve the scientific as well as the organizational tasks. Academician of Russian Academy of Sciences (RAS) V.A.Kotelnikov is one of them. He was one of organizers of the Special Design Bureau (SDB) of Moscow Power Engineering Institute, of the Radio Electronics Institute (REI) of RAS and of the Electronics Institute of the Chinese Academy of Sciences. Outstanding teams of researchers formed by this remarkable leader are still working and successfully co-operating in those three institutions.
The REI pioneered in the first successful experience in Solar system planet radar investigation, in investigating the radio waves propagation in various media, in making the Earth remote sensing systems.
The Chinese Electronics Institute provided for establishing the national electronics industry. The Institute was between those who introduced the novel technique of natural resources prospecting and monitoring the environment using onboard space equipment.
The SDB of MPEI is one of the key institutions of Russian space industry. Its history began in 1943 during the WWII when the USSR government decided to develop the radar branch. Thus the chair of radio instruments was established in MPEI and in 1947 it gave rise to the Special Tasks Department with V.A.Kotelnikov as chief.
In 1958 the Department became an independent organization SDB of MPEI. The SDB success was caused by its ongoing co-operation with the MPEI: 1) the MPEI scientific achievements became the background for the SDB designs; 2) the MPEI students were taking part in the SDB projects.
During the 50 years of its history the SDB has elaborated some innovative systems of global significance: the radio telemetering devices for the first satellites, whole TV systems for VOSTOK and VOSKHOD spacecrafts, VENERA-15, -16 onboard synthetic aperture radar for Venus mapping, etc.
The teams of the above three institutions are still co-operating. In 2000 an international conference on the results of joint work took place in Beijing.

Personal Bibliographical Index – a Source for the History of Science?

Birute Railiene The Vrublevskiai Library of the Lithuanian Academy of Sciences,
LITHUANIA

The communication will display a bibliometrical survey of personal bibliographical indexes of authors in different countries, an attempt will be made to select the science field. Universal Decimal Classification (UDC) index will be used to select records from the electronic catalogues of national libraries of the world: http://www.library.uq.edu.au/natlibs/ (107 countries). Data will be counted only from the libraries, which use UDC for systematising the records. The UDC index 012 describe"Author bibliographies. Individual bibliographies" (http://www.udcc.org). Number of personal bibliographies will be compared to the general number of records in a catalogue of a national library of a country, so indicating the standing of a source in a country. Only records of books, publishes after 1945, will be considered.
The tradition bibliographical indexes has a long history: from personal lists of scholarly works, published in first scientific magazines to a personal bibliography management software. The tradition of compiling an index of published works is well considered in academic world in many countries. Personal bibliography of a scholar, who initiated a scientific school or developed a certain trend in science, is a historical source, as it gives chronological picture of science, also data about co-authorship.
Personal bibliographies are both issued as books and as internet sources, i. e. in HYLE (International Journal for Phylosophy of Chemistry) "Bibliography on Boyle, 1940-": 455 titles, compiled by Robert Boyle Project (Michael Hunter); "Bibliography on Lavoisier, 1794-": 1,179 titles, compiled by Panopticon Lavoisier (Marco Beretta); "Bibliography on Liebig, -1997": 242 titles, compiled by William Brock, etc.
The communication will compare data of published personal bibliographical indexes in different sciences with reference to catalogue of the Vrublevskiai Library of the Lithuanian Academy of Sciences. The tradition of ower 50 years in compiling such bibliographical indexes for famous scholars will be presented, as well as the discussion for the real need and importance of such activity will be raised. Some examples of indexes will be presented to the audience.

The Circulation of Science as News: Newsreels and Regional Television in 1950s and 1960s Britain

Sally M. Horrocks School of Historical Studies,
University of Leicester,
UNITED KINGDOM

Over the past two decades scholars of science popularisation have produced a wealth of scholarship that examines the relationship between science and film, both documentaries and features, in the cinema and on television. Much of the research on science and the moving image has focused its attention on programmes with an exclusively scientific focus, with relatively little attention given to other ways in which visual images of science were presented to a popular audience, through news items for example. This paper will address this issue by examining how science was communicated to the public in the context of 'news' in 1950s and 1960s Britain. It does so through an analysis of material from newsreels and from ATV, the regional independent television broadcaster for the English midlands established in the mid-1950s. It will consider how the different demands of the two media, in particular the way in which they balanced information and entertainment, led to very different styles of presentation and focus. This diversity also provided audiences with disparate public images of the scientific enterprise from which to construct their own meanings. Finally I will consider the extent to which this material provides a resource not only for those historians interested in the popularisation of science, but also those more concerned with the research depicted in this material.

Standardizing Car Sound – Integrating Europe? The Circulation and Appropriation of Knowledge on Car Acoustics

Stefan Krebs Department of Technology, Innovation & Society,
Faculty of Industrial Engineering & Innovation Sciences,
Technical University Eindhoven,
THE NETHERLANDS

From the 1950's onwards road traffic has become the most significant noise source in human environment. Since then, traffic noise abatement has been high on the agenda of European regulators and engineers. Particularly for engineers, the development of new measurement instruments, the standardized setup of the test equipment, and the imposing of noise limits for different vehicle categories were crucial to tackle the noise issue.
To approach the noise problem the International Organization for Standardization (ISO) recommended a first standard on noise measurement in 1961: recommendation 362 – a norm that tried to combine subjective and scientific noise judgement. At the same time, the Organisation for Economic Co-operation and Development and the European Economic Community started to argue about joint measures to reduce traffic noise. Despite these efforts, the bi-annual conferences of the International Federation of Automotive Engineering Societies show that noise abatement entered the automotive engineering discourse not before the 1970's. Furthermore, the conference papers reveal the different national appropriation of ISO 362 and the diverting interests within the engineering community.
By focusing on the FISITA conferences, my paper will trace the circulation of special knowledge on car noise measurement and reduction in the international engineering field. The observed differences in the appropriation of ISO 362 questions the assumed European integration in traffic noise abatement.

A 'Language of Mathematics': Neutrality as a Facilitator of Circulation during Cold War

Helena Durnova Brno University of Technology,
CZECH REP.

Computing and cybernetics are two fields with many intersections, which often leads to confusion. As Slava Gerovitch has shown (cf. From Newspeak to Cyberspeak, MIT Press, 2002; 'Feedback of Fear', presentation at 23rd ICHST Congress, Budapest, July 28, 2009), cybernetics and its developments were heavily interconnected with politics on both sides of the Iron Curtain. Computing, on the other hand, was promoted on both sides of the Iron Curtain and compared to cybernetics, provided a more neutral ground for the exchange of ideas and concepts.
The most neutral part of computing is connected with those parts that are close to mathematic: with programming rather than with the machines themselves. When programmers realised the benefits of sharing the outcome of their work, computer programmes or software, they opted for a programming language "as close as possible to mathematical notation". In my contribution, I will examine how the neutrality of such language – the language of mathematics - facilitated sharing practices, ideas, and results of the endeavour among computer scientists. Special attention will be paid to the spread of the ideas of the Dutch computer programmer Edsger W. Dijkstra and his Discipline of programming and related works in the community of computer scientists in Czechoslovakia in the 1970s and 1980s.

Aircraft Narratives and Development in Indonesia, 1976-1998

Sulfikar Amir Division of Sociology,
Nanyang Technological University,
SINGAPORE

Situated in an archipelago, Indonesian founding fathers had from the outset realized that it was strategically necessary for the newborn nation to build capacity in building airplanes to connect thousands of its islands. Thus shortly after gaining independence from the Dutch rule in 1945, Indonesia started to develop an aviation industry. The aviation industry began to take off rapidly when the New Order regime led by General Suharto poured a huge amount of petrodollars to establish the Indonesian Aircraft Industry (IPTN) in 1976. Within ten years, IPTN turned into one of the most ambitious technological projects ever seen in the developing world. The ultimate mission of this mega project was to become a global aircraft developer able to challenge the dominance of Euro-American airplane producers. The development of the Indonesian aircraft industry was set upon a futuristic trajectory envisioned by Suharto's most trusted lieutenant B.J. Habibie. Following this trajectory, IPTN embarked upon two ambitious projects to develop its very own aircraft that involved tremendous financial resources resulting in significant technoscientific developments. The first project was the N250 turboprop airplane, and the second one was the N2130 jet airplane. This paper presents a historical study of socio-technical progress resulting from Indonesia's efforts in constructing the two mentioned technological artifacts. Situated in the Indonesian political context during Suharto's authoritarian rule, the observation in this paper is focused on three aspects. First, it sheds light on the basic concept of the N250 and the N2130, which will be discussed in relation to Indonesian development narratives. Second, it delves into intimate processes through which Indonesian engineers sought to adapt and translate foreign knowledge of aircraft technology into the local systems. And third, it critically examines the way the N250 and the N2130 presented by the New Order regime as the national pride.

SS10 Medicine in the 20th Century

Coordinated by the Conference program committe

Chaired by Mercè Piqueras (Universitat de Barcelona, Spain)
Jorge Molero (Universitat Autònoma de Barcelona, Spain)

Invisible Maps of the Body: Constructing Myths, Uncovering Legends

Karen Fleming (1) (1) Research Institute Art and Design,
Professor John McLachlan (2) University of Ulster,
Miss Gabrielle Finn (2) (2) Durham University,
UNITED KINGDOM

Anatomy is crucial in medicine and the public domain. However, anatomy is generally taught as a scientific discourse without aesthetic concerns. Textbooks contain bodymaps that students learn and use throughout their career. Dermatomes are areas of skin supplied by a single spinal nerve and are important in illness and anaesthetics, your doctor or physiotherapist's surgery probably has a dermatome map. The information contained in such maps dates back to 1893 and beyond.
Anatomy in medicine is diminishing in status. It has moved from a research-led science to a training tool. Anatomy has been reified as that which is 'known' and may be considered 'complete'. The artifacts and the body itself are normally presented as being value free and "scientific". The technology and design used to visualize and interpret the data is sophisticated. However when artist Karen Fleming and scientist John McLachlan mapped dermatomes from the most widely used sources onto real bodies they found that things weren't as simple as they seemed.
This highly visual presentation traces the evolution of the maps through the 20th century. A viral erosion in the successive redrafting of unaccredited 'knowledge' will be contrasted with the resilience of content through successive adaption and modification.
In this context the artefacts and the body itself are normally presented as being value free and "scientific" but it will be shown that medical illustrations are much more heavily cultural than is generally perceived. Before photography artists played an essential role in anatomy. Evolving artistic conventions, prevailing design values, ethics, politics and rebranding in successive illustrations have influenced the scientific interpretation of what purport to be neutral objects. The paper also develops a narrative to conserve and (re-) acknowledge the pioneering legends (Head and Campbell 1900, Foerster 1933 Keegan and Garrett 1948) whose research originated the clinically significant maps.

Science, Industry and Ideology in 20th-Century Catalonia: The Institute Ravetllat-Pla in Latin America between 1919 and 1939

Sara Lugo Márquez Universidad Autonoma de Barcelona,
SPAIN

Besides the controversy in Spain about Jaime Ferran i Clua's Anti-alfa vaccine and Calmette and Guerin's BCG during the first third of the 20th century, the veterinary Joaquin Ravetllat i Estech developed in Catalonia an alternative theory on the tuberculosis etiological variability. His ideas, together with the scientific and economic support of the physician Ramón Plá i Armengol, became fundamentals not only for founding the new Institute Ravetllat-Pla, but also for the fabrication and commercialization of two anti-tuberculosis products: the Suero Ravetllat-Pla and the Hemo-antitoxine Ravetllat-Pla. European hegemonic science was, however, committed to the mono-causality of Koch's bacillus. Therefore, Ramón Plá i Armengol was forced to expand his market to Latin America, generating a wide scientific and commercial network in approximately twenty countries from Latin America and Europe, including Portugal and Belgium. Through local commercial agents, the Institute not only distributed its products, but also spread its scientific ideas in scientific publications, including the journal published and edited by the Institute and entitled La Clínica (1924-1936).
The Institute Ravetllat-Pla became a corporation with a strong international projection, mostly thanks to the constitution and consolidation of a solid scientific and commercial network. This favoured the sale of their products, which embedded Pla i Armengol's scientific and ideological principles, and the survival of the Institute until 1980. Such a network model became crucial for exchanging ideas and constructing and developing knowledge. This case study will contribute to better understand historically how industries constituted an important mechanism for scientific legitimacy. Moreover, it will provide evidence of how both market economy and the legal and political definition of consumer products, specific from each country, are significant aspects in the making of science.

The Adaptation and Recycling of Instruments. A Closer Look at Albert Michotte's Psychological Laboratory of Perception

Sigrid Leyssen Eikones NCCR Iconic Criticism, Basel, SWITZERLAND
Leuven University, BELGIUM

When looking at a series of Albert Michotte's successive experiments on perception from the 1920s through the 1940s, it becomes clear that the instruments he used in these experiments were not fixed and stable entities. They were especially chosen and developed for being flexible and easy to adapt. Michotte's method required this easy access to the instruments in order to experiment on an extensive variety of related impressions. The instruments did not only constantly evolve within a certain series of experiments (e.g. the experiments on causality), but when a certain investigation was completed, Michotte often recycled parts of the instruments in order to create new instruments for a new experimental study. Many of the instruments, moreover, had already been borrowed from other laboratory practices or artistic practices, and had been adapted to the specific purposes of the experiment. The practices of adapting and recycling thus transcend the context of one psychologist or one laboratory. I will discuss these practices of adapting and recycling by looking at some concrete instruments used and developed by Michotte and his technician M.L. Roland.

From Books to Cities to Provinces. The Travel and Circulation of Knowledge on Trachoma in Interwar Turkey

Sanem Güvenç Salgırlı Department of Sociology, Marmara University, TURKEY

One of the greatest projects of the Republican regime in Turkey, established in 1923, concerned fostering the health of the public. As part of this endeavor, next to opening hospitals, clinics and dispensaries, the newly formed government made it a high priority to fight with and eradicate the infectious diseases of syphilis, gonorrhea, malaria, leprosy and trachoma, which were thought as presenting a serious danger for the wellbeing of the nation. However, even though the policies pointed towards the creation of a universal health care, major differences were observed in practice, especially on the spatial level. The policies that were implemented in the big cities and metropoles differed significantly from those in the provinces and the countryside. This paper is going to look into the struggle with trachoma disease during interwar Turkey as a case in such paradox. It is going to argue that the main reason behind this was the difference in the conceptualizations of trachoma knowledge, which changed significantly in its flow among various venues: as a malicious contagious disease that affected the health of the nation according to the state authorities; as an eye infection caused by a bacteria according to the medical textbooks; as a disease of the unhealthy and backward countries according to various health organizations; as a disease whose carriers must be avoided at any cost according to the eugenicists; and as a disease of the poor and needy, who needed to be taken care of, according to the local physicians. When considered to be entities that travel and circulate in different spaces, the heterogeneity concerning the knowledge of the diseases would enable us to rethink the nature of the public health measures.

Film, Medicine and Empire: Inclusion-Exclusion Discourses in Spanish Medical-Colonial Documentaries of the 1940s

Carlos Tabernero (1) (1) Internet Interdisciplinary Institute (IN3),
Isabel Jiménez (2) Open University of Catalonia (UOC),
Jorge Molero (3) (2) History of Science Studies, University of Malaga,
(3) Centre for the History of Science / Faculty of Medicine, Autonomous University of Barcelona (UAB), SPAIN

Inclusion-exclusion dynamics in contemporary societies are complex, multidimensional processes involving the active intertwining of wide-ranging social, economic, political and cultural factors.
In this regard, scientific-technological discourses, considered as a basic constituent of western hegemonic thought, play a fundamental role in the definition, classification, framing, rationalization and disciplining of distinct human clusters. This is especially apparent when conveyed through health-medical practices and policies, inasmuch as direct contact between experts (physicians) and laypeople (patients) necessarily occurs through practice itself, which in turn purportedly offers immediate solutions to pressing everyday life problems.
On the other hand, mass media, particularly when image-based, such as in the case of film or television, are crucially conducive of the construction, diffusion, representation, interpretation and reinterpretation of the beliefs and values upon which human communities are shaped. Moreover, they are also technological means of contact between experts (writers, directors, producers, distributors) and laypeople (readers, listeners, viewers), offering as well multifaceted immediate solutions (information, entertainment) to modern life needs, and thus bearing an undeniable strategic importance precisely from a joint social, economic, political and cultural point of view.
Upon these premises, our aim is to contribute to the historical understanding of the role played by the concurrence of the cinematographic and scientific-medical discourses in inclusion-exclusion dynamics in the context of post-war Spain. To do so, we have analyzed from this perspective five medical-colonial documentaries produced between 1946 and 1949, three of them in fact under the directive of Franco's government. In these films, a third discourse (colonial), equally strategic for the regime, plays an essential and complementary role as well. Thus, the joint articulation of these three discourses offers some explanatory keys for basic inclusion-exclusion traits pertaining to the categories of gender, class and ethnic group.

The Discovery of the Antihistaminic Drugs and of Chlorpromazine

Daniele Cozzoli Universitat Pompeu Fabra,
SPAIN

This paper reconstructs the story of the discovery of the early antihistaminic drugs and of Chlorpromazine. According to a number of historians, chlorpromazine (henceforth Cpz), the first neuroleptic, was synthesized as a by-product of investigations concerning antihistamines in the early 1950s at Rhône-Poulenc laboratories. Indeed, after Henri Laborit observed sedative side-effects of promethazine, Rhône-Poulenc decided to begin the research project which led to the synthesis of Cpz. However, a number of archival sources contend this linear story of an evolution from antihistamines to psychoactive drugs.
In this paper, I will show that there is some evidence supporting the thesis that cpz was synthesized by Rhône-Poulenc laboratories and that its psychoactive effects had been observed in 1948 by Bernard Halpern. Moreover, I will argue that the development of antihistamines in France was due to pressures by Us' companies: Merck & co. and CIBA Us' subsidiary. The development of antihistaminics in the 1940s and the delay of commercialization of neuroleptics were due to commercial reasons.
In this paper, I argue that psychoactive effects of products derived from phenetiazine were observed since the 1940s, but the development of neuroleptics was carried out only in the 1950s when pharma companies succeeded in pushing the use of psychoactive drugs in psychiatry. I also use this case study to advance a broader thesis on the role played by the history of science and the business history in understanding the history of pharmaceutics.

The Media Coverage of Asbestos Risks in Spain (1960-1990)

Mikel Astrain Dept. History of Science,
University of Granada,
SPAIN

The aim of this paper was to provide a first approach to media coverage of asbestos risks in Spain during the period 1970-1990. There appears to be a general consensus among public health officials, epidemiologists, industrial medicine specialists and trades unions about the low social visibility of work-related diseases in Spain and their systematic and generalized underestimation. Such underestimation occurred despite the rise in the industrial use of asbestos from the 1960s to the mid-1970s, when raw asbestos imports peaked at 126,000 metric tons per year, with the consequent exposure of large sections of the population.
Within the reasons proposed by experts to explain the lack of public debate on this issue, the role of media has received scant attention. In this paper I will analyse the coverage of asbestos risks provided by the Spanish TV (RTVE), the Andalusian TV (RTVA) and one of the most important Spanish newspaper (El País). I will explore the emergence of the problem in the media and its changing representations as an occupational issue or as an environmental problem. In so doing, I will propose an original hypothesis to explain the limited visibility of occupational and environmental asbestos risk in Spain during the period under scrutiny, which was in stark contrast with the situation in neighbouring countries, as France and the UK.
This research was supported by the Spanish Ministry of Science Project HAR2009-07543.

PVC and its Controversies

Maria Elvira Callapez (1) (1) Centro Interuniversitário de História das Ciências e da Tecnologia (CIUHCT),
Ernst Homburg (2) Faculdade de Ciências,
Universidade de Lisboa,
PORTUGAL
(2) Department of History, Faculty of Arts and Social Sciences,
University of Maastricht,
THE NETHERLANDS

Polyvinyl chloride (PVC), a polymer, is one of the most known and used plastics in the world. This plastic has worldwide applications in sectors such as construction, consumer goods and food packaging. In spite of usefulness of this material, in the early 1970s, complaints surfaced regarding potential links between a kind of liver cancer and vinyl chloride monomer (VCM), a small chemical unit that is used in synthesizing PVC.
This paper firstly analyses the health-history of VCM and PVC, and the outbreak of first the 'hand-disease' (acro-osteloysis) and then liver cancer (angiosarcoma), and secondly how chemists, the industry, the governments, the press, and public in general reacted to this event. We will analyse in a comparative manner the (different) responses in the USA and in Europe.

Contesting Expertise from Locally Produced Knowledge: Asbestos Hazard Management in Spain during the Transition to Democracy

Alfredo Menéndez-Navarro Departamento de Historia de la Ciencia,
Facultad de Medicina,
Universidad de Granada,
SPAIN

Social studies of science and the history of science have proven useful to challenge the expert explanatory model on the identification, management, and control of occupational risks. Lay epidemiology and locally produced knowledge have been proposed as driving forces to inspire a more comprehensive approach to occupational hazards and to contest the traditionally social decontextualised views supported by experts.
The aim of this paper was to explore alternative proposals to the expert model for the management and prevention of asbestos risks in Spain during the 1970s and early 1980s. These proposals emerged in the setting of a growing mobilization of workers and the active stance taken by the Comisiones Obreras (one of the two most important general trades unions) in denouncing occupational health problems during the transition to democracy. Their proposals were mainly embodied in the report issued in 1982 by Francisco Baéz Baquet, an office worker and member of Comisiones Obreras at the Uralita fiber-cement factory in Seville.
Attention will also be devoted to the role played by unions' instrumental use of scientific knowledge during the emergence of asbestos issue in the Spanish public sphere in 1977. Non-compliance with safety and hygiene regulations by the Uralita factory in Cerdanyola led to the Regional Board of Hygiene and Safety at Work in Barcelona ordering the temporary closure of one wing of the factory. This conflict was widely covered by local and national press. It sparked workers concerns about asbestos among the sector, and put into public awareness the issue of non-occupational asbestos exposure.
This research was supported by the Spanish Ministry of Science Project HAR2009-07543

W Workshop

Coordinated by Ida Stamhuis (Editor of Centaurus)
Chaired by Ida Stamhuis (Editor of Centaurus)

Workshop: 'Publishing in an International History of Science Journal (such as Centaurus)'

Ida Stamhuis (editor of Centaurus)
Helge Kragh (president and past editor of Centaurus)
Matthias Heymann (associate editor of Centaurus)
Raf de Bont (author and book review editor of Centaurus)

In this workshop editor, associate editor and past editor will explain what kind of papers are published in Centaurus. Authors will share their experiences between their submission of a paper and the ultimate publication. There will be time for questions and discussion.

Meeting of Journal Editors

Y Posters

Coordinated by the Conference program committe
Chaired by [N/A]

How Greek Sciences Passed to Europe by the Arab through Al-Andalus and Sicily

Inas Ahmed Elsayed Abbas Faculty of Arts,
Alexandria University,
EGYPT

It is well-known that the European Renaissance based on the Classical heritage ,transmitted to Europe by the Arabs, who did not render it the same as they had taken it.
We are concerned here with an exposition of the nature of that role, which manifested itself in 3 phases:1)Translating & editing: of the Greek text books both scientific & philosophic as well.2) Researching & analyzing :through detailed studies of these works, supplementing them with introductions, interpretations, scholia and comments.3) Application & experimentation: the scientific theories, thus laid the principles of the scientific method.
As previous studies enumerated the Arabs' contributions in the major fields of sciences, the present survey intends to throw into relief how the Arab scholars exceeded from the theoretical speculations to praxis. by applying this experimental practical method, using instruments & apparati developed or invented by them, drawing maps, making tables ,they opened new vistas for the appendix sciences either to medicine or mathematics to emerge and grow independently of these major sciences .
Andalus & Sicily as channels of the transmission: provided the institutes & universities in Europe, when the translation movement from Arabic started in the 12th century, with all these heritage & studies , where they remained open to fresh investigations & exhaustive researches. Thus paved the way to Europe to proceed into the Renaissance.
To sum up: the growth of knowledge should be looked up as the achievement of all humanity. the active nation who could benefit from the knowledge of the predecessors and then pass it to the successors, with new contributions of its own. In that process , the Arabs played their role.

Scientific Exhibits from the Virtual Museum of the University of Barcelona

I. Garcia Malet (1) (1) Vicerectorat d'Arts, Cultura i Patrimoni,
L. Cirlot (1) (2) Departament de Física Aplicada i Òptica,
S. Vallmitjana Rico (2) University of Barcelona
SPAIN

In January, the University of Barcelona opened its Virtual Museum. This experiment is a pioneering one in Spain and a project that began with the aim of publicizing the University's entire heritage to students, researchers, scholars and the general public.
The system that has been used is a particularly modern and highly specialized database designed for cataloguing all kinds of museum material. Linked to the program, we have also acquired the version making it possible to display the museum on the Internet.
The museum is currently organized in 9 collections and covers about 300 pieces, a small sample of the university's heritage which we have made available to the public in the form of an online showcase. We are now enriching the Virtual Museum with a second phase which introduces new pieces into the existing collections and also expands the number of collections.
This contribution is devoted to the description of the six scientific collections included in this virtual museum, which are:
The historic collection of the animal biodiversity resource centre collection, containing exhibits of birds and mammals from the Gabinet d'Història Natural.
The Sabater Pi Collection, which contains the scientific and artistic works of the emeritus naturalist professor Jordi Sabater Pi who donated his important private collection to the University of Barcelona.
The Herbarium BCN, which is supported by the University of Barcelona Centre for Research into Plant Biodiversity.
The Mineral Collection of the Faculty of Geology, housed in the Faculty of Geology building and contains a broad range of rock, mineral and fossil exhibits used in teaching and research.
The Scientific Instruments Collection, which contains exhibits of historical interest of the Faculties of Biology, Chemistry, Medicine, Pharmacy, Physics, and Psychology and in the School of Nursing.
The Catalan Pharmacy Museum gathers together objects of different kinds, old tools and medicines.

Keywords: University Museum, Virtual Museum, Academic Heritage, University Collections, Scientific Collections

Natural Philosophy and Religion in Byzantium: Dialogue or Conflict?

Manolis Kartsonakis The Hellenic Open University,
GREECE

Choosing the issue–the criteria
1. The enquired era – the timeline: The 9th century AC can be considered as a turning point in the history of philosophical and scientific thought in the greek speaking Byzantine Empire. On one hand, that century was located just after the Late Antiquity and the subsequent Dark Ages and, on the other hand, marked the beginning of the so-called Byzantine enlightenment. On the other hand, the 14th century indicates the terminating point of the Empire as it was gradually collapsed and finally conquered by the Ottomans during the 15th century.
2. The search of the introduction of original concepts.
3. The frequency of the records for phenomena.
4. Continual & multiply interpretative processes (rational & irrational).
5. Theological initiatives and outcomes. The conjunction between christian and ancient greek conceptions/ conclusions
6. The search of impressive phenomena which attracted scholars.

Conclusions
1.Living tradition in Byzantium. The background was placed on the corpus of the ancient Greek scientific thought mostly represented by Aristotle's works.
2.Church did not fully approve but Holy Fathers had tried to combine Greek and Christian principles.
3.We have found very useful historical references.
4.Serious interpretative attempts for natural phenomena.
5.They can be considered an opposition in terms of metaphysical explanations.
6.Byzantine interpretations were not spread sufficiently among the scientific community of that era in western Europe.

The combination of Aristotelian and Christian principles was a limitation towards the increasing opposition on behalf of the official Church authorities for total expelling of the Aristotelian texts from Universities.

Foundations of an Ancient Optical Textbook, Al-Baṣā'ir fī 'Ilm al-Manāzir, Comparing with Today's Textbooks and Major Books of Optics before it

Maryam Farahmand Institute for History of Science
University of Tehran,
IRAN

Training, Education and its different methods are nowadays considered as individual disciplines even with individual degrees. As a research in History of science an optical manuscript, al-Baṣā'ir fī 'Ilm al-Manāzir, has been studied. This textbook which has never been translated in order to be transmitted to the new world of science in Europe, remained so far unstudied and (erroneously) entitled as a digest of a major detailed book, Tanqīḩ al-Manāzir, of the same author, Kamāl al-Dīn al-Fārsī (1267-1319). By studying the transcript, step by step it was realized that not only it's not a summary book, but in fact it is an individual textbook in a different style of writing and headlines; different from all main optical manuscripts identified before.
There are many detailed reference books and manuscripts from ancient Greece until renaissance, consist of the collected analyzed sources, arguments, and proofs of a specified discipline and also many summaries of the most applicable transcripts. But rarely a textbook could be found which was written by the same author of the major reference, just for teaching the new junior students.
So the main purpose of this poster would be magnifying the pedagogical aspects of this old textbook, in comparison with today's optical textbooks and major optical manuscripts known until then. Beside History of Optics, this poster could also be categorized as history and foundations of textbooks and their style or methods. Extracting and studying the first constructs, gives the power to the roots that head up the trunk to view further landscapes.
The author of this textbook, Kamāl al-Dīn al-Fārsī (1267-1319) is an eminent mathematician and Physician of 14th century A.D. His most impressive work is Tanqīḩ al-Manāzir, a commentary on the Optics of Ibn al-Haytham or Alhazen (965-1039) on the advice of his teacher Quṭb al-Dīn al-Shīrāzī (1236-1311). When al-Fārsī completed Tanqīḩ al-Manāzir 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-Fārsī named this new book: (Kitāb) al-Baṣā'ir fī 'Ilm al-Manāzir which was finished in 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, effective definitions, and rules of optics.

History of Physics as a Didactic Tool

Jorgo Mandili Department of Physics
Silvana Mico University of Vlora,
Valbona Tahiri ALBANIA

History of Physics provides pupils and students with a knowledge of the history of human efforts in science. Through this discipline they know the life of the great scientists and gradual evolution of ideas. Whereras there are some correct theories accepted by all, however, scientific theories are still open for testing of new experiments and new ideas.
On the other hand, through this discipline pupils or students gain the opportunity to ask questions and be active in practice ,to collect historical materials for the establishment of a museum of physics, or to prepare soft-cleaved according to historical periods of development of science and technology .
In attempt to find strategies to improve teaching and learning science, one should consider the history of science, as a teaching tool and as a description of integrated school curricula.
In this article, we will treat some of these problems associated with the Historical Course of Physics. This course will reflect the general development of the main areas of physics as we know them today. It will appear as a clear linear model and discuss the major forms in each area where the evidence that science is trying to give a rational explanation of the rule in nature, a more precise explanation of magical or religious explanation. People in various countries of the world began to develop the science at different times, with different accents.Viewing the history of science as part of the culture to be broadcast in school can be argued that this should come as discipline separately. Expressing the opinion that the history of science be regarded as part of the curriculum seems appropriate to us note possible results of the introduction of historical arguments.
The first result is transmission of information on the historical development of science knowledge with the report - technology - society. The second result is the best appropriation of physics ideas through physical examination of the historical view. The third result is active learning of students with practical activities, projects, reports. The task to build a museum where the history of physics can lead to a greater integration between human and scientific field through an interpretation of history that each report carries - environment, human - nature, events related to technology development through an integrated analysis in the field of social, economic, etc.

Keywords: history of science, didactic tool, historical view, evolution of ideas