

FRIDAY 14 SEPTEMBER, 12.00-20.00

FRIDAY 14 SEPTEMBER	
12.00-14.30	ESHS COUNCIL MEETING
	IoE - Room 709a
14.00-20.00	REGISTRATION
	Institute of Education - Level 3, Bedford Way entrance Registration will remain open at the Institute of Education 09.00-18.00 Saturday and Sunday, and at the Science Museum 09.00-18.00 Saturday and Sunday and 09.00-11.00 Monday
15.30-16.00	CONFERENCE WELCOME
	IoE - Logan Hall
	ESHS President: Dr Antoni Malet BSHS Vice-President: Dr Patricia Fara UCL STS HoD: Professor Joe Cain
16.00-17.00	NEUENSCHWANDER PRIZE LECTURE
	IoE - Logan Hall
	Chair: Professor Dr Erwin Neuenschwander
	Professor Robert Fox (University of Oxford)
	<i>Memory, Celebrity, Diplomacy. The Marcellin Bertholet Centenary, 1927</i>
17.00-17.30	AFTERNOON TEA
17.30-18.15	YOUNG SCHOLAR LECTURE 1
	IoE - Logan Hall
	Chair: Dr Patricia Fara
	Dr Antonio Sánchez (Autonomous University of Madrid)
	<i>Artisanal Cultures and Practical Knowledge in the Early Modern Iberian World</i>
18-15-19.00	YOUNG SCHOLAR LECTURE 2
	IoE - Logan Hall
	Chair: Professor Ana Simões
	Professor Stephanie A. Dick (University of Pennsylvania)
	<i>Making up Minds: Mathematics, Computing, and Automation in the Postwar World</i>
19.00-19.15	WELCOME ON BEHALF OF THE BSHS & SCIENCE MUSEUM /CENTAURUS
	IoE - Logan Hall
	BSHS President: Dr Timothy Boon
	Centaurus Editor: Dr Koen Vermeir
19.15-20.00	WELCOME RECEPTION
	Institute of Education

SATURDAY 15 SEPTEMBER, 09.00-10.30

S07 EXPEDITIONS AND IMAGINARIES IN THE RUSSIAN/SOVIET BORDERLANDS

Location: IoE – Room 802

Chair: Lajus, Julia

Organiser(s): Jones, Susan D.

Bridging Europe and Asia, the vast lands that have been under Russian and Soviet control were the 'living laboratories' of generations of scientists. How did Russian and Soviet scientists navigate political, environmental, and sociocultural entanglements while on expedition in the far reaches of the empire? To explore these and other questions, our case studies include: organizing Russian natural history expeditions and border crossings in the early 19th century; fin de siècle disease ecology expeditions in Central Asia; early 20th-century Russian/Soviet climate science expeditions; and comparative Soviet geological fieldwork after the Great Patriotic War. While most Anglophone histories of science and environmental histories have presented a unified picture of Tsarist and Soviet government control, our case studies reveal a much more nuanced situation for scientific thinking and practice beyond Moscow and St. Petersburg. Producing knowledge and creating imaginaries for the borderlands was the work of geologists, biologists, anthropologists and others on multi-disciplinary expeditions that were an almost continuous feature of Russian science before, during and after the revolution. We present scientific work across time, borders, disciplinary and political differences, gender and ethnicity; and we bring new voices into the global history of science and environment. By spanning the 19th and 20th centuries and seeking to situate our historical case studies in trans-national context, we join a growing movement to integrate Russian/Soviet scientists' work and thinking into the broader historiography.

Feklova, Tatiana (Russian Academy of Sciences, St Petersburg)

Cross the line: the expeditions and the borders. The Russian expeditions in the 19th century

In 19th-century Russia, scientific expeditions were complex entities characterized by the need to navigate between the academy, government and merchant corporations (such as the Russian-American Company). Formed to help include places as distant as Russian America (now Alaska) to one space and formed united country Russian Impair, expeditions navigated much more than the difficulties of travel and scientific collecting. Organizational work prior to departure, and constant negotiation along the way, occupied a great deal of scientists' time and effort. This work was an essential part of the expedition's activities and successes, especially during this time period when the Russian government was organized according to a policy of "unity of command." Initiative, funding requests, and problems while traveling all required scientists to communicate with central planners, Academy of Sciences functionaries, and the companies developing these regions. Using correspondence, ledgers, and letters to tribal leaders, this paper briefly traces themes in the work of three scientific expedition organizers: I. Voznesensky (1839 – 1849; Russian America), H. Fritsche (1867 – 1883; China) and H. Lenz (1829; Caucasia). These documents provide insight into how each expedition resolved border disputes; balanced utilitarian aims with scientific goals; and managed relationships with local peoples around the Russian empire.

Jones, Susan D. (University of Minnesota)

Disease Ecology and Colonial Visions in Russian Central Asia

At the end of the 19th century, Turkestan (a vast region that includes today's Central Asian republics) was a restless borderland of the Russian Empire. The colonial vision of making Turkestan productive, according to Tsarist (and later Soviet) goals, depended on agricultural development and natural resource extraction. Both were often destructive of local environments and people. By traveling to remote areas and identifying both resources and

SATURDAY 15 SEPTEMBER, 09.00-10.30

obstacles to development, scientific expeditions were crucial to reaching central government goals. But expeditions were also complex, multi-disciplinary assemblages of people with their own intentions, working far from the centers of political power. David Moon and other historians have recently argued that scientists' work sometimes supported the opposite of colonial abuses: environmental preservation, conservation, and attempts to protect local citizens' health and well-being. The present paper contributes to this discussion by focusing on two scientists, Evgeny Nikanorovich Pavlovsky and Polina Andreevna Petrischeva, whose fieldwork helped to explain and control diseases endemic to the borderlands (diseases such as plague and tick-borne encephalitis). How did these scientists on expedition interact with local people, and how did local interactions shape scientific ideas and practices? Why did Pavlovsky, Petrischeva, and others make the choices they did, in order to navigate political imperatives alongside scientific aims and local needs in Turkestan? Using published and unpublished reports, papers and photographs, this paper analyzes how the complex local cultures of fieldwork shaped scientists' recommendations about settlement and agricultural development in the Central Asian borderlands.

Oldfield, Jonathan, and Shaw, Denis B. (both University of Birmingham)

Understandings of climate in Russia's borderlands: Lev Berg and the desiccation debate

Lev Berg (1876-1950) was a prominent Russian geographer, ichthyologist and climatologist whose career spanned the late tsarist, early Soviet and Stalin periods. Whilst Berg's scientific activity was in many ways encyclopaedic, examining numerous facets of the physical environment both chronologically and spatially, climate and climate change were abiding interests throughout his life. The paper will focus on Berg's determination to counteract the widespread belief in the desiccation of Central Asia (or even of the whole globe), advanced most notably by the Russian scholar and political activist Peter Kropotkin and the American geographer and environmentalist Ellsworth Huntington. Berg's principal publication on this issue appeared in 1911, based on prolonged periods of fieldwork in Central Asia. The paper will consider the wide range of evidence he brought to bear on the issue (mirroring his concept of climate as intimately linked to the whole of the natural environment) and reflect upon the broader political and intellectual context in which the work is to be understood.

Amramina, Anna A. (University of Minnesota)

The Common Language of the Earth: Field Work in US-USSR Bilateral Cooperation in the 1970s-1980s

The work done jointly by geoscientists in expedition builds an "environment of research", an intellectual effort rooted in interactions with the material world of natural environments and laboratory settings. The collaborative nature of earth sciences encourages collective effort and creates a kind of camaraderie among researchers. The universal language of fieldwork can help transcend political tensions in international scientific communication, as it did for American and Soviet geologists, seismologists, and oceanographers in the 1970s - 1980s. This presentation will discuss the expeditionary component of multifaceted scientific activities under the bilateral US-USSR Agreement on Cooperation in the Field of Environmental Protection of 1972 as a common identity for geoscientists. Non-verbal kinds of scientific information, from a rock sample to a landscape and observation data, are powerful tools of communication in earth sciences. They are of particular value when language barriers and political differences complicate the process of cooperation. Field work, often barring on adventure while being a way of scientific knowledge production, gave Cold War American and Soviet scientists a chance to become acquainted with each other and build a team. This presentation will follow oceanographic voyages, seismological rock physics experiments, and geological landscape excursions from California to Siberia and people who spoke a common language of field work.

SATURDAY 15 SEPTEMBER, 09.00-10.30

S30 THE SCIENCE OF REST IN THE NINETEENTH CENTURY

Location: IoE – Room 804

Chair: Dickson, Melissa

Organiser(s): Shuttleworth, Sally

Although there has been considerable work on ideas surrounding the human body and energy expenditure in the nineteenth century, little attention has been paid to diverse theories and practices of encouraging rest and recuperation. This panel looks at the rise of some of these ideas and practices, and the conflicting models they often suggested. In her paper, 'Sea or Mountain', Sally Shuttleworth looks at the moment when advice for recuperation and cure for nervous and tubercular patients was turned on its head, and instead of heading for warm climes, patients were encouraged to spend their winters sitting outside in cold mountain air. Taking Davos and Menton as her two key studies, she explores how both places developed, and were marketed internationally as health resorts, and the ways in which rivalries and divisions were played out in medical and cultural practices. Hosanna Krienke looks at another neglected aspect of the science of rest, the rise of the convalescent home in Britain, and its empire, and the different dynamics produced in medical practice when the focus lay not so much on the cure of disease, but rather on the development of a therapeutic environment for patients to spend considerable time in convalescence. The final paper by Sarah Green considers the surprising absence of rest in the voluminous Victorian literature on the dangers of sexual excess. While the warnings against expending too much energy in sexual activity fit squarely into the energy dynamics of the period, rest itself is also somewhat surprisingly construed as pathological. Instead what arises is a model of healthy, productive and indeed highly sensuous continence. The paper explores the interconnection of these ideas across medical works and also Decadent literature of the Fin-de-Siècle. By drawing together these diverse responses to ideas of rest in the nineteenth century, the panel aims to highlight the transmission of ideas across different fields, but also to show how the overarching, unifying model of energy dynamics could give rise to considerable diversity and conflict in interpretation. All the panel are researchers on the ERC funded project, 'Diseases of Modern Life: Nineteenth-Century Perspectives'.

Shuttleworth, Sally (University of Oxford)

'Sea or Mountain?': the Development of Menton and Davos as Health Resorts

With the development of medical climatology in the nineteenth century, patients were often sent long distances in order to find the right climate in which to rest, recuperate, and cure their various ailments. In this paper I look at the dramatic shift which took place from the 1870s, when previous advice to seek warmer climates was turned on its head, and it became fashionable for patients to spend winters in the mountains, reclining outside all day in sub-zero temperatures. Both Menton and Davos emerged in the final decades of the nineteenth century as leading health resorts, but with very different claims as regards the effects of their climates. Drawing on reporting in both the medical and popular presses, the paper explores the medical arguments, and cultural marketing that lay behind the development of both resorts. It also considers the conflicts and radical divisions of opinion which emerged in medical writing as regards to the merits of a warm, Mediterranean climate, or a freezing Alpine one, for the cure of nervous disorders or tuberculosis. While both sides were agreed on the necessity of extended rest, its forms and functions were the subject of fierce debate. The paper uses this controversy to consider more broadly the development in the nineteenth century of medical and cultural ideas on the importance of rest.

Green, Sarah (University of Oxford)

Sexual Excess and the Pleasures of Continence

Nineteenth-century writing about sexual health claimed that excessive sexuality could have all sorts of grisly physical consequences. But in its many recommendations to sufferers, it rarely mentions rest. Why is this the case? This paper explores how the remarkable absence of rest in sexual health nineteenth-century discourse speaks to the particular element that has been my own recent focus: the idea that sexual continence can be both healthy and productive. The paper will look initially at how rest was framed as part of the problem rather than the cure, as one element in the passive, slovenly, luxurious living that was widely associated with sexual excess. In contrast, the cure for sexual disorder was discomfort and activity, a regime of cold baths and hard beds, which owed much to wider codes of behaviour and ideals of self-control, particularly for men. But the physiological reasons given for sex's dangerousness, though sometimes involving loss of energy, also often discouraged the conclusion that general rest could do anything to address the issue. Cessation from sex was therefore rarely described as restful, but often as an active, healthy, productive state in its own right. The paper ends by indicating how this manner of imagining healthy, and sensuous, continence influenced Aesthetic and Decadent literature at the end of the century.

Krienke, Hosanna (University of Oxford)

Convalescence vs. Cure: The Role of Convalescent Homes in the Rise of Scientific Medicine

According to many Victorian observers, the stresses of modern life often nullified seemingly successful medical treatment. As one journalist put it, "In the bulk of cases, mere cure is not enough." Alongside effective medical treatment, Victorian patients required access, it was argued, to a period of holistic convalescent care directly after acute illness, with sympathetic caregivers, comfortable domestic spaces, and (most importantly) several weeks of unfettered leisure following hospital discharge. This paper will examine the rise of the philanthropic convalescent home movement which offered these benefits to impoverished patients. Many scholars have described the rise of scientific medicine in the nineteenth-century as an increasingly detached and clinical mode of physician-patient interactions. By contrast, my project demonstrates that this rise was accompanied by an exponential increase in the availability of holistic convalescent care, with many physicians and hospital administrators arguing that convalescent care was a necessary supplement to the shortcomings of scientific understandings of disease. While scientific medicine increasingly targeted disease processes within the individual body in the hope of identifying curative treatments, convalescent care focused on creating a therapeutic environment through which to ameliorate social, ecological, and economic stressors that took a toll on patients' bodies. Scientific medicine and convalescent care were united in their efforts to intervene in the health of their patients; however their disparate methods of intervention represent a significant collaboration that revises current scholarly assessments of medicine in the nineteenth century.

SATURDAY 15 SEPTEMBER, 09.00-10.30

S22/1 SCIENTIFIC PERSONAE AND THE (DIS-)UNITY OF MODERN STATISTICS IN COMPARATIVE PERSPECTIVE, c. 1860-1960

Location: IoE- Room 736

Chair: Stamhuis, Ida

Organiser(s): Mayer, Jochen F. (Independent Scholar)

Following Daston and Sibum's (2003) collection of essays, there has recently been an efflorescence of scholarship on scientific and bureaucratic personae (Becker and von Krosigk 2008; Paul 2014; Algazi 2016). Understood as an intermediary between the individual biography and the social institution, the persona concept explores processes of scientific knowledge making by looking at the interdependence between the subjectivity of the scientist and historically distinct cultural templates to which scholars were invited to conform: context-bound habits such as the 'learned forgetfulness' among married early modern scholars (Algazi 2003), or generic types of thinking, speaking, and working such as the impersonal observer 'from nowhere' in the case of 20th-century physicist Heisenberg (Carson 2003). Recent contributions, in turning to the Humanities around 1900, deploy a more narrow understanding of personae to emphasize discipline-specific virtues and skills deemed necessary to engage in scholarly practice (Paul 2013). Others still focus on the dynamics between the credibility of assertions in science and the ways in which scholars performed and embodied their identity as reliable and trustworthy (Bosch 2016; Shapin 2008). Against this background, this session explores the validity and usefulness of personae accounts for biographical research in the history of statistics during the period 1860-1960. By comparison to the Humanities or modern physics, statistics seem a particularly unpromising field for such a project. During this formative period, generations of statisticians, under the impulse of the 'probabilistic revolution' in science and public life, pushed the field further towards neutrality and technicality, and sought to produce statistical results and methods that were allegedly more 'impersonal' and 'objective' than the outcomes of any other scientific endeavor (Porter 2011). Yet the culture of statistics shapes and is shaped by the people who practice it. Exploration of how statistical credibility was secured beyond the recourse to the authority of the state or the epistemic powers of methods and numbers or, indeed, how statisticians attached moral value to their work, seems particularly timely now, as the very personae of the 20th-century government statistician or public expert – and the authority of the data they produced – have come under attack both from anti-democratic ideologies and developments in electronic database technology and the internet (corporate 'Big Data'). While there is a rich body of work on the institutional and epistemic histories of (governmental) statistics, scholarship (excepting Porter 2004) has only tentatively begun to explore the wide-ranging categories of people that around 1900 became involved in statistics, and the multiple moral and political visions implied. In contradistinction to claims, in numerous biographical encyclopedia, to the unity of statistics and a quasi-linear evolution of statistical science, this session explores the resources – moral, cultural, and epistemic – that had to be mobilized in the making of a 'successful', and 'good' statistician across various national scientific cultures, and how these demands changed during the early twentieth century. Papers may adopt a broad perspective on scientific personae (as outlined above) thereby further probing whether there can be discerned anything like 'statistical personae' in the first place.

Cladders, Lukas (Charité Institut für Geschichte der Medizin, Berlin)

Being non-political. Robert René Kuczynski as an exile demographer in the UK

SATURDAY 15 SEPTEMBER, 09.00-10.30

The economist and statistician Robert René Kuczynski (1876-1947) played a prominent role in the international community of population experts around 1930. He fled Germany shortly after the National Socialist's rise to power due to his left-wing political activities during the Weimar Republic. In exile in the UK, where he made a formidable career in demography, Kuczynski found himself in new professional and cultural circumstances. This meant an adaptation of what might be called his persona: from the statistician and social critic to the expert on demographic questions who was the first Reader in Demography at the London School of Economics and gave expertise in various institutional contexts. This development came along with a surprising silence on political implications of his findings and a high degree of technicality of his publications. Kuczynski considered himself in the English tradition of Political Arithmetic, a position that he shared with like-minded people in his early exile years. However, he soon heavily depended on researchers and activists who linked demography to the highly politicized questions of "race" and "class" under the heading of "reform eugenics". While some traits of his Weimar years proved helpful in this new context, like quarrelling with authorities for the improvement of statistical registration, other virtues became useless or might even have been counterproductive. My talk will investigate if the concept of professional personae helps to get a better understanding of the changes that marked Kuczynski's years in exile and how it can be utilized for discerning "the demographer".

Göderle, Wolfgang (University of Graz)

Remaking Objectivity: Statistics between Science and Administration in the Habsburg Empire between 1860 and 1890

Personae between science and administration have been of utmost importance when it comes to the genesis of modern statistics over the entire course of the 19th century. My contribution illustrates the evolution of the field of tension that emerged between the two poles of political and administrative interests on the one hand, and the increasing requirements of scientific objectivity on the other along two leading figures of Central European administrative statistics between 1860 and 1890, Adolph Ficker and Theodor Inama-Sternegg. Contrasting these two men and their careers will display how the field changed in less than thirty years – and how this related to the self-view of the statisticians involved and the relationship between the modern state and its instruments. Ficker – a trained historian and experienced civil servant – appeared to be a polymath, also in his scientific and scholarly activities, which stretched from statistics via ethnography to history. Inama-Sternegg, who took Ficker's office in the mid-1880s, had already enjoyed specialized scientific training as a mathematician with a strong specialization in statistics. He kept his distance towards state administration, despite being a part of it, and focused his activities on a very small and scientific statistical agenda. My contribution presents a bigger picture of the two figures introduced above and raises the question of how the complex evolution of statistics in this era relates to the overarching development of modern-statehood on a global scale.

Ferdinand, Ursula (Charité Institut für Geschichte der Medizin, Berlin)

Robert René Kuczynski – a modern statistician?

"Modern statistics derives from the recombining of scientific and administrative practices that were initially far apart."¹ In my talk, I will discuss this characterization by Alain Desrosières by following the activities of the economist and statistician Robert René Kuczynski (1876-1947) in the early 20th century. As a disciple of the German Historical School of Economics, he trained his skills under Richard Boeckh (1874-1902) at the Berlin Statistical Office before working in a different professional and cultural setting during a multi-year stay in the USA. One can argue that the professional virtues he developed there were fundamental for a new style of statistical reasoning and his professional persona after his return to Germany. As head of the statistical office of the city of Schöneberg from 1906-1921, Kuczynski shaped administrative practices and transformed his moral and political visions into research programs and social reform movements. The independence of his intermediate position (between local and federal

SATURDAY 15 SEPTEMBER, 09.00-10.30

institutions and between science and administration) allowed him to participate in border-crossing exchanges (between countries and institutions as well as between disciplines). While the centrality and totality of war economy changed the setting of his activities after 1914, Kuczynski nonetheless preserved his virtues. They helped him to have a transnational career as independent researcher after the dissolution of the Schöneberg office in 1921. I will discuss these findings in the light of a possible “statistical persona” and the (dis-)unity of statistics itself.

SATURDAY 15 SEPTEMBER, 09.00-10.30

**S01/1 UNITY AND DISUNITY OF THEORY AND PRACTICE IN RESEARCH ON
ECONOMICALLY SIGNIFICANT SPECIES**

Location: IoE – Room 828

Chair: Fedotova, Anastasia

Organiser(s): Fedotova, Anastasia, and Mueller-Wille, Staffan

The panel will be devoted to economically significant species as research objects and their impact on research agendas, methods, strategies, and institutional frameworks in natural history and biology. The topic is deliberately conceived as a very broad one that could potentially encompass a vast array of disciplinary fields within the life sciences. The panellists will consider research on such objects as crops, officinal plants, domesticated animals, fish and wildlife game species, insect pests, and species transmitting contagious diseases. It makes sense that economically significant species have always enjoyed better chances to become privileged research objects; however, there are numerous examples also when some of these species remained under-researched for a long time. The economic, ecological or medical significance of a given species may considerably vary from one national or regional context to another and from one point of time to a different century or decade. Technological changes, in particular, would inevitably lead to enhancing the importance of some species that previously never attracted focussed attention, while other species would cease to be treated as a valuable resource or commodity deserving such attention. Geographic location and economic conditions exercise a powerful influence upon what counts as a biological resource, and thus might affect the making of specific institutional, regional or national traditions and 'schools' within specific fields of study. The focus on economically significant species may have provided a convenient strategy to legitimise and enhance the credibility of a particular research agenda in the eyes of academic administrations and private and public sponsors. But even if the choice of some of these species as principal research objects was thus often pragmatically motivated, it could still lead to substantial changes in the institutional and methodological landscapes of science. In earlier periods in the history of life sciences, for example, local agents – farmers, craftsmen and entrepreneurs, hunters and healers, etc. – would usually have had vastly more substantial experience in dealing and working with a specific species than travelling naturalists who produced first scientific accounts of these species. Growing awareness of the economic importance of such species by the state would thus have pressured metropolitan scholars into changing social and institutional arrangements to tap into these knowledge sources at the periphery, forcing them to leave their familiar environment and relocate to new, often challenging and potentially dangerous milieus. At the same time, knowledge gathered in this way needed to be reported back and systematized, often causing major changes in the material culture and publication regimes of science. By looking at the history of research on economically significant species, we hope to arrive at a better understanding of the entangled histories of supposedly 'pure' and 'applied' research in different regions of the globe and what unites and separates different national and regional traditions in the history of the life sciences from the early modern period to the present.

Klemun, Marianne (Universität Wien)

Speik between the Alps and the Orient: The Disunity of Plants and the Unity of Economies

Research on the history of the economic impact of plants has hitherto focused mainly on cultivated species. The role of wild plants, on the other hand, has been widely ignored. In fact, uncultivated plants have never been as economically important as the potato, the tomato or the

SATURDAY 15 SEPTEMBER, 09.00-10.30

carnation on a global scale. However, they still played a certain role at the trans-national economic level. Spikenard or nard oil, also called nard or nardin, an extract from the roots of the valerian plant, is one of those natural substances that had economic significance. For centuries, this essential oil enjoyed great popularity as a versatile medicinal and hygiene product due to its intense fragrance and its refreshing, almost camphorous effects. Traditionally, nard oil was made from plants that came from different regions. As early as in ancient times, Indian, Syrian and mountain varieties were known and distinguished. For instance, nard was known in sixteenth century Hungary as “Béchy fiu”, that is “Viennese Herb”, because it was imported from Vienna to Hungary. The best spikenard in terms of fragrance comes from a small alpine region in Carinthia and Styria, where even mountain summits are called after the herb (Speikkogel). Collectors of this plain and unremarkable alpine plant were called “Speickgräber” – “spikenard diggers”. This activity proved to be a profitable secondary occupation for farmers and shepherds of this mountain region, and was even promoted by eighteenth century physiocracy. Over the course of time, knowledge about different places of origin and substitute plants such as lavender increased. Independent from the regional “spikenard” culture of the Alps, an academic botanical knowledge of the plant emerged that started to distinguish different species, but could pinpoint the best locations of spikenard (*Valeriana celtica* L.) only later. This is surprising all the more because genuine spikenard is very different from other valerian species. It was exported from Carinthia (Koralpe) and Styria to the Levant. From the sixteenth century to the 1930s, it was a most popular commodity of the Austrian monarchy. Its continuous economic significance can be seen as a consistent *longue duree*. At the same time, insights about different species and botanical knowledge increased considerably. Trade knowledge was based on the regional culture and non-academic knowledge. However, due to the cultural and economic significance of the plant, apothecaries and botanists increasingly influenced and interfered in this field. It was not before the end of the nineteenth century that different subspecies could be identified, which substantiated the differences between the plants from the Western and those from the Eastern Alps, also according to their odour intensity. The cultural and knowledge history of the spikenard plant as resource can be used as an example to illustrate the simultaneous development of and the encounter between science and economy. This special research object also highlights the spatial interconnection between the regional and the global dimension between field science and taxonomy.

Kraikovsky, Alexey (St Petersburg University)

“Monsters furnishing barrels of oil” – the whales and whaling in the governmental project of westernization of Russia in the 18th Century

The paper will present the history of the governmental efforts to develop the Russian whaling in the Arctic in the 18th c. The project failed and I argue that the explanation for this should be analyzed through the perspective of the image of marine Environment that existed in the heads of the educated society of the age. The very idea of whaling as profitable and advanced industry appeared after the Grand Embassy, when Peter I visited the Dutch whaling fleet that returned after the successful season from Spitsbergen in 1697. These impressions formed the base for the governmental decisions in combination with observations of the European economic practices and the projects provided by the interested actors. Therefore, Government based the activities in this sphere on the idea of the whales as easily accessible resource. At the same time, the Pomors of the Russian North for centuries had clear practical knowledge of marine animals hunt. They were quite experienced and successful in the blubber connerce based on the hunt for seals and walrus. However, as it became evident by the late 18th century, the peasants of the Russian North understood very well unprofitability of blubber extraction based on the whales in comparison to their traditional strategies. The paper will present and discuss the contest of these two complexes of knowledge that eventually resulted with the failure of the governmental plans.

Tammiksaar, Erki (Estonian University of Life Science)

Karl von Baer’s fishery expeditions to lake Peipsi and the Caspian Sea

SATURDAY 15 SEPTEMBER, 09.00-10.30

Karl Ernst von Baer on Chudzko-Pskovskoe Ozero in 1851–1852 – the birth of systematic fishery studies in the Russian empire and in the world. Chudzkoe-Pskovskoe ozero is a large natural lake situated in the basin of the Gulf of Finland (Baltic Sea). This lakesystem has been since historical times famous for its rich fish production and thus has played a very important role in the local economic and social life. Official fish catch statistics (e.g., for Chudzko-Pskovskoe since 1931, for Vänern and Vättern since 1914 etc) is nowadays still one of the most widely used data sources describing long-term fish stocks dynamics. Although the quantitative knowledge of fisheries of Chudzko-Pskovskoe ozero prior to the 19th century is relatively fragmentary, there are still available catching datasets enabling to compare the main problems of fishery in the lake in the 19th century and today. These statistical data were collected by Karl Ernst von Baer, full member of the St Petersburg Academy of Sciences, in 1851–1852, during a special fishery expedition to Chudzko-Pskovskoe ozero and the eastern coast of the Baltic Sea, organized by the Ministry of State Properties. The archival data in Baer's archive prove that the maintenance of the sustainability of fish stocks was continuously the main task of fishery in the last centuries. Although the Livland province of the Russian empire established since 1825 stricter control over fishery in Chudzko-Pskovskoe ozero, other governments – Estland, Pskov and St Petersburg (surrounding the lake system) – did not follow the example. Especially problematic was catching of fish younger than one year (age 0+). Baer pointed out in his expedition report that approximately 1000 tons of young fish were fried and salted every year. The results of the expedition to Chudzkoe-Pskovskoe ozero can be regarded as an important prerequisite to the Caspian expedition by von Baer (1853–1856). Making preparations for the Caspian expedition, von Baer followed several methodological principles he had used at the Chudzkoe-Pskovskoe expedition: the collection of statistical, economic and natural historical data as from archives as well as from Caspian fishermen, also from officials and those involved in fishing industries, etc. Similarly to his earlier expedition, he considered instructions for members of the Caspian expedition very important in order to coordinate the collection of data according to the same principles. The science historians have considered the expedition to the Caspian Sea by von Baer and study methods applied the beginning of the systematic study of fisheries in the Russian empire. Actually, it was the expedition of von Baer to Chudzko-Pskovskoe ozero that denoted the birth of systematic fishery studies in Russia. The methods how to study fishery elaborated during Chudzko-Pskovskoe expedition were improved during the Caspian expedition. These approaches derived by von Baer unite his and further expeditions carried out to inland fresh-water reservoirs of the Russian empire and theoretical approaches for the fishery study developed by Russian ichthyologists in the second half of the 19th century.

S19/1 MATHEMATICS EDUCATION IN EUROPEAN MILITARY ACADEMIES (18TH AND 19TH CENTURIES): UNITY OR DISUNITY?

Location: IoE – Committee Room 1 **Chair:** Blanco, Monica

Organiser(s): Blanco, Monica, and Bruneau, Olivier

It is well known that military academies and schools contributed essentially to the production and circulation of higher mathematics in 18th- and 19th- century Europe. Over the past thirty years there has been a fair amount of historical work on mathematics education in European military academies, approaching the subject matter in a variety of ways. A number of studies focus on the mathematical courses produced and used at the Spanish military academies and pinpoint their outreach. Others address the importance of the military academies of Woolwich and Sandhurst in the circulation of mathematics in Great Britain and in the appropriation of mathematical knowledge across the Channel. Meanwhile, recent works on the American military schools (e.g. West Point) consider the mathematical exchanges between France and the United States. Finally, the École Polytechnique and its school of application in Metz played a central role in the development of mathematics early in the 19th century.

SATURDAY 15 SEPTEMBER, 09.00-10.30

Throughout the eighteenth and nineteenth centuries, these military schools and academies underwent several evolutions regarding their status, their ways of recruitment and changes in their curricula. So far such evolutions have been studied mainly individually, from a local or national perspective exclusively. Such a simplistic pattern has led up to a lack of case studies dealing with the mathematics education in military academies with a wider global perspective, and studying the local obstacles within the pedagogical, institutional or diplomatic framework. Through this symposium, we envisage exploring the local and national dynamics involved, and assessing their impact on mathematics education in the military context. More cross-national and comparative case studies will doubtless contribute to improve our understanding on the construction and circulation of mathematical knowledge in 18th- and 19th-century Europe. Hence, the circulation of mathematical knowledge between a number of military schools and academies, not only within national boundaries, but also across borders, will be considered. We are also interested in discussing whether changes in mathematics curricula took place simultaneously or rather independently. That is, if one school underwent a change of curriculum, could the same change be tracked down at other national or international schools? Or did they prefer to stick to a more traditional education? In short, the aim of this symposium is to provide a cross-national comparative analysis of the production and circulation of mathematics in European military academies through a number of case studies from the 18th and 19th centuries. This crossnational comparative analysis can help identify points of unity or disunity in the military educational context.

Velamazán, M. Ángeles, and Ausejo, Elena (University of Zaragoza)

Mathematics Education for Military Engineers in 19th-Century Spain

It has been said that mathematics in early 19th-century Spain is an offshoot of French Enlightenment. This is also the case of the Spanish Army's Academy of Engineers, which was created in 1803 under a clear French polytechnic influence. This paper considers the series of mathematics curricula (1803, 1816, 1839, 1870, 1875, 1882, 1893), especially the long lasting 1839-1870 curriculum. During this period, there is documentary evidence on how Spanish military engineers considered French and Belgian military schools as a model to be followed - there were even officers sent abroad to learn in place, preferably to the *École Polytechnique* and the school of application in Metz. Meanwhile, early Spanish translations of Monge's and Lacroix's works marked a trend that expanded and consolidated in different ways throughout the 19th century. For instance, the publication of textbooks on infinitesimal calculus and different branches of geometry was fostered and rewarded in military teaching institutions. As a result, a number of these textbooks were essentially original works based on a careful selection of different French sources. Especially military engineers and artillerymen appear all throughout the 19th century as the main characters of a story of appropriation of mathematical knowledge across the Pyrenees, with happy consequences for the circulation and development of mathematics in Spain.

Beckers, Danny (Vrije Universiteit Amsterdam)

March on math: Math curricula at the Dutch Military Academy, 1813-1880

Mathematics education at the Dutch Military Academy changed with the regime in 1813. In that year, the freshly inaugurated king William, founded a new Military Academy at Delft. Although traditional forces within the military at first tried to resist the changes that the new government envisaged, a new curriculum was imposed during the 1820s. Math as a formal subject was introduced in a "French" curriculum, with a focus on a propaedeutic function for mathematics. During the second half of the nineteenth century the curriculum was changed again. This time changes were due to a confluence of two forces. Firstly, the changing educational opportunities

SATURDAY 15 SEPTEMBER, 09.00-10.30

in the country. In the 1840s, middle class pupils had flocked to the Military Academy, seeking the opportunity of social climbing. On their behalf, training colleges had been founded, that had adopted the math curriculum of the academy as a way to prepare their pupils optimally. Secondly, the growing academic ambitions of the academy (partly made possible by these preparing colleges), trying to meet new criteria for both specialised military training and a research agenda. To meet these new demands to the curriculum, the academy launched a new series of textbooks, written by its own professors, both on math and engineering subjects. This talk will focus on the inspirational sources of the math curricula and the way they were “sold” to the military. By doing so, circulation of mathematical knowledge can be discussed by a close look at the core and ideal curricula.

Blanco, Monica, and Puig-Pla, Carles (both Universitat Politècnica de Catalunya)

The Study of Mixed Mathematics in Spanish Military Courses of Mathematics in the 1750s: Two Ephemeral Cases

Towards the end of 1750 an Academy of Mathematics was created within the Royal Guards Headquarters in Madrid, under the direction of Pedro Padilla (1724-1807?) up to its closure in 1760. In 1753 Padilla started publishing his Military Course of Mathematics for the use of this academy (1753-56). Although it is true that most of the treatises connected with mixed mathematics remained unpublished, the fact that mixed mathematics played an important role in the public examinations held in this academy proves the importance granted to this subject in this context. The concern to have mathematical texts in Spanish for a practical use in the military field led to the creation of the Royal Military Society of Mathematics in 1756 in Madrid under the direction of Pedro de Lucuce (1692-1779), the headmaster of the Military Academy of Mathematics of Barcelona since 1738. The members of the Society were in charge of the elaboration of an extensive mathematical course, in which mixed mathematics was regarded as essential for military training and engineers. The Society, dissolved in 1760, succeeded in gathering an excellent scientific and technical library that served to supply future military libraries. The aim of this contribution is to explore how the study of mixed mathematics was approached in these two cases and to examine on which sources they were based.

Bruneau, Olivier (University of Lorraine)

Mathematical curricula in the Royal Military Academy of Woolwich: the unity in the disunity

In 1741, the Royal Military Academy at Woolwich was created by the Board of Ordnance in order to instruct the officers in artillery and engineers in which “several parts of Mathematics [are] necessary to qualify them for the service of the Artillery, and the business of Engineers”. During the Eighteenth and Nineteenth centuries, several rules about teaching were elaborated. In this paper, we will firstly provide an overview of these states of mathematical teaching. For instance, we will assess the distribution of this teaching in different teachers (fortification, artillery, mathematics, drawing...) and evaluate the evolution in order to this distribution (introduction of specific parts of mathematics as perspective or differential calculus...). Furthermore, we try to enlighten modifications and constants facts by different facts. At the beginning of the Nineteenth-century, a competitive exam was established. We will see the influence of this creation on the mathematical learning. In the same vein, we want to point out on the long term evolution and constancy in mathematical learning due to political choices, mathematical advances, evolution of recruitment.

S25/1 CIRCULATING GENDER IN CONTEMPORARY SCIENCE

1. WOMEN SCIENTISTS IN THE TWENTIETH CENTURY

Location: IoE – Room 822

Chair: Fara, Patricia

Organiser(s): Santesmases, María J.

This pair of sessions presents contributions about travels and shifts experienced by woman scientists as well as by gendered scientific objects in the history of science during the long, influential twentieth century. The aim is to investigate the concepts of circulation for a feminist epistemology of the sciences that focuses on the permanent movement and travels of women and gendered objects in history of science. We are interested in tackling the issue of exploring experiences in the laboratory, the field and the factory. By following the movement of women's scientific practices from one place to another, from one time to another, we aim to demonstrate their permanent presence in the contemporary sciences, institutions and laboratories, in teaching duties and academic practices.

Barahona, Ana (School of Sciences, UNAM)

Women and the workplace: Collaborative Work of Women Geneticists at the first Unit of Human Genetics in Mexico

My talk will address the gendered organization of the scientific work at the first Unit on Human Genetics of the Mexican Institute for Social Security (IMSS). There, women and men had different tasks, duties and authority according to their gender, and individual and professional skills. I will focus on Mexican virologist-turned-geneticist Leonor Buentello (1940-), who studied medicine at the National University of Mexico and graduated on virus genetics at Freiburg, Germany and close friend and colleague Argentine physician-turned-geneticist Susana Koffman Epstein (1938-2017), who studied medicine at the Buenos Aires University and graduate studies in paediatrics with Giovanni de Toni in Italy. Buentello began her career in medical cytogenetics alongside Armendares, learning cytogenetic techniques and joining him in their practice. After graduating in Italy with a thesis on De Toni-Debré-Fanconi Syndrome, Koffman spent a year learning cytogenetics and clinical genetics with Jérôme Lejeune at the Hospital des Enfants Malades in France. She was hired at the Pathology Department of the General Hospital, but spent all the time with Buentello at the unit due to the lack of a genetics laboratory in the hospital. Given their skillful handling of these techniques, they conducted tissue cultures and karyotyping of the hospital's patients. This narrative intends to return them to the forefront of the history of cytogenetics in Mexico and to illustrate the contribution of women to scientific developments and the dissemination of ideas on cytogenetics and medicine when research on human genetics was becoming a medical domain for diagnosis at an international level.

Tunlid, Anna (Lund University)

Eva Hansen-Melander and the circulation of knowledge within the cancer chromosome network

In 1953 Eva Hansen-Melander was appointed as a scientific assistant at the newly founded Cancer chromosome laboratory at Lund University, Sweden. The lab was set up by the cytologist Albert Levan, who started his career as a botanist studying *Allium* chromosomes but in the early 1950s changed his research focus to the studies of chromosomes in cancer cells. Levan developed close collaborations with cancer cytogeneticists in the US, among them Theodore Hauschka in Philadelphia. Besides that, he continued his partnership with the cytogeneticist Joe Hin Tjio, from Zaragoza (Spain), who regularly spent periods of time at the Cancer laboratory in Lund. In the presentation, I will discuss the central role of Eva Hansen-Melander at the laboratory in Lund during the 1950s. As a key person at the lab in Lund, she was part of the circulation of knowledge, materials and technical skills between Lund,

SATURDAY 15 SEPTEMBER, 09.00-10.30

Philadelphia, and Zaragoza. She had the main responsibility for the daily work of the laboratory, ranging from administrative duties to care for the breeding of the experimental animals. In addition, she conducted independent cytogenetic work on animal and human chromosomes, and she visited other laboratories in Sweden and in Europe to learn new techniques. During Levan's extended visits abroad she took the full responsibility for the lab. She represented, I would argue, the kind of continuity of a laboratory that was extremely important in the circulation of knowledge within the early cancer chromosome network.

Paškevičiūtė Kundrotienė, Eglė (Lithuanian Academy of Sciences)

Women in the Lithuanian Scientific Society – from self-taught to the first women doctors of science

I will present a historical trajectory of the participation of women in the Lithuanian Scientific Society (LSS), active between 1907 and 1940, later renamed as the Lithuanian Academy of Sciences. At the beginning of the 20th century woman rarely had secondary education in Lithuania, and those with high education could be counted by tens. The Lithuanian Scientific Society accepted women collaborators with diverse education experience, self-taught or having vocational education. Among them were the first woman writers and PhD in Lithuania. Out of almost 1500 members during the whole period of activity of the LSS, one fifth of them were women. Although women were never elected to the top management's positions, they were members of audit commission, secretaries during the sessions, and maintained the LSS's library, archive, and museum. Financial support to the Society, donations to the museum's exhibits and the library was a significant input by women. Exceptional role in this regard was played by Emilija Vileišienė. Distinguished women are found among the members: authors of textbooks such as Sofija Čiurlionienė and Klara Šepetienė, and medical doctors such as Vanda Tumėnienė, Ms. Burbaitė, and sisters Janulaitytė. These women's roles in the LSS were not episodic. From 1918 onwards women increasingly joined LSS's activities and they can be seen working in different scientific fields.

Pablos, Ana Romero de (Consejo Superior de Investigaciones Científicas)

Spain's woman researchers working on nuclear energy

My presentation will show the research developed by four woman scientists -physicists and chemists- who in the early days of nuclear energy in Spain –late 1950s and during the 1960s-, they all work at the Junta de Energía Nuclear (Spanish Nuclear Energy Board). This public institution was created in Spain in 1951 to govern the developments of nuclear energy and promote research in this field. María Aránzazu Vigón, Margarita Celma, María Alicia Crespí and Dolores García Pineda did research there and took responsibilities in reactor physics, nuclear medicine, chemical engineering and measurement of environmental radiation. Although there are records of their work in the institution's reports and publications, they remained hidden as well as mixed up with their male colleagues. This was due to the format of academic citations, which only reflected the initials of first names, the large work groups that characterize the practice of physics, and the collective authorship of results. But, above all, they remained silenced by the masculine gender of scientific and political authority in regard to nuclear energy. I propose to retrieve them to the forefront of the history of nuclear energy in Spain and remove them from the invisibility during their lives and in the historiography of Spanish nuclear energy, so as to show the permanent presence of women in any scientific field, nuclear energy included.

SATURDAY 15 SEPTEMBER, 09.00-10.30

S15/1 TOWARDS A CURRICULUM OF POLITICAL EPISTEMOLOGY: THEORY AND CASE STUDIES

Location: IoE – Room 780

Chair: Omodeo, Pietro Daniel

Organiser(s): Omodeo, Pietro Daniel

Political epistemology brings into focus the praxis of science, in its collective and oriented character. It programmatically aims to reach a unified cultural understanding of the apparently disunited strands and dimensions of science. Its historical-epistemological approach considers that science emerges from the historical terrain of the human activity and work that bring together the hand and the mind within collective spaces of interaction. It specifically looks at science as mediating between the socio-economical and the cultural-ideological. On the one hand, it evidences the function of science to secure the production and reproduction of societal formations. On the other, it takes into account the ideological dimension of science insofar as it provides for ways to justify and criticize social order and helps reorient, transform and imagine alternative ways of living. In accordance with these premises, we propose that historians of science explore cases that enable us to contend with the political economy of knowledge in its making. In particular, we would like to emphasize the following entangled themes: *The political dimension of cognition as alienated (extracted, codified, abstracted, externalized) practical knowledge should be investigated through the ways in which science historically reflects (mirrors, parallels, reinforces) social difference and power relations. * Further research in history of science should consider how political structures and ethos (in democratic republics, authoritarian states, court society etc.) informs science at the level of contents, epistemic values and methodologies (argumentation, demonstrative procedures, reasoning, styles for instance). * Political epistemology thirdly requires to study the political directedness of science, that is, to study it as contested fields of ideological struggles for cultural hegemony.

Babu, Senthil (French Institute, Pondicherry)

Surveying as a Case in Political Epistemology

I would like to take up the case of surveying as a historical case to develop a module for a curriculum in political epistemology. Taking acts of surveying land and surveying the sky together, in different historical and cultural contexts, I would like to explore how regimes of commensuration made tools that are simultaneously cognitive, social and political, to exercise truth making. How were such devices used to make a distant reality amenable to control as well as for contemplation, making truth and values at the same instance? The mathematization of territory and space as a particular movement in history could also be studied in tandem with the making of property – commensurating space with the idea and truth of property – bringing in state as credible agency to guarantee fairness and accountability, just as accuracy and precision promised mathematization its source of credibility. I will initiate such an exploration with specific reference to the case of the British colonial surveying experiments and their institutionalization in India during the late eighteenth and the early nineteenth century. Using this, I would carry forward this exploration by identifying cases in Europe and China as part of future study. The driving questions would be to ask what kind of material and epistemic activities rendered such values their interchangeable qualities in history of knowledge and that of the state, making particular types of political control possible.

Schemmel, Matthias (MPI, Berlin)

From Historical to Political Epistemology: Examples from the History of the Exact Sciences

SATURDAY 15 SEPTEMBER, 09.00-10.30

In my contribution I want to explore the potential of historical epistemology for addressing questions of a political epistemology. To this end I will outline central concepts of a historical epistemology that views science and its historical manifestations as resulting from long-term developments of material and symbolic means of knowledge representation and the co-evolution of cognitive structures (see, e.g. Damerow 2007, Renn 2004, Schemmel 2016). The crucial role of available means of knowledge representation and the inevitable institutional boundedness of collective processes of knowledge transformation thereby highlight the fundamental significance of social, economic, and cultural conditions for the development of any particular type of socially shared knowledge. I will raise the question of how to address the political from such a perspective by discussing examples from the exact sciences such as mechanics or the conceptualization of space under different historical and societal conditions, focusing on the themes mentioned in the panel description, namely: a) the ways in which science historically reflects social difference and power relations; b) how political structures and ethos inform science at the level of contents, epistemic values and methodologies; and c) in what ways science is to be viewed in terms of contested fields of ideological struggles for cultural hegemony. In order to illustrate my claims, specific case studies will be chosen and discussed (from Schemmel 2016).

Omodeo, Pietro Daniel (Ca' Foscari University of Venice)

Cultural Politics of Cosmology in Europe in the Early Modernity

Can the history of post-Copernican serve as a case study of political epistemology? And if so, in what manner? What can the history of early-modern cosmology reveal of the praxis of science, in its collective and oriented character? Cosmology was a field of tense ideological struggles during the early Modernity. The fact that polemics were expressed in a religious language should not make us neglect the eminently political character of the most varied attempts to hegemonize the scientific debates by cultural, educational and editorial means. This can be evidenced by the rise of academic and scientific networks bonded together by confessional and political ties. The confessional embedment of cosmology in the framework of the late scholasticism of Jesuit colleges stood in stark opposition to similar efforts in different contexts, especially in the mobile topography of interlinked protestant universities. Two examples will illustrate my claim: first, the reworking and embedment of the Copernican planetary theory at Wittenberg in accordance with the Melanchthonian cultural-political agenda of a reformed education; secondly, I will briefly consider the political-cultural dimension of the transfer and reworking of protestant geo-heliocentrism in Catholic settings after the Galileo affaire. A study of the religious-political drives behind much early modern European cosmological skirmish (in astronomy, physics, philosophy, epistemology) is a contribution to the political treatment of the advancement of science, especially insofar as it can be regarded as a contested field of cultural hegemony. In particular, the study of the hegemonic drivers of early modern cosmology offers a case for which a political treatment of epistemic values and the ways they informed the scientific enterprise proves necessary for a full-fledged understanding of past and present ideology controversies over science.

S67 READING EUCLID IN THE EARLY MODERN WORLD

Location: IoE – Room 784

Chair: Wardhaugh, Benjamin

Although Euclid's *Elements of Geometry* was next to the Bible the most prolifically printed work in the early modern era, appearing in nearly three hundred often markedly different editions, surprisingly little has been known up to now about how this work was read, taught, or otherwise engaged with in various educational and social settings. Equally, there is considerable difficulty in reconciling the multiplicity of editions of the *Elements* with the book trade in seventeenth-century Britain that notoriously struggled to generate the financial resources necessary for the printing of new mathematical works. The talks in this symposium, emanating from the *Reading Euclid* Project at the University of Oxford, will explore the production and reception of the *Elements* on three main levels. First, they will consider what the material evidence provided by surviving copies together with other resources such as contemporary diaries and letters can tell us about the reasons behind the various editions themselves – their language, composition, level of commentary, and so on. As the *Elements* were used as an introduction to geometry, copies can often reveal a high level of interaction between the reader and the various editions, as reflected in workings, diagrams, and other marginal annotations. The talks will reflect on what such annotations can tell us about the way the text was used and seek to identify different patterns of readership. An important part of the transmission and circulation of scientific texts in the early modern world was played by book auctions. The symposium will secondly look at the evidence provided specifically by auction catalogues as to how mathematical books were transmitted and collected in the second half of the seventeenth century. Among the questions addressed will be collection practices of scholarly purchasers and the representative nature of collections themselves. Third, the talks will investigate how Euclid was edited and adapted to serve the needs of fundamentally different markets ranging from that of mathematical practitioners to critical editions aimed more at the scholarly community. They will consider the relationship between mathematical book producers on the one hand and their target constituencies on the other, and consider how scientific practices in the early modern world are reflected in the multiplicity of Euclidean texts.

Wardhaugh, Benjamin (University of Oxford)

Defacing Euclid in early modern Britain: reading and learning from the *Elements of Geometry*

This talk will explore the rich evidence provided by surviving copies of Euclid's *Elements of Geometry* from early modern Britain. On the one hand, decisions by editors and printers about the text: its language and notation, scope, layout, diagrams and the degree of editorial explanation. On the other hand, marks made by readers to record ownership and intellectual engagement, including the unique processes involved in learning mathematics in this period. Together these lines of evidence allow us to reconstruct a distinctive world of geometrical teaching and learning.

Beeley, Philip (University of Oxford)

Editing Euclid. Scholars, practitioners and their audiences

Euclidean geometry was presented to the public in early modern Britain in a rich variety of printed forms, ranging from mathematical books directed primarily at the practical market, which generally assumed no prior knowledge of the topic, to full-fledged critical editions complete with a carefully-prepared scholarly apparatus, such as that produced by David

SATURDAY 15 SEPTEMBER, 09.00-10.30

Gregory in 1703. What do these differences in publications aimed at different markets tell us about their audiences and about their authors or editors? How successful were mathematical schools, Gresham College, and the universities as institutions in the dissemination of geometry? This talk will seek to provide answers to these and other questions.

Nasifoglu, Yelda (University of Oxford)

Collecting Euclid. Assembling mathematical knowledge in the early modern world

Euclid's *Elements of Geometry* occupied a locus between the scholarly transmission of classical texts from antiquity and the increasing purchase afforded to mathematical knowledge in the early modern world. Extant evidence such as manuscript lists of personal libraries, and printed catalogues of booksellers, auctioneers, and scientific institutions, tell us much about how mathematical books, in particular the *Elements*, were collected and circulated. This talk will evaluate the evidence in the context of seventeenth-century Britain, with a particular focus on the hammer copy of the auction of Sir Jonas Moore's library. By examining the identities of the buyers and their patterns of purchase, it will seek to contextualise the *Elements* within the proliferation of mathematical texts towards the end of the century.

S54 SCIENCE CRITICISM FROM WITHIN: WHAT'S THE PRICE OF SELF-REFLEXIVITY?

Location: IoE – Room 790

Chair: Schwerin, Alexander von

Organiser(s): Schwerin, Alexander von

Commentator: Harwood, Jonathan

This symposium tries to figure out what the price of the much cited "reflectivity"-turn of science has been. Did it foster unity or disunity of science? Therefore, the section will focus on debates within science that transcended in the one or other way the normal business of scientific discussion and discourse, but that added an element of self-reflexivity. This, especially, has been – and is – the case with criticism of science that was not addressed from the outside of science but from within and that has gained in importance from the 1970s onwards – according to the reflexivity-turn hypotheses –, such as atomic scientists criticizing atomic energy technology, biologists questioning the gender bias of behavioral biology or ethnographers reflecting on the Western aprioris in ethnographical methods. This symposium draws the attention to inner science criticism, to those scientists reflecting on science, to the reactions from the academia and to the effects in personal and general terms. There have been (and are) those – publically influential, but sometimes not so well-known – scientists who were notoriously known in their scientific community to be guilty of fouling their own nest. Those critics reflected on their own profession in a meta-scientific, political, ethical or cultural way. What made them turning "against" their scientific "home land"? What was their background? How did they bring forward their criticism? What channels did they choose? And how was their criticism connected to their own scientific work? What were the reactions from colleagues towards this kind of self-reflexivity and activism? What was the reaction of scientific communities and academia in general towards scientific self-reflexivism and practices of self-responsibility? What were in turn the effects of scientific self-reflexivity on the specific scientific communities and the scientific culture in general? What turned out to be the result of the self-reflectory processes in the end? Did it change anything in science or in the public? Did it affect the career of the critics, in what way? Was self-reflection out of place or did it become an integral part of scientific communities? Did scientific self-reflexivism and scientific responsibility-practices join together or divide in the end?

Borck, Cornelius (University of Lübeck)

Critiquing Neuroscience and Critical Neuroscience: New Loops of Feedback

Since the Decade of the Brain and with the availability of fascinating imaging methods, the neurosciences enjoyed a steep rise in public attention, but they had to face also harsh debates on (allegedly) exaggerated claims or inflated conclusions. Quickly, the new brain sciences were criticized of reviving the outdated concept of phrenology; the "salmon of doubt" raised concerns about routine data-acquisition procedures; the "voodoo correlations" accused leading laboratories of following unsound statistical methods; and a group of (mainly young) scholars formed the "Critical Neuroscience Group" – to name just the most prominent critical initiatives. The paper compares, contrasts and evaluates these different critical approaches to a rising research field. The presentation is guided by the idea that from the various critiques of the neurosciences a new and perhaps exemplary mode of critique can be derived, that is as pointed and sharp as it can be digested and swallowed by the side critiqued. The most recent move in this critical feedback loop is a counter-critique from brain researchers based on arguments derived from historical epistemology and laboratory studies.

Schwerin, Alexander von (MPI, Berlin)

SATURDAY 15 SEPTEMBER, 09.00-10.30

From Implicit to Explicit Criticism: Genetics and National Socialism

The burden of history was heavy on German geneticists, anthropologists and human geneticists since they had supported racial policy and politics of National Socialism, and many of them had been involved in unethical human experimentation and other kinds of human rights violation. In the 1950s and 1960s, there was almost no systematic reflection on this. However, there were tensions in the German life sciences that rooted in the common knowledge of these misdemeanours. Especially, molecular biologists turned therefore against the older generation of geneticists, though not explicitly. Their hostility became embedded in the disciplinary conflicts of old-school genetics and rising molecular biology. This changed from the 1970s on when molecular biologists turned their leftists and antifascist identity into explicit historical reflection on the guilt of their teachers and sciences. The book publication "Murderous Science" by the Cologne geneticist Benno Mueller-Hill in 1984 marked the climax of this self-reflective turn. This talk will sketch the history of the inner scientific criticism of science in the National Socialism from early implicit forms to the publication of "Murderous Science". The main task will be then to analyse the turn to explicit reflectivity from the 1970s onwards and the reaction of the national and international genetic community to Mueller-Hill's book. Although Mueller-Hill published this book as a historiographical and not genetic approach, German geneticists made him pay in scientific currency -- he became isolated and suffered disadvantages for his career.

Satzinger, Helga (UCL)

Gendered in-ter-ventions

Women scientists' criticism of science, its concepts and uses, both political and technological, has a long tradition in the 20th century. It ranges from the warnings of the next war of poison gas in the 1920s, the use of pesticides in the 1960s, the critiques of biological theories on women legitimizing hierarchical gender orders in the late 1970s to the critique of the recombinant DNA technologies and the questioning of a binary sex difference in the 1980s. Starting from a minority position in the sciences, criticism saw a fundamental causal link between the type of science produced and the exclusion of women scientists. Efforts to increase the number of women in the scientific professions were linked to the hope for a „better science“. At the turn of the century, Londa Schiebinger saw that Feminism had indeed changed science. The film "Hidden (female afroamerican) Figures" nearly made it to an Oscar, writing the forgotten women mathematicians' contribution to NASA's programme back into history. The Royal Society awarded Cordelia Fine the Insight Investment Science Book Prize for her book „Testosterone Rex, unmaking the myths of our gendered minds“ – provoking protests by those who see male and female as distinct entities in a binary natural order. It seems that gendered in-ter-ventions did indeed change the sciences. What were the gains and the costs for the women scientists involved? What was the political space they could use, either inside or outside the sciences? What areas of science remain resilient so far?

SATURDAY 15 SEPTEMBER, 09.00-10.30

S38/1 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES: CRITICISMS AND CHALLENGES

Location: IoE – Room 731

Chair: Haddad, Thomas A.S.

Organiser(s): Silva, Matheus Alves Duarte (Ecole des Hautes Etudes en Sciences Sociales)

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945.

Raj, Kapil (Ecole des Hautes etudes en sciences sociales)

La circulation n’est pas fluide!”: Spaces of Circulation and Cross-Cultural Knowledge Encounters

The problematic of the circulation of knowledge has been used fruitfully over the past decade to analyse processes of encounter, negotiation, and reconfiguration of knowledge that occur in cross-cultural interaction, while at the same time being sensitive to the asymmetries of power in such processes and the resistances that might ensue. However, far from suggesting that these phenomena ideally entail the smooth flow of knowledge between individuals, communities, civilities and institutions, thereby implying a synonymy between circulation and fluidity, circulation occurs within bounded and unevenly landscaped spaces. Based on a series of case studies from the Indo-British colonial encounter of the late 18th century, his talk develops the concept of spaces of circulation in both its social and physical dimensions.

Smith, Chase (University of Oxford)

The limits of go-between knowledge in the works of Manuel Godinho de Erédia

Manuel Godinho de Erédia was a highly mobile mestiço cosmographer who moved between and worked in various parts of the Portuguese Estado da Índia. Erédia was the son of a Portuguese

SATURDAY 15 SEPTEMBER, 09.00-10.30

and a Malay, and his geographical works reflect his mixed heritage and Jesuit education, drawing on ideas from classical Western geography, developing Renaissance 'geographical science', and indigenous Asian knowledges. Recent scholars have labelled Erédia an archetypal early modern 'go-between'. This paper seeks to nuance this broad characterization, and to explore the limits of Erédia's 'hybridity'. While Erédia's works attempted to balance multiple knowledge traditions which circulated and interacted in the space of the Estado da Índia, this paper will question the stability of this balance. To what extent did these divergent 'ways of knowing' amalgamate, if at all, to produce a cohesive whole? This paper will argue that the term 'go-between' ultimately masks the contradictions and challenges faced by Erédia as he tried, and only partially succeeded, to combine various geographical knowledge traditions. Furthermore, it will explore the methodological possibilities of using global microhistory to link local intercultural knowledge transfer with broader, global processes of knowledge 'circulation'. To do so, the paper draws on Erédia's diverse geographical works, focusing on the maps and text of his magnum opus, the *Declaração de Malaca e Índia Meridional com o Cathay*. This re-reading of Erédia aims to shed light on the limits of, and not merely the opportunities of, crossing knowledge boundaries in the circulatory space of the early modern Portuguese empire.

Silva, Matheus Alves Duarte (Ecole des Hautes Etudes en Sciences Sociales)

Scientific connections and the shaping of a therapeutic market between France and India (1894-1920)

From 1894 to 1920, the bubonic plague was a major health problem in many parts of the world. In parallel with its spreading, different laboratories and scientists became interested in the possibilities of controlling and stopping the disease with the help of microbiological techniques. One of these was the Pasteur Institute of Paris, where scientists were working in the development of the antiplague serum. Another was the group that took form in Bombay, the epicenter of the epidemic, where an antiplague vaccine would be created and exported. These two groups would be connected in several occasions: throughout the Pasteur's scientific mission in Bombay to study the bubonic plague; during the tests conducted by some doctors based in Bombay with the French antiplague serum, which would allow them to produce statistical knowledge concerning the efficacy of the product; at the time of the tests with the Bombay antiplague vaccine conducted in Paris, followed by its production in France; and finally, by the establishment of a global market concerning both antiplague sera and vaccines. By focusing on these multiple connections, this paper aims to discuss the following questions: how were these connections shaped by the scientific borders of the microbiological field and by the political borders of the French and the British Empire? How did the historical actors based in Paris and in Bombay create a particular space within those borders, where they would be able to share, transform and construct knowledge about the sera, vaccines and the control of bubonic plague?

Menon, Minakshi (Humboldt University)

Did Kāśīnātha Tarkālānkāra know Sanskrit? Recovering the Thought Worlds and Practices of "Brokers" in East India Company India

Did Kāśīnātha Tarkālānkāra know Sanskrit? Recovering the Thought Worlds and Practices of "Brokers" in East India Company India Historians of science have responded to the challenge of writing histories of science in the "non-west" by using the concept of the "broker" in order to analyze cross-cultural knowledge flows. The broker or go-between has been used as a capacious category by historians to accommodate translators, spies, teachers, preachers and healers. But to deploy the category of broker is all too often to read the subject position of actors embedded in complex social relationships as always already brokers; and to reduce thick histories of their social and cultural practices to those aspects that facilitated their function as brokers. This paper examines the history of Kāśīnātha Śarma (fl. 1785-1801), a celebrated Bengali pandit, appointed the first Rector of the Benares Sanskrit College, founded in 1791. He collaborated with the famous British orientalist, Sir William Jones (1746-1794), but attracted

SATURDAY 15 SEPTEMBER, 09.00-10.30

the opprobrium of British administrators, who found him villainous and dishonest. The philologist, H. T. Colebrooke (1765-1837), meanwhile, disparaged his competence as a Sanskrit scholar. Reading against the grain of annotations by Colebrooke in Sanskrit manuscripts, and colonial reports, I recover the immanent logic of Kāśīnātha's intellectual and material practices to reveal the meaning context of his actions. I ask: does the category "broker" capture the nature of Kāśīnātha's relationship with British orientalists in East India Company India?

SATURDAY 15 SEPTEMBER, 09.00-10.30

S09/1 (DIS-)CONTINUITY BETWEEN THE EAST AND THE WEST: THE HISTORY OF METEOROLOGICAL KNOWLEDGE TRANSFER IN COLONIAL CONTEXTS

Location: IoE – Committee Room 2

Chair and Commentator: Hall, Alexander
(Newman University)

Organiser(s): Williamson, Fiona; Jankovic, Vladimir; and Hall, Alexander

While histories of meteorology have increasingly begun to consider global and non-Western perspectives, the distinction and/or continuities between Western and Eastern approaches to meteorology and the networks that have historically transferred knowledge across diverse geographies and cultures have to date been understudied. These two linked panels aims to address this gap by exploring the dynamism of material, institutional and intellectual engagements between the 'local' and 'metropolitan' constructions (and uses) of atmospheric knowledges and various forms of meteorological cultures that have defined the colonial scientific space through the processes of domination, appropriation, resistances and hybridity. Our panels are sponsored by the International Commission for the History of Meteorology (ICHM).

Chen, Zhenghong (China University of Geosciences, Beijing), and Yang, Guifang

The history of meteorological development in colonial-era China: Unity and Disunity with Chinese Characteristics

China provides an excellent case-study for the study of meteorological development and transformation in the colonial context, because most natural science in modern China has been the result of Western culture and ideas as they have spreads to the East, as Joseph Needham so strongly asserted. Atmospheric science is a classic example of the colonial processes. This proposal focuses on several small case studies of colonised areas of historic China, especially several areas and cities on the eastern Chinese seaboard. Tsingtao Meteorological Observatory was the German centre for meteorological observation in the early half of 20th century, as well as for strategic, colonisation purposes. The Shanghai Xujiahui Meteorological Observatory from 19th century to the 20th century, was also the result of overseas colonization. Hong Kong Observatory has a deeper colonial flavour than the any site on the Chinese mainland. In addition, during the anti-Japanese War, the Japanese built a colonial meteorological observation and forecast institution in northeast China. From missionaries stationed at the Chinese Royal Palace, to the colonial meteorological observatories, Western meteorological science was spread in China, which led directly and indirectly to the development of modern Chinese atmospheric science, and inspired local people at the same time. It stimulated the patriotic feelings of Chinese meteorologists, for example, such as Coching Chu, and promoted the development of local meteorological science in China. This complex and pluralistic meteorological history of China is a rare and highly valued research example of 'unity and disunity' in science.

Zuidervaart, Huib (Royal Netherlands Academy of Arts & Sciences) and Grab, Stefan (University of the Witwatersrand, Johannesburg)

Early Modern Meteorological Observations in The Dutch Colonies of East and West

The state of the weather always played an important role in the Dutch colonial settlements in South Africa (Kaap de Goede Hoop) and the East- and West-Indies. The logs of many ships sailing from Holland to these areas provide testimony of the attention given to the state of the atmosphere. However, more scholarly organized systematic observations in the Dutch colonies themselves are a rarity. The first weather records using scientific instruments in these sites only appear during the mid to latter half of the 18th century. Our contribution will investigate

SATURDAY 15 SEPTEMBER, 09.00-10.30

these earliest systematic instrumental meteorological observations in the Dutch overseas colonies, the reason why and how these were collected, and their reception back home in the Dutch Republic.

Mahony, Martin (UEA)

On the disunity of colonial science and society: meteorology in Mauritius

This paper will examine the place of colonial Mauritius on the map of 19th and early 20th century meteorological knowledge production. Although in many respects a classic example of a colonial 'periphery', a number of historical actors sought to position the island as a centre both of trade and knowledge-production, with the capital, Port Louis, sporadically coming to function as an important entrepôt for both a range of commodities, and of information and scientific data. In the second half of the 19th century Port Louis became an important centre of Indian Ocean meteorology, as observations from ships were amassed and new laws of cyclone behaviour delineated. However, this 'centre of calculation' was marked by significant differences between English and French scientific traditions, with consequences for how scientific authority was sought and contested among the wider colonial society. Focusing on the work of meteorologists Charles Meldrum and Albert Walter, this paper will offer new perspectives on the historical geographies of colonial science, and on the place of Mauritius, and Port Louis, as sites of knowledge construction, exchange and hybridisation.

I144 BIOGRAPHICAL STUDIES

Location: IoE – Room 709a

Chair: TBA

Hernando, Santiago S. (Independent Scholar)

The Universal Vision of Mijail V. Lomonosov. Pioneer of Science in Russia

The purpose of this paper is to present some theoretical aspects about the concrete role historically played by the Russian scientist Mijail V. Lomonosov, insofar as it can be considered as a pioneer in the advancement of the science which was developed in eighteenth century Russia. Nonetheless, his philosophical perspective and scientific research, not only contributed to the creation of an incipient national identity by means of science, but also identified with the European tradition associated with the Enlightenment imaginary. On the one hand, we have to take into account that Lomonosov's enormous work corresponds with a significative period characterized by the establishment of scientific academies. In fact, Lomonosov was elected in 1745 as a member of the Academy of Sciences of St. Petersburg and was one the first native members of that institution traditionally dominated by foreign scientists. In this sense, Lomonosov epitomizes the encyclopedic ideal focused on reaching, through reason and science, all the possible knowledges about the hidden mysteries of the Universe. In addition to this, Lomonosov's predisposition for the unification of knowledge is also reflected in his scientific achievements. At this point, it is necessary to indicate that Lomonosov establishes the well-known Law of the Conservation of the Mass in chemical reactions, 40 years before Lavoisier and postulates the existence of an Atmosphere on Venus, using the data of the Transit of Venus collected from the observations made in 1762 in more than 70 points throughout the terrestrial globe, which was the first international scientific undertaking.

Naponiello, Gaia (Roma Tre University)

Unity and disunity in chemistry vision in the early 1900s: Georges Darzens didactic contribution to the basics of chemistry

The atomic theories developed at the turn of the 1900s (Thomson, Rutherford, Bohr) were destined to have a deep impact on the conception of matter and on chemistry basis, directing research in discontinuity (but also in continuity) with the nineteenth-century. The fallout of this theoretical tension on chemistry teaching expresses its relevance from a historical-epistemological point of view, since the introduction of the atomic model changed the students' approach to chemistry. In this regard, Pierre Lazlo (1994) examined the disagreements that broke the unity within the French scientific community: Georges Darzens (1867-1964) chose to deal with this topic in his courses at the École Polytechnique (1912-1913), which led to a harsh rebuke by Henri L. Le Châtelier (1850-1936). Darzens was an eclectic and an innovator, whose work combines the attention to the chemical theory with that to the experimental aspects. In this communication we examine the didactic choices that Darzens proposed in his contribution to the series of "Initiations scientifiques" animated by the French mathematician and politician Charles-Ange Laisant (1841-1920). His Initiation Chimique (1909) adresses teachers and families to help children in their first steps in the chemical world. Darzens captures the Reader's attention by proposing a variety of simply described experiments. Furthermore the Reader is unconsciously exposed to the theory (without mentioning the atomic models) which is seen as essential to fully understand the chemistry "magic game". Darzen's work offers an insight Darzens' didactical choices in his contribution on the epistemological debate of this period.

Nivet, Christiane (Université Paris 7)

Life of Gregor J. Mendel (1824-1884) wedged between the revolutionary nationalist movement of the Moravian Czechs and the conservative authority of the Viennese imperial power across the second half of the nineteenth century

SATURDAY 15 SEPTEMBER, 09.00-10.30

Augustinian monk of German origin, GJ. Mendel developed in the monastery St Thomas of Brno (Moravia) the experiments which allowed him to define the principles of genetic analysis which he published in 1865. However Mendel's genius was not discovered and recognized by the international scientific community until 1900. We think that other aspects of Mendel's life have to be unmasked. For example, the biographs Hugo Iltis and Vitezlav Orel, present Mendel as a substitute teacher who had not been able to reach the rank of qualified teacher despite certain pedagogical gifts. We propose to examine the causes of this situation and show that this helplessness must be attributed to an untold political blockade caused by the support given by the monks of the Saint Thomas monastery to the Czech nationalist cause combined with Emperor Francois Joseph's legendary mistrust for revolutionary teachers.

Railiene, Birute (Wroblewski Library of the Lithuanian Academy of Sciences)

A chemistry of life and science: Jędrzej Sniadecki at the University of Vilnius

We are proud to present a famous Polish professor, scholar, physician and educator Jędrzej Sniadecki (Jędrzej Śniadecki, 1768–1838), who, after studies in Italy and Scotland gave 40 years of his most active life to Vilnius University as a head of Department of Chemistry, a head of Clinics of Therapy. He is famous for a theory of living beings (1804), also for making to meet science and humour – as a president of secret humorous society. The paper will argue a possibility for academic knowledge to be passed on in a difficult political situation of wars and economical shortage and prove that a strong personality can overcome interruptions. Sniadeckis was among personalities, who forth come his epoch, made brave conclusions and opened new horizons for chemistry and biochemistry. In a short time he brought chemistry to the number of the most popular subjects at the University. He conducted lectures with the greatest enthusiasm, which was driving the audience into a “chemomania”. The order of Russian empire was getting more brutal in all fields of life, education was not an exception. It was closed in 1832, instead of it the Academy of Medicine and Surgery was established. The Academy was evicted from Vilnius and closed 1842. The historical conditions were unrewarding and doomed to dispersing the scientific school of chemistry of the old University of Vilnius. Though his pupils and followers spread to other schools and countries, they preserved the knowledge and scientific ideas of their teacher.

SATURDAY 15 SEPTEMBER, 09.00-10.30

S33/1 STABILITIES AND INNOVATIONS IN THE ASTRAL SCIENCES: PERSPECTIVES FROM CHINESE, SANSKRIT, ARABIC, AND LATIN SOURCES

Location: IoE – Room 777

Chair: Husson, Matthieu

Organiser(s): Husson, Matthieu

It is often a tacit belief in the study of history of science that habitual and customary practices are of lesser interest than innovations and novelties. The agency and creativity of historical actors are supposed to chiefly required for innovations, whereas the stability of their practice implied some sort of passivity. This view also usually implies that innovation need to appear against or in spite of conservative forces. In contrast, we want to explore a more dialectic interpretation of stabilities and their relations to innovations, by investigating questions such as: What are the particular knowledge elements that remained stable in given context of scientific practices? What kind of active choices and concrete actions endorsed by historical actors allow those knowledge elements to remain stable in a given context of practices? How do these efforts to maintain stability of specific knowledge elements allow historical actors to investigate reconfigurations of other aspects of their scientific practices? We hope to substantiate the view that there is a plurality in the ways of a scientific practice to select and retain a specific set of knowledge elements as stable within a given context; and to use them to explore other possibilities of reconfigurations and innovations. For instance in Alfonsine astronomy, during the late medieval period in Europe, astronomical parameters remained stable for almost two centuries while the layout and organisation of tables varied a lot. We expect to address these general methodological issues in the history of science from case studies in the development of the astral sciences in Arabic, Sanskrit, Chinese and Latin sources. While astral sciences is not the only field of exploration for these questions, it certainly offer a promising start to this endeavour. For instance astronomical practices involve a range of knowledge elements from fundamental mathematical ones like numbers or geometrical objects to more global ones like epistemological values expressed, for instance, in cosmological theories, observations, or reasoning practices. The material cultures of astronomical practices are also quite diversified. Multiple different kinds of instruments are known to be used and various different form of texts are available to us, for example: oral texts (prose or verse), numerical tables, technical diagrams, iconography, etc. Moreover, the practices of astral sciences were often socially distributed across various milieus. These ranged from highly specialized individuals working in intellectual, political or religious institutions to more modest practitioners engaged with astronomy in some specific and limited way. In this way, the field of astral sciences offers a choice of relatively well-connected historical contexts necessary to explore these issues, while at the same time, it provides a topical focus to compare various case studies in a meaningful and effective manner.

Li, Liang (Beijing Institute for the History of Natural Science)

New astronomy served the old astrology: The calculation of lingfan in the early modern China

The astronomical phenomena lingfan 凌犯 (literal meaning encroachment; the occultation and conjunction among the moon, the five planets and the fixed stars) plays an important role in both Chinese traditional astronomy and astrology. China has a long tradition to record the history of last dynasty known as official standard histories, and the astronomical part “Monograph on astronomy” in the official standard histories has a routine to record the lingfan

SATURDAY 15 SEPTEMBER, 09.00-10.30

in history. However, the Chinese traditional calendrical astronomy could not solve the problem of planetary latitude, so it was impossible to predict the phenomena of lingfan in advance. In the fourteenth century, after the adoption of Islamic Huihui lifa in China, this puzzle was eventually solved. With the assistance of the Islamic method, a kind of ephemeris listing the daily prediction of lingfan turned up, and to submit these ephemeris to the emperor annually became a custom from then on. Even though the Chinese used the innovational Islamic method to calculate the lingfan, they still referred to the Chinese traditional astrology but not the corresponding Islamic astrology to explain the portents. With the Jesuits introducing western astronomy into China in the sixteenth and seventeenth centuries, the Chinese began to revise the method of predicting lingfan with the new European astronomical methods and to update the procedure of the ephemeris compilation. This paper will discuss how the Chinese astronomers tried to solve the problem of lingfan flexibly with the innovational foreign methods, and to what extent they followed the unchanging tradition.

Brentjes, Sonja (MPI, Berlin) (in absentia)

On the uses of anthropomorphic images of star constellations in Islamicate societies

In my talk, I will discuss major forms of use that the anthropomorphic images of star constellations in 'Abd al-Rahman al-Sufi's respective book have served in different material setting and socio-cultural contexts. I will reflect on the relationship between astronomical and art practices, royal gift giving, education, legitimation and representation of power, and artisanal skills.

Loizelet, Guillaume (Université de Toulouse)

Distances of wandering stars to Earth: Al-Bīrūnī's diachronic approach

In Chapter 6 of book X of his *Qānūn al Mas'ūdī*, Al-Bīrūnī addresses the problem of distances of wandering stars to Earth. Reviewing and discussing on his greek, indian and arabic predecessors works, Al-Bīrūnī endorses an historical point of view and thus let us investigate on what is stable and what is not in this peculiar field. I intend to utilise chapter X.6 as a generic example in regard both to permanence of cosmological views Al-Bīrūnī stated and to the selection of specific points he elected as questionables.

Wang, Guangchao (University of Chinese Academy of Sciences)

A Chinese effort to determine the solar model in the 18th century: the case of the Lixiang kaocheng

Ancient Chinese mathematical astronomy in its maturity was generally described as independent with the assumptions about the real motions of the physical luminaries. It was not until seventeenth and eighteenth centuries Chinese astronomy experienced a conceptual revolution under the influence of Western astronomy. Western astronomy, which Jesuit missionaries introduced during that time, had a more pervasive and profound influence on Chinese astronomy. Chinese native astronomers adopted Western mathematical methods from their Jesuit colleagues, they shifted their original paradigm from numerical and algebraic procedures to geometric model. This change allowed them not only to predict but also to explain astronomical phenomena. The solar model which adopted in Lixiang Kaocheng provides a concrete example of the way how Chinese domestic astronomers deal with computation and observation. Different with the eccentric solar model in Xiyang Xinfu Lishu, Kaocheng used the double epicycle model considering that the computation should be in agreement with the observation. Though it was a big apparent change from eccentric model to double epicycle model, but the accuracy of the data computed from the solar model did not increase largely compared with the previous calendar. Moreover, it has been found that the observational data which was the basis for computing the parameters of the solar model were so accurate that the astronomical instruments could not reach. These data probably come from the calculation result of extant western astronomical tables.

Weill, Dror (MPI, Berlin)

SATURDAY 15 SEPTEMBER, 09.00-10.30

Stabilities and innovations through Translation: The Fourteenth-Century Naturalization of Arabo-Persian Astronomy in China

We tend to think of translation in terms of change in language or media. However, translation projects can represent political attempts to preserve older systems and useful knowledge for the sake of maintaining political stability. The case of the naturalization of Arabo-Persian astronomy in China during the late-fourteenth century illustrates the two effects of translation. The proposed talk discusses the first Ming emperor's project of translating and naturalizing Arabo-Persian astronomical knowledge during the second half of the 14th century, amid the sociopolitical transition from the Yuan to the Ming dynasties. It will show how the translation of Arabo-Persian astronomical texts into Chinese served the Ming ruler in his ideological oscillation between preserving the Yuan institutions and creating new ones. Translation, I argue, enabled the first Ming emperor to display his disengagement from the institutions of the former Mongol rule, and at the same time to benefit from the astronomical accomplishments of the Yuan. By charting the attitudes of the newly established Ming dynasty toward the use of Arabo-Persian astronomical knowledge, the proposed talk points to continuities and ruptures in the accommodation of astronomical knowledge at the Chinese court. Looking at how the Ming court accommodated Arabo-Persian astronomical knowledge by creating continuities and innovations in the application of court astronomy, I will use this case how Ming China entangled politics and knowledge production processes and its attitude towards foreign knowledge.

SATURDAY 15 SEPTEMBER, 09.00-10.30

S39/1 CULTURES, STARS AND NUMBERS: INTERCULTURAL EXCHANGES IN EAST ASIAN MATHEMATICS AND ASTRONOMY

Location: IoE – Room 826

Chair: Cullen, Christopher

Organiser(s): Cullen, Christopher (Needham Research Institute, Cambridge)

Pre-modern East Asia was the home of distinctive traditions in both mathematics and astronomy. During the first millennium CE these traditions, first developed in China, became common to the whole region, including Korea and Japan. Within the broad theme of the conference, 'Unity and Disunity', the aim of this panel is to encourage discussion of relevant issues in a regional and global historical and cultural context. Despite their common roots, the theory and practice of mathematics and astronomy was by no means uniform across the whole East Asian land-mass. It is thus illuminating to trace the way that elements of these disciplines were appropriated, adapted and developed as they moved across regional and cultural boundaries. Moreover, pre-modern East Asia was highly permeable to the flow of ideas from the rest of the Eurasian continent - first from South Asia in the context of the coming of Buddhism in the first millennium CE, then from the Islamic world from the Yuan dynasty (1271-1368) onwards, and finally from early modern Europe with the arrival of Jesuit Christian missionaries in the later part of the 16th century. The complex interactions that followed from these contacts are revealing not only of the nature of the East Asian traditions in astronomy and mathematics, but also of the traditions that scholars in East Asia encountered afresh.

Chen, Yiwen (Institute for Advanced Study in History of Science, Northwest University, China)

The tidal cycle of ancient China

The interpretation of the tide phenomenon was recorded in many literatures in ancient China. In the report, the elaboration on the tidal issue in *Haitao Zhi* published in Tang Dynasty (2nd half of 8th century) will be discussed. By revisiting and analyzing the relevant data in *Haitao Zhi*, it is discovered that Dou Shumeng who is its author has profoundly realized the rhythm of tides (tidal patterns), and first calculated a tidal cycle in human history.

Dauben, Joseph W. (City University of New York)

Right Triangles and Triangulations, Discoveries or Transmissions Across the Silk Routes?

The history of mathematics is often faced with examples of what may seem problems and methods that are so similar they suggest transmission rather than independent discovery. Among these are such problems as studies of right triangles and proofs of the gou-gu or "Pythagorean" theorem, or of the use of the double-distance rule which first appeared in a Chinese work, Liu Hui's *Sea Island Mathematical Manual*, and later in works by Indian mathematics Āryabhaṭa and Brahmagupta, subsequent Islamic mathematicians like Al-Bīrūnī, and finally appearing in the Latin West in such practical geometries as those of Gerbert and Hugh of St. Victor. Kurt Vogel discussed this phenomenon in "A Surveying Problem Travels from China to Paris" (1983). This presentation will discuss questions of independent discovery and transmission of mathematical ideas and procedures between ancient China and the West.

Lee, Yong Bok (Seoul National University of Education)

Projection method for solution of spherical astronomy by Nam Byeong Gil in 19th century

Western mathematics and science were greatly influenced to Korean scholars in 18th century. Most of them were imported from China as books written in Chinese. Especially they were interested in astronomical books and instruments from Western countries. They were closely connected with mathematics and geometry. The Scholars in Korea studied Western

SATURDAY 15 SEPTEMBER, 09.00-10.30

mathematics and geometry with deep concern. They applied it to calculate on the motion of celestial bodies and to produce for astronomical instruments. One of them is Nam Byeong Gil (1820-1869) who worked as a government officer as well as a Confucian scholar. He wrote a lot of astronomical books like as projection method for spherical astronomy, calculation for solar eclipse, and instruments which are based on Western mathematics. His works greatly contributed to the development of Korean astronomy. We studied on the solution of spherical astronomy using graphical method that was based on Western mathematics. And then we found how could be applied to making astronomical instruments.

Mak, Bill (Kyoto University)

The dissemination of the concept of the week and weekday computation in East Asia

In 759 CE, Shi Yao 史瑤 in his recension of the Xiuyao jing 宿曜經 based on the teaching of Amoghavajra commented that if one would like to know the day of the week, he should consult a foreigner. He then provided a multilingual glossary of the names of the seven days of the week in Sogdian, Middle Persian and Sanskrit along with their Chinese names. Five years later in 764 CE, dissatisfied with Shi's text, the court official Yang Jingfeng 楊景風, who was also a disciple of Amoghavajra, made a revision of the text. He removed the glossary and replaced it instead with a supplementary chapter on weekday computation, taken from Gautamasiddhartha's Jiuzhili 九執曆, a Chinese treatise on Indian astronomy composed half a century earlier in 718 CE. The concept of the week and the computation of weekday since then spread to other parts of East Asia, mostly by the Buddhists of the Esoteric Sect to notably Japan, where such concepts along with other Tang astral lore are preserved to this day. In China, on the other hand, the concept was reintroduced a number of times, most notably by the Islamic astronomers and later the Jesuits, but without much success until the 20th century.

S53 CONTESTED NATURE IN URBAN SPACE: NATURAL HISTORY IN BARCELONA AND BUENOS AIRES (1880-1980)

Location: IoE – Room 739

Chair: Stráner, Katalin

Organiser(s): Hochadel, Oliver

This session will ask how knowledge about nature was produced and circulated in (and between) the urban spaces of Barcelona and Buenos Aires from the late nineteenth century until the late twentieth century. The assumption is that the urban space conditions (generates, facilitates but also obstructs) the production, appropriation and communication of knowledge. And in turn: the process of generating knowledge about nature, but also about man and society) shaped the modern city in Europe and Latin America in significant ways. What role nature should play was highly contested. Concepts of nature differed enormously among the historical actors and were inevitably charged politically. Naturalists of all sorts, physicians and hygienists, taxidermists and veterinarians, science popularizers, journalists and writers, politicians, social reformers and eugenicists, anarchists and freethinkers, but also the numerous and various publics of the modern city held often conflicting views about nature and how to represent it. The case studies will thus put specific emphasis on the media that deal with nature (including human nature), natural history and wild-life. The hypothesis is that these media, ranging from zoological gardens, newspapers and journals to TV documentaries and comics, convey a specific “urban” view of nature. The discourses of the historical actors are crucially shaped by the urban milieu they lived in. This “production of nature” ranges from the (usually moralizing) rhetoric of contrasting the city with the countryside to the emergence of preservationist concepts and the protection of nature through natural parks. It also contains a paper that describes how anarchists were cast as “natural criminals” by anthropologists – and how these anarchists fought back arguing that nature never “produces” anything imperfect. This symposium will also try to go beyond the urban space of one individual city. Some of the case studies will not only compare cities but also ask for the connections between them. In this trans-urban space we assume a dialectical and multi-directional exchange of ideas and practices but also of objects and persons.

Hochadel, Oliver (IMF-CSIC, Barcelona)

Educating the Argentine people”. The early decades of the Buenos Aires zoo in its urban and transurban context (1880-1910)

In June 2016 the zoo of Buenos Aires hit the headlines worldwide: after 128 years of existence it was closed down. The city of Buenos Aires withdrew the license from the private company that had run the zoo since 1996. The company had been accused of not caring properly about the animals. A growing public sentiment that animals should not be kept “in captivity” for the sole benefit of the human onlookers formed part of the criticism. Around 1900 the zoo of Buenos Aires was considered exemplary. French zoo reformer Gustave Loisel praised the innovative research being conducted there but he also considered the zoo as the “œuvre éducatrice ... du peuple argentin”. This paper will look at the first decades of this institution. The foundation of the zoo was very much tied up with the urban planning discussion of the late nineteenth century on how to modernize the city of Buenos Aires. The creation of parks – the “green lungs” for the city – was a central feature of this debate. At the same time the talk will situate the Buenos Aires zoo in the international networks of reformers of natural history and the quickly growing trade of exotic animal. Through personal contacts, visits and publications the Buenos Aires zoo is surprisingly present in the European discussions on zoo reform. Looking at the zoos around 1900 helps to reconstruct a transurban space in which theoretical knowledge, practical

SATURDAY 15 SEPTEMBER, 09.00-10.30

experiences but also living creatures were exchanged across borders and across oceans.

Girón, Álvaro (IMF-CSIC, Barcelona)

The construction of anarchist criminology in trans-urban networks: Barcelona88/Buenos Aires (1890-1910)

In the last decade of the nineteenth century, the close association between anarchism and political violence took form. A series of terrorist attacks throughout the world triggered a global reaction materialized in increasing international collaboration of governments and police forces. Small wonder that criminal anthropologists started to define the limits and nature of “anarchist crime” by creating a close link between madness, degeneracy and libertarian ideology. Anarchist criminals were customarily placed in the fringes of the cities, forming part of the dangerous classes. Anarchists reacted by criticizing Cesare Lombroso’s identification of anarchists and madness. Their counter-attack was not limited to Lombroso’s reflections on political crime. Anarchists derided his theory of the native criminal and created their own literature on the origins, definition and remedies of criminality. They tapped different cultural resources including the French criminal sociology of the time. By the very nature of the libertarian movement, this was a trans-urban effort. The anarchist “Republic of Letters” was a transnational network in which the press took the leading role. Barcelona and Buenos Aires were important nodes in this network or rather networks. This paper explores how a set of *histoires croisées* between militants of both sides of the Atlantic contributed to create an anarchist criminology. Specific attention will be paid to the interaction between the aforementioned networks and the specific urban settings. This paper will ask how this alternative criminology was disseminated and resignified in and between Barcelona and Buenos Aires.

Carandell Baruzzi, Miquel (UAB)

Modernizing the zoo in a dictatorship: Antoni Jonch’s reform plans for the Barcelona Zoo (1952-1956)

In the early 1950s, the Barcelona Zoo had still not recovered from the devastating effects of the Spanish Civil War. Situated in the restricted space of the Parc de la Ciutadella it was in very poor condition and in dire need of renewal and reform. At least since 1952, the high school teacher Antoni Jonch (1916-1992) established much needed contacts, gathered experience and knowledge in order to take on the challenging task. Jonch dined with politicians, gave public lectures, wrote articles and a couple of reports about his ideas on how and where a new zoo should be built. His lobbying and networking was successful: In 1956, Jonch became first curator of Barcelona’s Zoo and later its director until 1985, well into the democratic period. Jonch is arguably the most powerful and influential director the Barcelona zoo had since its foundation in 1892. This paper will analyze these crucial years between 1952 and 1956. It will focus on the relationship between Jonch, the city of Barcelona and the zoo. What was Jonch’s motivation? What concept of nature did he expound in his reform plans? Where did Jonch’s knowledge about zoos originate? Who were the audiences of his talks and written works? How did the context of Franco’s national-catholic dictatorship impact on Jonch’s thinking and his “zoo politics”? In attempting to answer these questions the paper will try to show the specific milieu of Barcelona shaped the future zoo and the way exotic nature was presented to its inhabitants.

S28 COLLECTING NATURE AROUND 1600: FROM STABLES THROUGH BOOKS TO PHARMACIES

Location: SciM - Dana Study

Chair: Margócsy, Daniel

Organiser(s): Margócsy, Daniel

The literature on early modern cabinets of curiosities and collecting has exploded in the past three decades. The groundbreaking works of Pomian, Daston & Park, Findlen, Impey & MacGregor, and many other scholars, have revealed the stakes, passions and wonders of collecting before the establishment of modern museums. The scholarship has scrutinized in detail how these early modern collections were the site of erudite or polite conversation, how the exchange of curiosities could make or destroy friendships, and how they contributed to the development of natural knowledge. Our panel contributes to this historiography exploring some of the neglected sites of collecting in the years around 1600. Together, they propose to move beyond the cabinet of curiosity as the primary site of collection, and to study what other sites could facilitate collecting activities in this period. Anna Svensson suggests that we need rethink the printed book as a material object, and as a container of naturalia in this period. Early modern readers and bibliophiles stored a plethora of objects between the pages of a book. Her focus is on the emerging practice of pressing plants in books, and she considers how this practice contributed to the development of botanical knowledge, and more specialized herbaria. Daniel Margócsy claims that the earliest of cabinets of curiosities emerged from stables, and that we need to consider how the architecture of stables and the collecting of horses shaped early modern cabinets of curiosities. Valentina Pugliano calls attention to the pharmacy shop as the site of collecting. While the blockbuster, and atypical, cabinets of an Imperato or a Calzolari have been well-studied, we still know very little about how the pharmaceutical trade influenced the development of less impressive collections, and vice versa. Last, but not least, Irina Savinetskaya returns to the classic collections of the Emperor Rudolph II, and points out how our focus on the Rudolphine Kunstkammer has made us forget the imperial court could keep and collect objects in other locations, as well, e.g. in a medicinal chest. The medicinal and symbolic value of the objects in this chest help us reinterpret what collecting meant for the Habsburg ruler. Taken together, these four talks provide novel avenues to understand how one could keep, store, collect, breed and produce plants, animals, and medicinal drugs in the early modern world, and help us move beyond the traditional dichotomies of artificialia and naturalia. They reveal how early modern collections did not only contain symbolic objects of high values, but were active and practical sites of knowledge production.

Pugliano, Valentina (University of Cambridge) (in absentia)

Collecting in the Renaissance Pharmacy Shop

In recent years apothecaries have been the recipients of a resurgence of interest in the scholarship on natural history. Their place and status in the natural historical networks of early modern Europe has been reappraised, and apothecaries have emerged as key intermediaries for specimens and information on their acquisition and cultivation for naturalists. The examination of their collecting practices, however, has remained limited. Attention has been primarily devoted to those artisans, such as the Neapolitan Ferrante Imperato and the Veronese Francesco Calzolari, who created two of the earliest and largest cabinets of curiosities of the sixteenth century. How the average apothecary collected, and how such collecting was tied to pharmaceutical practice and more specifically to the site of the pharmacy shop still remains in need of analysis and conceptualization. This paper will take the case of sixteenth-century north

SATURDAY 15 SEPTEMBER, 09.00-10.30

Italian apothecaries to examine 'pharmacy shop collecting'. It will explore the nature of collecting in the pharmacy shop, and the role this played both in the birth of scientific collecting and in fostering the solution of pedagogical and market problems in the workshop. Apothecaries collected not just for leisure but also for utility: to instruct apprentices, to test potential innovations, and to create a catalogue of fraudulent ingredients that they should stay away from. In turn their discussions of substitution and adulteration, of forgery and truthfulness to nature, and their savvyness in devising techniques for the preservation of specimens had much to contribute to the emerging field of natural history.

Svensson, Anna (Royal Institute of Technology, Stockholm)

Pressing plants in books in the early modern period

Occasionally a researcher or librarian comes across a plant between the pages of an old book. Why were the plants pressed in this particular book? Who put them there? When? These questions are often impossible to answer conclusively, but taken as a category pressed plants offer valuable perspectives on the rich overlap between the world of books and plants in the early modern period. This paper explores the pre-Linnaean practice of pressing plants, building on previous research of the versatility of the book as a container or collecting space spanning the field, the garden and the library. Although the odd plant has been found in medieval books, they become much more common in the early modern period coinciding with the spread of the hortus siccus. Pressed plants in printed books can be analysed as a form of marginalia that reflects a range of possible relationships between the plant and the page in the hybrid space between print and manuscript. This becomes clearer through comparing different genres of books in which plants were preserved, such as herbals, garden catalogues and other plant-related literature, as well as devotional books such as bibles. There are patterns in how the plants have been entered into the book (for instance glued or labelled), as well as deliberate and accidental imprints and traces left by plants that have since been removed. This paper draws on a range of examples, as each is unique and resists fixed categorization.

Margócsy, Daniel (University of Cambridge)

The Stable Collection: Horses and Museums in Early Modern Europe

When historians discuss early modern collections, they rarely mention stables. Yet the horses kept at aristocratic and royal stables were one of the most luxurious commodities that served as status symbols and objects of pride for their owners. Within Europe, they were frequently exchanged both as gifts and in financial transactions, and across the globe, they were major agents of the Columbian Exchange. This talk will recount how horses were kept, exhibited, and made to perform at stables and manèges, and how early modern travelers described their visits to stables in terms comparable to those of cabinets of curiosities. As it argues, the first *Kunstkammern* emerged in sixteenth-century Europe in stables. In Munich, Dresden, Vienna, the Schloss Ambras in Innsbruck, and elsewhere, the same buildings housed horses and curiosities. This talk examines the reasons for housing early modern collections in stables, and how the consideration of horses may help revise our understanding of what curiosities are. Like the tulips analyzed by Anne Goldgar's *Tulipmania*, horses were the result of the artful manipulation of nature. As live beings, they never became museological objects, but were instead the subject of various breeding experiments. Instead of showcasing particular animals, early modern collectors tended to collect breeds, and their aim was to maintain and improve the quality of their stock. While the literature on museums tends to focus on the material particularities of individual curiosities, my talk instead focuses on how one could collect intangible, abstract and generalized things such as a breed.

Savinetskaya, Irina (Independent Scholar) (in absentia)

[Naturalia in the Medicinal Chest of Rudolf II]

This paper examines naturalia in the medicinal chest of Emperor Rudolf II, described and illustrated in the little-known book *Spagyrische Hauss- und Reyss-Apotheca dess Kaisers Rodolphi*

SATURDAY 15 SEPTEMBER, 09.00-10.30

II. Originally written by Emanuel Sinicker, the head of Rudolf's laboratory in Prague, the manuscript was found several decades later by Heinrich von Schennis. Schennis translated the text into German and published it in 1628. Made of ebony, the three-tiered medicinal chest contained drawers divided into dozens of small compartments. The top of the chest was decorated with four standing cones and a pyramid, the cones representing the four elements water, fire, earth, and air. The pyramid was crowned with a pentagram with the word *sanitas* written on it. As this paper demonstrates, the chest acted both as a symbolic display of knowledge as well as a collection of useful objects. As such, it invites to re-examine Krzysztof Pomian's concept of "semiophores" and the role of naturalia in German princely collections as a whole.

R64 CURATING PHOTOGRAPHY AND CHEMISTRY ROUNDTABLE

Location: SciM – Dana Studio

Chair: Belknap, Geoffrey

Participants: Belknap, Geoffrey (National Science and Media Museum)
Wilder, Kelley (Photographic History Research Centre, De Montfort University)
Henning, Michelle (University of West London)
Ramalingam, Chitra (Yale University)

A photograph is a three-dimensional thing, not only a two-dimensional image. As such, photographs exist materially in the world, as chemical deposits on paper, as images mounted on a multitude of different cards, subject to additions to their surfaces, or drawing meaning from their presentation /context (frames/albums). Photographs are both images and physical objects that exist in times and space and thus in social and cultural experience.

This roundtable will explore the interrelated histories of photography and chemistry, from the start of the nineteenth century to the advent of digital photography. Bringing together curators with historians of science, photography and chemistry, the discussion will explore the processes and practices behind the invention and application chemical knowledge to photography, and photographic knowledge to chemistry, and ask how these histories might be displayed through objects within a museum setting.

Tracing the chemicals that make photography possible, the roundtable will explore a variety of different spaces where photography and chemistry interact: the laboratory, the kitchen, the 'field', the hospital, the high street (boot's development lab). This spatial argument will also extend to the technical spaces of paper, plates and glass, chemical glassware and chests, development troughs and dark rooms.

By exploring the transforming spaces and materials of chemistry in photographic work, this roundtable will help us understand the evolution of photographic technologies in a new context, one linked not to aesthetics but to the limitations of technology, exploring how technology and society interact.

In order to frame the discussion in each of the papers, this roundtable will also ask: how an integrated history of photography and chemistry can be informed by the collections held at the Science Museum Group – and how these histories and objects can inform a proposed temporary exhibition on photography and chemistry. Based on the foundational collections of photography and chemistry held at the National Science and Media Museum (Bradford), the Museum of Science and Industry (Manchester) and the Science Museum (London), the discussion in this roundtable will explore the relationship between photography and chemistry, and ask how research into this intersection can help frame a new understanding of photographic history for both academic and public audiences.

I105 BIOLOGY AND BOTANY FROM THE EIGHTEENTH TO TWENTIETH CENTURIES

Location: IoE – Room 802

Chair: de Chadarevian, Soraya

Dias da Silva, Ana Margarida; Marques, Maria Beatriz; Santos, Maria José Azevedo; Gouveia, António Carmo (University of Coimbra)

Unity in Disunity in the botanic collections of the University of Coimbra: the contribution of the systemic perspective and the holistic view of the information

This paper intends to highlight the benefits of a systemic perspective and holistic view of Information, in providing important contributions to contextualize the knowledge produced within the scope of memory institutions. Contrarily to the assumption that different parts of the knowledge production process should go to different places (disunity), the emphasis on information eliminates physical distinctions between types of records and thus, presumably, the need for organizational distinctions in the management of the systems within which these records are handled, restoring unity and meaning to what is often compartmentalised. The General Theory of Systems (GTS), applied to the phenomenon and process of social information, emphasizes the role of context and structural organicity in the genesis of information, providing a complex and comprehensive knowledge of information phenomena, upholding the importance of integral understanding of phenomena and not the isolated analysis of its constituents. The systemic perspective is thus characterised by the observation of the interrelation between all the elements of the system, between these and their parts and with the environment that surrounds them. Using the historical botanic collections (plants, herbarium, museum objects, archive, and books) of the University of Coimbra as a case study, we aim to present examples of how the systemic perspective and the holistic view of the Information can add new context, unity, and full knowledge to its collections. The adoption of the GTS can improve results by applying the systemic perspective and the holistic view of the information to historical collections.

Boanova Viegas, Sofia (Centro Interuniversitário de História das Ciências e da Tecnologia (CIUHCT-FCUL) & Museu de História Natural e da Ciência da Universidade do Porto (MHNC-UP))

Unveiling the scientific and historical value of a colonial botanical collection of a University Herbarium

Established in 1892, the Herbarium of the University of Porto (PO) is one of the most important herbaria in Portugal, containing about 120 000 specimens, including bases of the Portuguese flora, such as the collection of the famous botanist Gonçalo Sampaio, historical collections and hundreds of type specimens. In 2015, the PO Herbarium moved premises to the renovated Museum of Natural History and Science of the University of Porto (MHNC-UP). During this process there were some collections of plants, algae and fungi, mostly gathered in the African Portuguese colonies during the 19th and 20th centuries that stood out by the volume and scarcity of associated information. To understand the circumstances that led to the current invisibility of these collections, devoid, for the most part, of historical and scientific contextualization, there are key questions to solve; in what scope did these collections appear? What were the political and/or scientific motivations for their creation? Who were the collectors? What is their historical and scientific value in the national and international context? What was their relevance then? What is their relevance today? This presentation is made as part of an ongoing doctoral project, which aims to clarify the role of the academic community of Porto in the construction of botanical knowledge of the Portuguese colonies in the 19th and 20th centuries.

Rose, Edwin (University of Cambridge)

Unifying the South Seas under a new system of natural history: Joseph Banks, Daniel Solander and the library of the *Endeavour* (1768–1771)

SATURDAY 15 SEPTEMBER, 11.00-13.00

In 1768, the Royal Society and Admiralty appointed James Cook to sail to the Pacific, observe the transit of Venus (1769) from Tahiti and search for the 'unknown southern continent', Terra Australis Incognita. Accompanying this expedition, on HMS *Endeavour*, was Joseph Banks (1743–1820) and his team of field assistants, which included the Swedish naturalist and former student of Carl Linnaeus, Daniel Solander (1733–1782), the Finnish naturalist and secretary, Hermann Spöring (1733–1771) and the natural history artist Sidney Parkinson (c. 1745–1771). This paper examines natural historical practice over the course of the Endeavour voyage, during which Banks, Solander and their team of field assistants discovered thousands of new species previously unknown to European natural history. In order to successfully catalogue and classify the new specimens they collected, Banks and Solander employed a complex system of information management, for which they used an extensive library of annotated printed books, manuscripts, illustrations, specimen labels and the physical objects themselves. These practices held their basis in the Linnaean system of classification, which, when combined with a range of different paper technologies, provided the basis for the rigorous classification of a collection which expanded rapidly as the voyage progressed. Throughout their voyage, Banks and Solander kept detailed records of every species they discovered and often relied on indigenous communities for information when they formulated their botanical descriptions, unifying the previously unknown natural history of the South Seas under the Linnaean system of classification.

Paxton, Charles (University of St Andrews)

Giant gooseberries, the silly season and Conan the Barbarian: statistical patterns in reports of sea serpents over the last two hundred years

Over the last two hundred years there have been thousands of reports of sea serpents from around the world. Here I look at statistical patterns in the reports of sea monsters and see how they reflect changing knowledge of palaeontology and some other rather surprising, sociological influences.

Thomas, Marion (University of Strasbourg)

Apes as “servants of science”: Contrasting the French and American visions in a post-Darwinian and colonial context

In 1922, in French Guinea, Albert Calmette, a staunch Darwinian, launched an overseas Pasteur Institute (commonly known as “Pastoria”), which used apes as its central research model. Abundant and accessible in the African colonies, apes reinforced the attractiveness of the French Empire, becoming a raw material to be exploited. I specifically examine how Calmette used psychology research as a lever to include Pastoria in scientific networks at a time when primate research was undergoing an internationalization process. Indeed, the American psychologists Robert Yerkes and Henry Nissen used Pastoria, not only as a supplier for their own laboratories, but also as a platform to venture into the wild to study chimpanzees. Then, while Yerkes and Nissen, as discipline builders, followed a research agenda in which apes were central, and which combined a laboratory and a field approach, the Pastorians mainly envisaged apes as commodities to yield knowledge about human diseases, and used naturalistic knowledge to improve apes’ conditions of captivity. Finally, while Yerkes viewed apes as “almost human” and strove to evidence their role as an ideal model of study to help man improve, the French colonists had plans to educate generations of primates. If these plans never came true, they nonetheless inflamed the imagination of the American press, fueling the burning question of man’s relation to apes, and also the idea that apes could be “servants of mankind”. So apes reflected two visions of society, the one eugenic and utopian, the other echoing the French ideology of secular “civilizing mission”.

I110 CHEMICAL MATERIALS

Location: IoE – Room 804

Chair: Blumenthal, Geoffrey

Marques da Cruz, Sara; Rodrigues, Sofia; Neto, Marta Martins; Callapez, Maria Elvira (Centro Interuniversitário de Universidade Lisboa)

Unbalanced Perceptions about Plastics: gradual feelings besides acceptance or rejection

Plastic is a complex synthetic material that throughout its short life has achieved and lost its noble material status. Although the variability of this status matters in the eyes of the consumers, the use of plastics has undoubtedly unified certain material realities in our society, which result from their growing relevance amongst the variety of materials applied to the physical construction of our everyday life. Plastics have established themselves.

Fruit of the evident advantages of plastic materials, we can rely on, for example, safer and lower energetically consuming cars, more economical textiles or packages whose lightness simplifies transportation on a global scale.

Despite the generalized use of plastics, explicit or implicit, assumed or not even pondered, this material also engenders rejection in different degrees. This rejection does not ensue evenly, but instead with different sensitivities: from the radical environmentalist's fierce rejection, believing in the complete dismissal of these materials, to the informed consumer who accepts the inevitable use of this material but still wishes for a better way of controlling the life cycle of the plastic. In this presentation, we will discuss the dissension and differences of perspectives resulting from the use of plastics, bearing in mind the real value of this material. In the same sense, being the plastic an innovative material par excellence, we will analyze to what degree its status has suffered mutations.

Paskins, Matthew (LSE)

The Substitutes Committee: natural resources and material substitution in the British Ministry of Supply 1940-1945

This paper discusses the work of the Substitutes Committee, an expert advisory group convened by the British Ministry of Supply during World War Two. The Committee sought to unify problems of material substitution for the British government across civilian and military realms. This unifying approach was crucial to how the Committee saw its work; its members were terrified that successful substitution in one area would lead to shortages in another. Its scope was industrial and imperial, concerned as much with agricultural surpluses in the British Empire as the effective utilisation of plastic by the RAF. Existing historical accounts of material substitution have focused chiefly on three main topics: 1) morale-building exercises such as scrap-drives 2) the production of ersatz goods, especially in Nazi Germany 3) attempts to find new uses for resources of which there is a surplus 4) the introduction of new materials, as replacements for less-obtainable ones. By reading the Committee's records, we can see how substitution was articulated as a problem, and the ways in which different kinds of scientific expertise were brought to bear on substitution problems. The committee members' distinct views about what could count as substitution, and the narratives of use and supply which their enquiries developed, can help us to think about how scientific knowledge related to natural resources and their possible replacements. Substitution emerges as a technical and scientific activity which occurs on several different temporalities simultaneously, and includes everyday improvisations as well as more systematic introductions of novelties and replacements.

Werrett, Simon (University College London)

Thrifty Science: Making the Most of Materials in the History of Experiment

This paper explores the nature of "Thrifty Science", my term for a distinctive approach to material culture which, I argue, was critical to the emergence of experimental science in seventeenth and eighteenth-century England. Early modern books of domestic "oeconomy" encouraged people to value their material possessions as open-ended things with multiple uses,

SATURDAY 15 SEPTEMBER, 11.00-13.00

to be maintained, repaired, transformed and passed down over several generations. Diversifying uses or “making use” in the household provided a constitutive context for experimentation by householders, both men and women, and elements of these experiments were cast as the “new science” of the seventeenth century. I contrast this culture with an “economic” approach to materials that has become widespread in modern times, involving a quite different view of use, re-use, and adaptability in the sciences. Restoring a sense of “thrifty science” may help to resolve problems of sustainability in the sciences that such an “economic” approach has given rise to.

Bonney, Amelie (University of Oxford)

Constructing expertise: scientific and medical conflicts over occupational diseases caused by toxic colours in France and Britain, 1830-1860

At the turn of the nineteenth century, the invention of new production methods for colours such as arsenic green and white lead meant that workers were increasingly exposed to these substances. In the 1830s, cases of widespread disease among workers in these industries sparked debates within the scientific community over the properties of these colours. Some claimed that they were highly toxic, while others argued that they were harmless and could not be the cause of occupational diseases. Disagreements over the nature of the diseases of workers and the chemical properties of colours sometimes coincided with political disagreements and differing conceptions of public health. However, these debates were also a means for chemists, pharmacists, toxicologists, hygienists and medical men to assert their professionalism and expertise. In both France and Britain, disagreements frequently arose over the use of different methodological approaches and the debate created rifts between institutions. While in France, Montpellier’s medical school was eager to study occupational health problems, only a few students of the Paris medical school focused on this topic. In England, Scotland’s medical school became the first centre for the development of toxicology whereas London medical practitioners were, at first, only superficially trained to recognise cases of poisoning caused by these colours. This paper will examine these tensions and show how a provisional agreement was reached in the 1860s, when influential hygienists such as Alphonse Chevallier established themselves as the leading experts of the field, and minimised the hazards of arsenic green and white lead production.

I145 MODERN SCIENCE AND ITS PROBLEMS

Location: IoE – Room 822

Chair: Quirke, Viviane

Oliver, Kendrick (University of Southampton)

‘The lucky start towards today’s cosmology?’ Trading zones, working worlds and the thick contexts for the confirmation of the origin of the universe

Cosmology began to re-emerge as a productive field of scientific enquiry in the mid-1960s. The principal catalyst was the detection of the cosmic microwave background (CMB) and the identification of that radiation as the relict heat of ‘big-bang’ nucleosynthesis. The terms of cosmological debate decisively shifted in favour of the ‘big bang’ model, whilst the CMB itself has been exploited as a physical archive for the testing of other cosmological ideas. Many accounts of the CMB’s discovery emphasize its serendipitous nature. Arno Penzias and Robert Wilson, the two Bell Labs radio astronomers who detected the radiation, did not know what they had found. It took a third party to introduce them to a team of Princeton physicists, led by Robert Dicke, who – having recently embarked on their own CMB detection project – were able to link the Bell Labs measurements to cosmological theories. Drawing upon wide archival research, this paper explores the thicker context for confirmation of the ‘big bang’ model. It describes how the Cold War state became a patron of Dicke’s cosmological studies. It explores how radio astronomers became incorporated into a broader trading zone of researchers - linking military services, universities and communications companies - focused on extending use of the microwave region. New tools – horn antennas, masers, reference loads, cryogenics - were being developed to improve signal-to-noise ratios in that region. Given their access to and experience with all these tools, Penzias and Wilson were better placed than anyone else to detect the CMB.

Williams, Elizabeth (University of Massachusetts Lowell)

Unity in Theory, Disunity in Practice: The Science of Agriculture in Late Ottoman and French Mandate Syria, 1880-1940

This paper explores the common ground shared by Ottoman, French, and Syrian officials regarding theories of agricultural innovation even as they diverged in their imperial policies and approaches to local implementation. These technocrats championed the application of a “scientific” agriculture made conceivable by the invention of new technologies such as chemical fertilizers and mechanized equipment as well as their associated methods. Despite this united zeal, differing visions for imperial and, under the French mandate, national development drove conflicting programs and practice. Tracing interactions through global technocratic networks that spanned the periods of late Ottoman and French mandate rule exposes the ideological agreement that characterized the thought of these officials as the region transitioned from an Ottoman to a French imperial space. Looking at proposals for implementation at the imperial level and attempts to translate them into practice locally demonstrates how, despite Ottoman and French officials’ adoption of a common discourse of science, there were key divergences in the agricultural policies they advocated. It also underscores how these discourses shifted in the post-World War I period, when nationalist Syrian technocrats found themselves at odds with French mandate officials over “scientific” agriculture policy. Using sources in Arabic, French, and Ottoman Turkish from archives and libraries in Turkey, Lebanon, and France, this paper argues that despite sharing a common technocratic language, differing imperial, and later national, prerogatives led to distinct, conflicting conceptions of how the science of agriculture should be applied.

Wolff, Stefan (Research Institute, Deutsches Museum Munich)

Nationalism and Antisemitism – a threat to the unity of science? German physicists between

SATURDAY 15 SEPTEMBER, 11.00-13.00

1914 and 1933

Jenner's famous "the sciences were never at war" in 1803 expressed that even under such circumstances nationalism should not disunite scholars. However, universality of science and unity of the scientific community became seriously called in question in the further course. As a belated nation the German people including their scholars especially emphasized their national identity. This led to a strong nationalism and sometimes to an exclusion of Jews, then called Anti-Semitism. We shall study these phenomena in a few case studies of German physicists from the begin of World War I till the takeover of National Socialism. International networking did not prevent most of them to sign chauvinistic proclamations in 1914. After the war Anti-Semitism became a subject of internal controversies, the Einstein debate is one example for it. The professional societies of physicists refused to finish the anti-boycott and did not join international organisations. After the Nazi laws of 1933 which displaced all scholars with a Jewish background we must realise a disunity of the total German scientific community. Nearly all of those who had not been concerned did not object – not only because of fear – but being convinced that there had been too many Jews at the universities. We present contemporary reports. Only very few displaced colleagues were interested to become an exception as their children would be citizens of second class only. The principle of equal rights had not been rooted in German society and physicists did not distinguish in this respect at those times.

Gandolfi, Haira Emanuela (University College London - Institute of Education)

Global History of Science and Science Education: uniting science curricula and Science and Technology Studies

The inclusion of History of Science (HOS) into Science Education has been advocated by different research for decades and among its contributions to school science is teaching about how scientific communities work – "nature of science" (NOS). Nevertheless, even though contextualising and "historicising" scientific development, HOS is still employed at secondary schools mainly as a guide to understanding epistemic aspects of scientific work (theories, laws, experiments), with less attention to the analysis of science as an integral part of economy, politics and society, that is, as a cultural product. To promote a more holistic, culturally and sociologically-informed teaching about NOS, this work describes a classroom-based investigation of the inclusion of HOS into secondary school science grounded on the Global History and Decolonial Science fields. Working alongside a teacher at a state school in London/UK, perspectives from Global History of Science were employed to bring together discussions from Science and Technology Studies (STS) and scientific content from the National Curriculum (e.g. Medicines and Drug Trials, and Magnetism) during regular science lessons (students aged 12-13). Results are promising regarding students' engagement with these global narratives about science, and also regarding the science curriculum: the global approach to HOS resulted in a natural, intrinsic connection between talking about scientific content and about the work within scientific communities. Considering these positive results, more research is needed to bridge the gap between Global HOS research and science teaching at the school level if we aim at a more thorough integration between STS and school science.

Mayrargue, Arnaud (CNRS: SPHERE, UMR 7219, France) and Guedji, Muriel

Education formelle, éducation non formelle: quels apports de l'Épistémologie et l'Histoire des Sciences et des techniques?

Cette communication a pour objet de s'interroger, du point de vue de l'Épistémologie et l'Histoire des Sciences et des Techniques (EHST), sur sa projection dans deux domaines, qui font respectivement partie de l'éducation formelle et non formelle, l'école et les musées de science et d'histoire des sciences et des techniques. En France, l'EHST est intégrée dans les programmes de l'école et de formations universitaires. Pour autant, ni les objectifs à atteindre, ni les compétences à acquérir ne sont définis clairement (Maurines, Beaufile, 2010). Faut-il en conclure que l'EHST est partie intégrante de l'éducation non formelle, que Daniel Jacobi caractérise en affirmant qu'elle « prend la forme d'actes volontaires effectués dans la période de

SATURDAY 15 SEPTEMBER, 11.00-13.00

loisirs, sans programme imposé et sans contrôle ni évaluation » (Jacobi, 2018) ? Nous nous proposons ici d'éclaircir à la fois le rôle et la place de l'EHST dans l'enseignement, et les possibilités de son introduction à l'aide des dispositifs proposés dans le cadre de l'éducation non formelle (musées de sciences). Pour cela, nous interrogerons, dans le cadre du courant matériel, les dispositifs d'apprentissages et de médiations pouvant être conduits à partir des objets des collections universitaires. Des études de cas, dans et hors de la classe, permettront d'illustrer et d'analyser de manière réflexive l'interface entre éducation formelle et éducation non formelle et d'éclairer les apports de l'EHST à ces dispositifs. A l'articulation des éducations formelles et non formelles c'est bien l'unité méthodologique de l'EHST qui est ici mobilisée pour questionner les spécificités attachées à chaque domaine.

SATURDAY 15 SEPTEMBER, 11.00-13.00

S16 NARRATIVE KNOWING: THE FUNCTIONS OF NARRATIVE THAT UNITE AND DISUNITE MODERN KNOWLEDGE

Location: IoE – Room 736

Chair: Morgan, Mary

Organiser(s): Berry, Dominic

Our papers pick out and highlight the functions of narrative in modern science, taking in a rich range of case studies that might allow us to make broad conclusions. Historians and philosophers of science have already dramatically expanded the range of ways in which knowledge making activities can be described, characterised and understood. Ways of knowing, styles of thought, epistemic things - projects such as these have gathered their own communities of scholars with different versions sometimes competing but more often simply highlighting different aspects of scientific life. Our symposium is dedicated to thinking within these kinds of framework, but also cutting across them, by starting with a particular kind of knowing, that of knowing through narrative, and considering how far this may be a unifying or dis-unifying feature either across the practices of science or within these broader frameworks. The work of scientists' narratives in the history of science has not yet received this kind of dedicated attention. While there are key exceptions, Gillian Beer's work on narrative in Darwinism and John Forrester's exploration of case studies in medicine foremost amongst them, the time is ripe for this kind of communal effort (as only just begun in the recent issue of SHPS vol. 62 2017). The questions of whether scientific knowing is distinct from other kinds of knowing; and whether narrative knowing in science is different from such forms in the humanities, or in other communities where expert knowledge is found and used, are important questions and highly relevant to the conference themes of unity and disunity. Our questions address this unity issue by undermining those who would see science as distinct from 'humanistic' understanding, and by providing rich grounds for a renewed appreciation of scientific research in all its variety, and so new insights into how we know. The five papers explore the functions of narrative in different countries, sciences, contexts, and periods. Dmitriy Myelnikov focuses on phage research in soviet Georgia and how narrative was of use to those trying to discern what phage were and explain their actions. Ageliki Lefkadiou considers the transformative potential of the museum setting in communicating historical and contemporary scientific narratives at the intersection of texts, things, spaces and people. Meira Gold explores the roles of contrasting field narratives and visual tools in early twentieth century British Egyptology. Debjani Bhattacharyya turns her attention to the recording of shipwrecks and the making of a new narrative knowledge for the purposes of insurance and imperial power. Lastly Dominic Berry considers the twentieth century flight from narrative in the plant sciences through the case of synthetic biology.

Myelnikov, Dmitriy (University of Manchester)

The lively narratives of bacteriophage therapy in Soviet medicine, 1930-1956

The term 'bacteriophage' (devourer of bacteria) was coined by Felix D'Herelle in 1917 to describe both the phenomenon of spontaneous destruction of bacterial cultures and an agent responsible, which D'Herelle believed to be a virus. Debates about the nature of bacteriophage raged in the 1920s and 30s, until the viral hypothesis was accepted with electron microscope evidence in the 1940s; there were also extensive attempts to use the phenomenon to fight infections. While it eventually became a crucial tool for molecular biology, therapeutic uses of phage declined sharply in the West after World War II, but persisted in the Soviet Union,

SATURDAY 15 SEPTEMBER, 11.00-13.00

particularly Georgia. Increasingly isolated from Western medical research, Soviet scientists developed their own metaphors of phage, its nature and action, recruited in drug development, and communication to medical professionals and patients. In this paper, I focus on how researchers at the Tbilisi Institute of Microbiology, Epidemiology of Bacteriophage, a key centre for phage therapy, built narratives around phage, its healing properties, and liveliness. While viruses have been largely seen as barely living, phage narratives featured heroic animacy, conceiving of phage as a specific agent in the destruction of bacteria and an ally to human immunity. In the late 1940s, these stories had to be augmented to navigate the precarious realms of Lysenkoist biology. I will argue that phage narratives were not merely decorative, but key in establishing the efficacy of phage therapies and ensuing the survival of phage research.

Gold, Meira (University of Cambridge)

Archaeological story-telling: Uses of narrative and visualisation in early 20th century Egyptology

How have archaeologists used narratives to explain their practices and interpret the past? This paper addresses this question by focusing on one episode: the 1906 excavations directed by Egyptologist W. M. Flinders Petrie and his wife Hilda Petrie at Tell el-Yahudiyeh, for their new training and funding body, the British School of Archaeology in Egypt. The Petries' field records provide an opportunity to understand the movement and communication of Egyptological knowledge between several sites of production—from the field trenches, to the excavation tent, to private studies in London, and to public spaces of dissemination and consumption. Through text (field notes, correspondence, media communiqués, and site reports) and new visual tools (artefact drawings, photographs, pottery comparisons, and site maps), the Petries provided contrasting narratives. On one hand, there were deprecatory autobiographical accounts of fieldwork, which emphasized struggles of living and working in an open chaotic site shared with locals, and the archaeological possibilities if field conditions had been better. This was translated into coherent, chronological, narrative explanations of the ancient past, aimed to satisfy private donors and support their new training and research program. Comparison of the Petries' textual and visual narratives illuminates the process of mobilising and managing information, closely related to the process of 'ordering' the field. It further highlights tensions between attempts to legitimize Egyptology as a scientific discipline at the turn of the century, and the financial dependence on promoting archaeological work to public audiences.

Lefkaditou, Ageliki (The Norwegian Museum of Science and Technology)

Active Encounters: Narratives of Historical and Contemporary Science in Museums

What happens to historical and contemporary scientific narratives in the meeting with diverse audiences, texts, things, people and spaces? This paper focuses on a recent exhibit at the Norwegian Museum of Science and Technology to explore how narratives firmly connected to materiality bring together distinct ways of knowing and invite us to rethink what counts as expert knowledge. The exhibition explores research on human biological diversity by juxtaposing scientific practices of interwar racial science with contemporary human genetics. The emphasis is on practices of measuring, visualizing, classifying, mapping, standardizing and (e)valuating human variation and their multiple entanglements with society, culture, politics, technology and economy. The exhibit is the result of multi-disciplinary collaboration between scientists, humanists, professionals from museum sectors, as well as community groups. The paper shows how complementary and competing narratives on human biological similarities and differences challenge collaborating researchers, communication practitioners, and whole institutions and communities, to reflect on, reimagine, and reshape their research and practices. The main hypothesis is that this (be)coming together in the assembling and experimental museum setting carries significant transformative potency for all implicated human and non-human actors. The paper will analyze the museum as a site of conjectures that questions binary oppositions between science and humanities, past and present, expert and non-expert knowledge. Thus, it will conclude by considering the strengths, challenges and limitations of

SATURDAY 15 SEPTEMBER, 11.00-13.00

narrative knowing in museums and the possibilities of narrative in providing new insights into how we know.

Bhattacharyya, Debjani (Drexel University)

Sea of Storms: Narrating Science in Colonial Courts

In 1865 British colonial officials set up a department called the Wrecks in Indian Waters to record shipwrecks in the Indian Ocean and the Bay of Bengal. The purpose of recording shipwrecks was twofold: assessing the nature of disasters at sea, determining their causes and developing precise weather predictions. There were multiple audiences intended for these annual reports. While they were initially produced under the auspices of the military, these reports were migrated into the Trade and Commerce department within a decade and were widely read and referred to by colonial meteorologists and tidal scientists. At the same time the narrative of the reports of the Indian Wrecks Department was produced as a documentation to be used in marine insurance settlement cases. An analysis of the reports reveal how narrative causality and colligation (Morgan 2017) were used to reconstruct the moment of the wreck and the knowledge production about human error vis-à-vis natural disaster on a sliding scale. By analyzing how colonial meteorologists and tidal scientists mined these reports produced for insurance settlement claims, this paper will ask what continuities we might trace between a legal narrative structure of arranging events, producing evidence, validating claims and similar concerns in the writings of colonial meteorological scientists.

Berry, Dominic (LSE)

Narrative burden: plant science's flight from narrative through synthetic biology

One way to characterise the rise of synthetic biology across the life sciences is by attention to narrative knowledge. Metabolic pathways, developmental maps, evolutionary lineages: each of these conform to a narrative form of knowing. By the end of the twentieth century, some biologists and engineers judged that these had grown to become unwieldy and cumbersome. Rather than an aid to research or its ideal goal, these kinds of narrative knowledge had become a hindrance or a distraction. For these discontents, the purpose of synthetic biology was to shift the epistemic goal posts by making a virtue out of ignorances, and a vice out of the seemingly endless layering of knowledge onto established biological forms and functions. Making the case for this reading of the history of synthetic biology, my paper focuses on the plant sciences. I show how the field was created as a reaction to narrative knowing in biology, which they sought to replace with neat abstractions, attention to small and discreet cellular mechanisms, and an emphasis on biological phenomena interpreted as useful for the goal of engineering. But did synthetic biologists escape narrative knowing, or just swap certain forms for others? What might narrative knowing in the context of biological engineering look like? Is synthetic biology uniting or disuniting the life sciences? Answers matter more broadly for how histories of biological science and biotechnology relate to and inform one another, opening up future potential historiographic paths.

SATURDAY 15 SEPTEMBER, 11.00-13.00

S13/1 THE HISTORIOGRAPHY OF SCIENCE AND RELIGION IN THE CONSTRUCTION OF MODERN EUROPE

Location: IoE – Room 828

Chair: Navarro, Jaume

Organiser(s): Navarro, Jaume

“Science and Religion” is a popular category in the Anglo-American world, both among academics and the public at large. In a 2006 seminal paper, Peter Harrison challenged the historical origin of this three-word category. In his work, Harrison historicises the modern origins of “science” and of “religion” as we understand them today and concludes that their relationship is a result of the evolution of both notions. But the story he tells, we would argue, is one that focuses mainly in the Anglo-American Protestant world. The separation between religion qua “virtue” and religion qua “the content of faith”, which he traces back to the conflicts between Catholics and Protestants in the Early Modern period, would be the seed of the long tradition of a specifically Protestant natural theology. In this session we suggest to explore the limits of this historiographical notion in other Christian and non-Christian traditions, and the ways in which “science-and-religion” has spread throughout different European contexts. The emphasis on mysticism in the Orthodox world, for instance, or the neo-Thomist notions of reason (not science) and faith (not religion) in some Catholic worlds, are but only two examples that may challenge the usual historiography and current relationships between science and religion. Papers in this session cover a broad geographical spectrum: from Turkey and Greece over to Italy, Germany and Spain and focus majorly in nineteenth and early twentieth case studies of Orthodox, Muslim and Catholic milieus, as well as non-denominational and alternative views on religion and knowledge.

Tarrant, Neil (University of York)

Science, Religion and Italy’s Seventeenth-Century Decline: From De Sanctis to Croce

It is a widely accepted proposition that, from the mid-sixteenth century onwards, Italian science entered a period of decline. This development is often attributed to the actions of the so-called Counter-Reformation Church, which had grown increasingly intolerant of novel ideas. In this paper I argue that this interpretation of the history of science is derived from an Italian liberal historiographical tradition, which linked the history of Italian philosophy to that of the state. I suggest that historians of science have appropriated this distinctive narrative to underpin the argument that Italy underwent a scientific decline during the seventeenth century, but, more importantly, that they have not always fully understood it. In this paper I consider the manner in which science was considered within the liberal tradition, by focussing on the work of two of its most significant figures: Francesco de Sanctis and Benedetto Croce. Both explicitly suggested that the actions of the Church had caused Italy to enter into a period decline. Nevertheless, they argued that science represented one of the few areas in which Italian intellectual life actually continued to thrive. Croce acknowledged that examples of individuals practising science were not representative of the cultural life of the period as a whole, but he maintained that it was the historian’s duty to record them. These isolated cases represented the continuance of Italy’s traditions of free thought, which would be expressed once more during the Risorgimento.

Bloemer, Julia (LMU, Berlin)

Nature in Seclusion – Monastic Natural Scientists in the Catholic Enlightenment

The story seems to be clear: the underdevelopment of the scholarship and enlightenment of Southern Germany in the eighteenth century can be explained with restrictions of the Catholic Church and its conservative position on education, culture and erudition. Secularization then released suppressed potentials and cleared the way for a scientific rectification. However, there

SATURDAY 15 SEPTEMBER, 11.00-13.00

is a catch in this master-narrative: Examining Bavarian and Upper Austrian monasteries, one finds extensive libraries with the latest literature, astronomical observatories and large scientific collections. How can we fit this together? In the eighteenth century, scientific efforts found their realm in academies, universities and most notably in monasteries. Benedictines, Augustine Canons among others collected, observed, communicated, and demonstrated; they gave public lectures in experimental physics and published articles in the transactions of academies. This talk presents characters whose life closely combined both categories – science and religion. But monks did not see themselves as priests of nature, they did not practice natural theology. Nevertheless, their lifestyle did fundamentally influence their scientific practice, both through the structured daily schedule, their transregional network and their education possibilities. Astronomical and meteorological observations produced role conflicts as well as role interactions influencing communication channels and habitual behavior. Above all, scientific endeavors could legitimize a lifestyle that had already come under criticism. Within this talk I argue for looking at these yet unconsidered monastic natural scientists and to use their example for determining the relationship between science and religion, between science and Catholic Church in the eighteenth century anew.

Navarro, Jaume (University of Basque Country)

Draper in Spain. The conflicting circulation of the conflict thesis

In this paper I suggest to explore the appropriation of Draper's book in the Spanish Restoration (1874-1931). The presentation of the translation of *History of the Conflict between Science and Religion* into Spanish was a major cultural event. With a preface by Nicolás Salmerón, a former president in the First Spanish Republic, the publication of the book triggered a very heated public discussion, but one that was mostly philosophical and political, not properly scientific. As a matter of fact, Salmerón criticised the book he was presenting on a number of fronts. In a way, Draper and Salmerón did not agree on what counted as religion, as knowledge and as science. And still, the book helped his reforming agenda in spite of these disagreements. This episode adds to the increasing scholarship on the way historiographical myths were appropriated for local political purposes. Draper's book came in handy for Salmerón. On the official side, the Royal Academy of Moral and Political Sciences, set up a competition to choose the best essay against Draper, thus indirectly reinforcing the thesis of a conflict. Interestingly, the major actors in these arguments were mostly statesmen, clerics and philosophers, rather than scientists, which helps us question the role of the thesis of an overall conflict as a political tool.

March Noguera, Joan (Universidad de las Islas Baleares), and Ceba, Agustín (University of Valencia)

Reforming Seminaries in Majorca. Antoni M. Alcover (1862-1932), science, culture and politics

This paper will examine the teaching of science in the Catholic seminary in Majorca, particularly interesting case study because from 1842 to 1969 there was no university on the island and the curricula could differ among Spanish seminaries. It focuses mainly on Antoni Maria Alcover's role (1862-1932), a multifaceted priest, philologist, folklorist, historian and cultural promoter. He was the closest collaborator of Antoni Campins, Bishop of Mallorca (1859-1915) who named Alcover General Vicar (the second most important position of the Diocese) the same year he was designated Bishop. Both implemented together a new curriculum (*Ratio Studiorum*) at Sant Pere Seminary of Mallorca the following course. This syllabus was consistent with Pope Leo XII encyclicals, especially *Aeterni Patris* (1879), which established how reason and science could be used to call people to faith, returning to scholastic thinkers, especially Thomas Aquinas. The changes and the influence of neothomism in the seminary will be compared with Institut Balear, the only State School in Majorca at that time. He firstly, introduced two new subjects – Astronomy and Physiology and Hygiene--, as well as an annual prize of science. These will allow us to analyse the vast readings of seminarians. Furthermore, they created an astronomic observatory which became a new pedagogical and research space. For instance, it was used in the total Solar eclipse of 1905, when Mallorca turned into a scientific centre of European

SATURDAY 15 SEPTEMBER, 11.00-13.00

astronomical expeditions.

S52/1 SHADOWS ILLUMINATED: INVISIBILITIES OF SCIENCE AND ITS (DIS-)UNITIES

Location: IoE – Committee Room 1

Chair: Martins, Ana Cristina

Organisers: Martins, Ana Cristina, and Pérez Sedeño, Eulalia

As is commonly the case in other historical fields, in the history of science the invisibility of actors, spaces and projects in science remains an ongoing problematic. A particular challenge is due to the types of sources essential to uncover and retrieve the names and activities that for one reason or another have been forgotten, ignored or kept away by and from historiography. Nonetheless, some progress has been made in overcoming this challenge. For instance, there is a considerable number of interdisciplinary studies published in recent years that explore the relationship between gender and science, making visible those subjects previously rendered invisible to history. There are, however, other invisibilities in the history of science that remain neglected. These invisibilities include field and laboratory assistants and collectors, museum staff, journalists, writers, tourist guides, patrons, publishers of science (non scientists) and private institutions, together with scientific authors that remain obfuscated within or completely absent from bibliographic references and end notes. Rediscovering scientific actors (individual and collective; public and private), theories and projects, and understanding the reasons for their occultation, demand a permanent and innovative interdisciplinary and comparative research endeavor. This is why, using different kinds of primary and secondary sources; combining methods used by different social sciences, such as the history of science, and gender studies; applying actor network theory and social network analysis; and uniting apparent disunities, we will identify, reveal and contextualize names, theories, practices and projects belonging to different humans and natural sciences, between late 19th century until more recently. Engaging comparative, cross-disciplinary and complementary examinations of the matter, this session will capture, for the first time, the state of the art of this fascinating, demanding and inspiring research field within the history of science, whilst making recent research results on this topic readily comprehensible to a wider public. We propose to establish a new - holistic and integrated - way of looking into the past: a new way of doing (in this case) history of science, so as to illuminate some of its persistent shadows.

Rocha, Gustavo Rodrigues (Universidade Estadual de Feira de Santana)

“Rejected Knowledge” and Shadow Episteme in the Modern System of Knowledge

My research is on the construction, circulation and dissolution of worldviews in science, beginning with my master’s thesis on the history of atomism, continuing with my research project on the history of modern cosmology at UEFS (2009-2011), and afterwards with my PhD on the history of the foundations of quantum theory and its popularization in 1970s around the San Francisco Bay Area. My trajectory led me to investigate the history of modern university in its dialectical relation to this not integrated epistemic shadow/residue. My attention has specially been drawn to two aspects of these epistemic shadows: how they have addressed the problems of i) meaning within the modern system of knowledge, in the sense of Viktor Frankl’s “ultimate meaning,” or Paul Tillich’s “ultimate concern,” or Max Weber’s “Sinn der Welt” (which resists “objectification”) and ii) unity within the modern system of knowledge (which resists “specialization”), i.e., transdisciplinarity, as a response to the split of rationality, expressed as the division of the three cultures: humanities, social sciences and natural sciences; the fact/value dichotomy; and the conflict between science and religion. I will thus present in my paper some interesting lessons I’ve learned by investigating the Sursem as my case study, an

SATURDAY 15 SEPTEMBER, 11.00-13.00

alternative research initiative that gathered around 40 top researchers from different backgrounds for about 15 years around the subversive concept (against the background of mainstream neuroscience) that the brain does not produce the mind (but rather sort of filter it).

Pérez Sedeño, Eulalia (Consejo Superior de Investigaciones Científicas)

Looking at the sky and teaching from the earth

Looking at the sky and teaching from the earth Astronomy has a long tradition. Not only are there different footprints in prehistoric caves that manifest the interest of the stars, but also certain traditions from far back were developed. Astronomy has historically been a discipline favorable for women. Even in ancient times, women were admitted to some scientific-philosophical schools like the Platonic or Pythagorean. And the contributions of many "mothers" "wives" or "daughters" as Maria Winkelmann Kirch, Caroline Herschel or Maria Mitchell are well known. In the late nineteenth century, increased funding and the provision of a set of new techniques, especially photographic, allowed undertaking a number of projects and attention was paid to certain areas of study previously neglected, as variable stars. But if astronomical observation and research is important, so is its teaching, thanks to which new researchers and professionals are trained. In this field, there have been women who have developed an important teaching profession, who have not been sufficiently 'revealed'. In this work we recover the magisterium exercised by some Spanish astronomers. They were pioneering before the takeoff of astronomy in Spain, that is due, mainly, to a series of actions taken in the last third of the twentieth century; and we will analyze the multiple knowledge that they developed and we discuss the difficulties they faced.

Abrams, Ellen (Cornell University)

Invisible Labor in American Mathematics: 1894-1945

During the first half of the twentieth century, American Mathematics grew from an upstart, nascent enterprise into a well-established program of international renown. In this paper, I explore two modalities of hidden labor in the growth of American Mathematics: the hidden labor that made growth possible and the labor that became hidden due to the coupling of growth and exclusivity. When, in 1894, the members of the New York Mathematical Society voted to change the name of their organization to the American Mathematical Society (AMS), they faced the challenge of making mathematics a nation-wide endeavor. Often unable to attend East Coast meetings, mathematical participants across the country struggled to be visible in a Society geographically centered around New York and New England. Mathematics was made accessible across space, however, through the work of local organizations, publications, and lending libraries. Yet as the growing AMS narrowed its focus from promoting interest in mathematics to supporting mathematical research, the term "mathematician" became increasingly exclusive. Teachers of mathematics and avocational participants, including many women who had been active members in the Society, but were often denied official credentials, remained in the shadows. In the archives of mathematical institutions and of individual mathematicians, I have found traces of these shadowed historical actors who were both essential to and excluded from the growth of American Mathematics.

Albuquerque, Sara (Universidade de Évora)

Depicting the invisible: Welwitsch's map of travellers in Africa

In the communication I will address a 19th century African manuscript map which has hitherto remained 'invisible'. This manuscript was produced by Friedrich Welwitsch (1806–1872), an Austrian botanist at the service of the Portuguese government, and held by the National Museum of Natural History and Science, University of Lisbon Museums/Museu Nacional de História Natural e da Ciência, Museu da Universidade de Lisboa, Portugal (MUHNAC). This historical document contains names of several travellers, many of them 'invisible' explorers, located in different parts of the African continent, picturing the relationships in both a visual and geographical way with notes and relevant historical

SATURDAY 15 SEPTEMBER, 11.00-13.00

observations. Welwitsch, as so many contemporary fellow botanists, was in contact with many scientists, exchanging not only correspondence, but knowledge and collections. This map is a key document, a true hub of Welwitsch's network of knowledge in which the scientific networks, the types of actors, interactions, methodologies and practices of botany are revealed providing insights into the botanical exchanges that contributed to the making of Welwitsch's African collections.

Krivosheina, Galina (S. I. Vavilov Institute for the History of Science and Technology, Moscow)

Invisibilities in Soviet Science: A Case of Anatolii Bogdanov

In the present paper, drawing on the example of Russian zoologist and anthropologist Anatolii Bogdanov (1834–1896), I tried to analyze the factors that made this popular man of science essentially invisible for Soviet historians of science. Bogdanov was one of the most original and industrious figures in Russian science of the second half of the 19th century. His students occupied chairs of zoology in almost all Russian universities, he established several scientific societies, organized a number of grand scientific exhibitions and some new public institutions, including Polytechnic Museum and Moscow Zoological Garden. He was also one of the founders of physical anthropology in Russia and a chair of anthropology in Moscow University. Nevertheless during Soviet period his contribution to Russian science was strongly underestimated and his name was rarely mentioned by historians. The reasons for this stem from a particular tradition of Soviet ideology and historiography to divide all actors of the past and present including men of science into “proletarian”, or “democratic” ones who were to be aggrandized and “bourgeois” ones who were not worth mentioning. Bogdanov belonged to the latter since during his lifetime he had a misfortune to provoke displeasure of some of his liberal colleagues, especially Kliment Timiriazev who was an icon of Soviet ideology. In addition I'll analyze Bogdanov's personality and background in order to reveal additional conditions that strengthened his invisibility.

I101 HISTORY AND FOUNDATIONS OF MATHEMATICS AND THE IDEA OF UNITY

Location: IoE – Room 780

Chair: Falconer, Isobel

Castells, Marina (Faculty of Education - Universitat de Barcelona)

History of Science in the narrative and activities design of a Teaching Science Sequence about Galilean Relativity. Levels, Illustrations and Framework

The History of Science (HS) has been fundamental for the development of the of Science Education and it has been present in the Science Teaching Learning Sequences (TLS) in various ways. We will reflect about the possible roles of the HS in the narrative of a TLS in Secondary Education or Pre-service Science Teacher Training in our XXI Century times. How the HS could be used at several levels for a narrative of a TLS will be illustrated through several classroom sessions and activities about Galilean relativity designed and inspired mainly in the Dialogues of Galileo. These levels can be, among other, a source of inspiration for a particular science teaching narrative, the specific narrative of a TLS or any part of a TLS or unit, the inspiration of some specific tasks carried on in science classes. We don't neglect the possibility that HS science could be the inspiration of an ongoing project during a large period of time in a specific group class or course, or also, that in a wider project of a school the HS could be the centre of an interdisciplinary approach. Our framework is mainly based on research about students' conceptions in science (Saltiel & Malgrange, 1980); Modelling in science teaching-learning (Couso & Garrido, 2016) and 'teaching based-in/on-context' (Gilbert et al., 2011).

Herreman, Alain (Université Rennes 1)

How much is "quatre ou cinq opérations"? Re-reading the first paragraphs of Descartes' Géométrie, 1637

This paper proposes a re-reading of the first paragraphs of Descartes' Geometry. We will start from the interpretations that have been given of the "four or five operations" considered. Particular attention will be paid to the conditions for the possibility of putting problems into equation and reducing geometry to constructions from segments. We will discuss several interpretations of these paragraphs.

Masson, Thierry (Aix-Marseille University)

The role of Mathematics in Natural Sciences: how History of Science sheds some light on this "marriage of convenience"

It is commonly assumed that Mathematics plays an essential role in many branches of Natural Sciences, as the "language of Nature" (G. Galilei). It is also agreed to be surprised by "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" (E. Wigner). During 6 years, I have had the opportunity to give courses on the role of Mathematics in Natural Sciences in the Master "Philosophy and History of Fundamental Sciences" at the Aix-Marseille University. In opposition to Wigner's view, one of my thesis during these lectures what to convince my students that Mathematics are not so well implemented and, even worse, essential, in many branches of Natural Sciences, for instance in Chemistry and Biology. Only Physics really uses all the ressources of the mathematical specificities, namely "counting" on the one side, and "structuring" on the other side. I would like to explain how it was important and essential for me to use (and misuse?) history of sciences at large during my lectures to illustrate this point with a convincing argumentation based on examples.

van Helden, Alice (Aix-Marseille Université)

Einstein and Schrödinger: two different paths in the criticism of the Copenhagen interpretation of quantum mechanics

Picture yourself the year 1935. Apart from the political war, a scientific battle has been raging for 30 years. Its trigger was the birth of quantum mechanics and now the whole paradigm of modern science – and maybe even our daily worldview – is at stake. The dominant side, now

SATURDAY 15 SEPTEMBER, 11.00-13.00

called the Copenhagen interpretation, doesn't mind giving up the reality of physical objects itself to describe the experimental oddities. On the other side, a handful of opponents amongst whom Albert Einstein and Erwin Schrödinger. The Copenhagen physicists would lump them together as “conservatists”, but would anyone who knows these two men hold that they were afraid of change? In 1935 they both published an article partly inspired by their epistolary correspondence of that summer, and these two publications – the EPR paradox paper and the “cat paper” – were able to shake the dominant thought. Note that the reasons why they proposed alternate interpretations of quantum mechanics were not quite similar. They had actually as much disunity as unity in their struggle against the dominant point of view. We might find in their unity a reason to keep questioning the present quantum theory, which lays its foundations on the Copenhagen interpretation. And on the other hand, analyzing their disunity will provide us with a more subtle understanding of these two giants of physical thought, and we might find that if so different minds came to the same questioning through different paths, there may actually be something to see there.

SATURDAY 15 SEPTEMBER, 11.00-13.00

S65/1 TRIBUTE TO MASTERS: RUSSIAN AND SOVIET HISTORIANS OF SCIENCE OF THE 19TH AND 20TH CENTURIES

1. HISTORY OF PHYSICS AND TECHNOLOGY

Location: IoE – Room 784

Chair: Volkov, Alexei

Organiser(s): Bayuk, Dimitri, and Volkov, Alexei

The new approach to the history of physics manifested in the presentation of B. M. Hessen (Борис Михайлович Гессен, 1893 – 1936) “The Socio-Economic Roots of Newton’s *Principia*” at the Second International Congress of the History of Science in London considerably influenced the work of numerous Western historians of science. Unfortunately, for a number of reasons (in particular, the Cold War and language barrier) a number of works of Russian/Soviet authors remained underestimated or, in the worst cases, unknown to their Western counterparts for several decades. After the fall of the Berlin Wall the situation started to change, yet it can be argued that numerous publications in Russian still have not been duly appreciated (or even known) to Western historians of science.

The participants of the panel were invited to make contributions on works of the most influential Russian/Soviet historians of physics and technology, in particular, B. M. Hessen, V. S. Gokhman (В. С. Гохман), S. E. Arshon (С. Е. Аршон), V. P. Zubov (В. П. Зубов), and I. D. Rozhanskii (И. Д. Рожанский). This is the way in which the major theme of the Conference, “Unity and disunity,” will be addressed: the speakers will discuss the closeness of approaches of historians of science who worked in Russia/USSR and in Europe in the 19th and 20th centuries and the disunity related to language barrier and to the political circumstances (Russian revolutions of 1917, Second World War, Cold War).

Hall, Karl (Central European University, Budapest)

Sarton’s rivals: Disciplinary dilemmas of history of science circa 1931

The Second International Congress of History of Science and Technology, held in London in 1931, has often been treated as little more than a proto-disciplinary moment for history of science. If George Sarton was the best-known advocate of professionalization in the Anglophone world, the turn to epistemological questions as constitutive of good method in history of science was dominated by philosophers, most prominently Alexandre Koyré. The most notorious participant in the London Congress, Boris Hessen, presented a Marxist thesis on Newton that was hostile to “idealist” methods, yet it has likewise been judged harshly qua philosophical propaedeutic for training latter-day historians of science. I want to propose an alternative meta-history that relocates Hessen in the curricular transformation of Soviet physics in the 1920s, and juxtaposes his concerns about the disciplinary functions of history of science with those of several obscure figures outside the Anglo-French nexus. Czech historian of mathematics Quido Vetter, Emanuel Rádl’s successor at Charles University, witnessed the Soviet delegation in London and despised its “apodictic” attitude, yet he maintained that “bourgeois” history of science “has already long ago taken notice of the social and economic aspect as well.” By shedding light on this and other (non) receptions of Hessen among Europeans in the 1930s—Aleksander Birkenmajer, Władysław Szumowski, József Ernyey, Ede Lósy-Schmidt, Valeriu Bologa—my intention is to highlight anxieties about disciplinarity itself and the potential mediating role of history of science in the post-1918 educational settings of the newly constituted European nation-states.

Drozdova, Darya (National Research University “Higher School of Economics,” Moscow)

Alexandre Koyré and Vasiliï Zubov on early modern science

SATURDAY 15 SEPTEMBER, 11.00-13.00

Western tradition of the History of Science often praises Alexandre Koyré as its forefather. Koyré is widely recognized thanks to his research in the Renaissance and Early Modern science. His claim about philosophical background of the Scientific Revolution of the seventeenth century produced a paradigmatic shift in historiography of science of the twentieth century. However, in Russian historiography of science we can find a scholar of similar stature, Vasilii Pavlovich Zubov, whose writings on the history of the medieval and modern science demonstrate a level of scrupulousness and depth similar to that of Koyré.

Zubov was almost a complete contemporary of Koyré. Being eight years younger, Zubov died one year earlier, in 1963. Like Koyré, Zubov was a historian and a philosopher deeply interested in historical development of the scientific and philosophical thought from Antiquity through the Modern Times. They both even studied the same historical figures: nominalists and rationalists in the thirteenth century, Leonardo da Vinci, Gassendi, Galileo. In the late 1950s and early 1960s they established personal relations and met several times at international conferences. Zubov was elected a member of the International Academy of History of Science in 1958 when Koyré was its perpetual secretary.

Given a certain intellectual similarity between the two great historians, convergences and divergences in their researches are worthy to be examined with focus on the development of the science in the Early Modern Times. Whereas they both recognized the leading role of philosophical ideas in transformation of scientific knowledge, Zubov paid more attention to artistic and technical dimension of the late Renaissance and early modern science when Koyré put an emphasis on theological aspects. Therefore, they works complement each other and give a multidimensional description of the history of scientific thought.

Fedorova, Olga (S. I. Vavilov Institute for the History of Science and Technology, Russia)

Ivan Rozhanskiĭ (1913–1994) and his work on Ancient Greek Science

Ivan D. Rozhanskiĭ (1913–1994) was a son of the prominent Russian physicist, academician Dmitriĭ A. Rozhnaskiĭ. He graduated from the department of physics and theoretical mechanics of the Leningrad Polytechnic Institute in 1935 and received his PhD degree in theoretical physics in 1940. However, he gained his reputation in a different field, namely, in the history of Ancient Greek and Hellenistic “science of nature”. He was well versed in humanities, became interested in the classic philology, and gained proficiency in four foreign languages, namely, Ancient Greek, Latin, German and English, thanks to the education he received in his family. Since 1967 to the end of his life he was affiliated with the Institute for the History of Science and Technology of the Academy of Sciences of the USSR (since 1991 -- S. I. Vavilov Institute for the History of Science and Technology, Russian Academy of Science), where he defended his dissertation on the history of ancient natural philosophy and obtained his “Doctor of Science” degree (1974). In 1970 he opened a regular research seminar on ancient science and philosophy for researchers and graduate students which he directed through 1970s and 1980s. Thanks to his training in physics and humanities and his knowledge of ancient and modern foreign languages Rozhanskiĭ played an outstanding role in both research and training of graduate students. In his work he used the principles of analysis of ancient texts adopted in classical philology. At that time he was the only historian of science of the period who worked directly with primary sources rather than with the translations of the texts into modern languages. He also was among the first historians who introduced methods of classical philology into the history of science and conducted the analysis of technical terms and scientific concepts (such as, for instance, *physis* and *homeomeria*).

Bayuk, Dimitri (Financial University under the Government of the Russian Federation, Moscow)

Translating and printing projects in the Russia of the first third of the twentieth century

Russia's tendency towards self-isolation from the rest of the world has always been among the most important factors in determining its national culture. In some periods this tendency took

SATURDAY 15 SEPTEMBER, 11.00-13.00

on extreme forms, while in others it was more relaxed. The establishment of the Academy of Science in St. Petersburg in 1724 was a serious attempt to reduce the degree of isolation, even though initially the Academy had to function in Latin, which later changed to German and then to French. Making Russian the language of science was another attempt to render Western scientific culture in a more accessible form. Tragically, the climax of this translating and printing activity fell on the years when Russian politics took a turn for the worse: the Soviet transformation of the state in the late 1920s and 1930s ensured its total isolation. Nevertheless, it was the 1930s that saw the appearance of an unprecedented corpus of scientific literature in the vernacular, covering mathematics, physics, biology, architecture, philosophy and linguistics. Practically no one is now aware that the majority of key texts on the theory and philosophy of architecture first appeared in Russian translation in the 1930s. An outstanding example is Vasilii Zubov, the first translator of Vitruvius' *De architectura* and Daniele Barbaro's commentaries to it and also of some works by Leon Battista Alberti, including *De re aedificatoria*, *De re ludi mathematici* and *Descriptio urbis Romae*. Some of these are first translations into any foreign language. Vasilii Zubov's name in this context is especially interesting, because through his work he established connections between three different fields: history of art, history of philosophy and history of science.

A different, although related example, is provided by the Newtonian tradition. Evidently, tentative efforts to translate Isaac Newton's fundamental works had been undertaken as early as the 1860s – 1870s, at the same time as the first translations of Leibniz's writings were published. The first parts of Alexei Krylov's version of Newton's *Principia* were published in 1914, soon after World War I had begun. At exactly the same time it emerged that somebody else, hiding under the fictitious names Chakalov / Chekalov / Chekanov, was working on an alternative version, which was only ready for publication in 1938. This project was closely connected with Boris Hessen, Adolf Yushkevich, and Nikolay Bukharin.

By the time of World War II all these projects had been halted and their participants either executed or sent to labour camps, or at least deprived of the possibility of productive work. These tumultuous events had a profound effect on Russian/Soviet cultural life in general, leading to its deterioration in the long term. But the fruits of the period have unprecedented value which is still to be discovered.

Gouzévitch, Dmitri (CERCEC, Ecole des Hautes Etudes en Sciences Sociales), and Gouzévitch, Irina (Centre Maurice Halbwachs/EHESS (Paris))

Pondering on the phenomenon of “ideologically charged science”: some reflections on the historiography of Soviet science and technology

First theoretical attempts to deal with the concept of ideologically charged science for the Soviet context were made in the Perestroika time (i.e., in 1986-1990). They implied that any scientific discipline is intimately related to a couple of other information blocks: (a) philosophical reflection of the discipline methods and results, and (b) its reception by public consciousness (including general interest press and visual arts). The concept of ideologically charged science is a form of admitting that these two blocks could reciprocally influence the scientific discipline itself, establishing what methods it may use and what results it can obtain. Here can be found roots of “proletarian” or “Aryan” or “Orthodox Christian” science. Crucially important for the Soviet historiography of science and technology happened to be Lenin's paper on the party principle in the literature, whose basic ideas were generalized and applied to other (virtually all) domains of human activity, and, in the first term, on science and technology. A fraction of Soviet historians adapted to this system, just hiding under the “ideologically correct language” the essence of their research, whereas another fraction even found a pleasure in actively implementing the decrees sent from the authorities into the very body of science. Thus, the requirement to build a scientific research upon the Marxist-Leninist philosophical basis became the conventional background, while the principle importance was assigned to the sequence of the intermitting political campaigns for “formation of proletarian science,” “leading role of Russian science” and against “self-humiliating overestimation of the West

SATURDAY 15 SEPTEMBER, 11.00-13.00

(низкопоклонство перед Западом)” and “neglect of national priority in science (космополитизм в науке)”. These ideological moves were accompanied by self-isolation of the Soviet scientific community. While the history of technology as a field of research was growing worldwide, this discipline was not properly developed in the Soviet Union (similar processes took place in Italy and Germany). As result, the research conducted in the USSR and, later, in the countries of Communist Block, remained virtually unknown in the West; rare attempts to take them into consideration were often disappointing, since they contained a number of factual errors and overestimation of the importance of Russian and Soviet contributions. The authors encountered this phenomenon in the early 1990s when they moved from Soviet Union/Russia to France. Since then we stressed that (a) the Soviet/Russian historiography of science and technology is highly valuable and, to a large extent, reliable; (b) to operate with the Soviet/Russian secondary sources one should apply a particular technique of reading and interpretation. In our paper we will provide examples of detailed analysis and relevant approach to Soviet historiography (steam engines, Nartov’s machines, railways).

I131 MEDICINE 1

Location: IoE – Room 790

Chair: McGuire, Coreen

Beck, Catherine (Independent Scholar)

'Wretched and Expecting': Madness, Reputation and the Patronage of Sanity in the Royal Navy 1740-1820

In 1801, Lieutenant Charles Wintour wrote to John Markham at the Admiralty, asking to be removed from his position. Wintour suffered from a debilitating depression and nothing except the prospect of serving in 'some quiet station' or being 'allow'd to retire altogether from the Service', could prevent his 'terrible infirmity of mind' causing him to meet a 'fatal & dishonourable end'. The letter, although not unusual in type, is striking in its honesty and desperation. Wintour signed off: 'May you Sir live long and free ever from Mental Misery, prays your Wretched and Expecting Charles F Wintour.' Markham granted Wintour's wish but when the lieutenant recovered, Markham refused to offer further patronage. Revealing mental instability could significantly damage an officer's reputation and career. The navy had a pragmatic approach to mental health but in the competitive environment of the late eighteenth century, the smallest character flaw could prompt a patron to sever a connection. Courts Martial could be lenient in the sentencing of men who exhibited odd behaviour, loss of reason or unusually low spirits, but still often dismissed them from the service. Yet, many men also returned to their ships after treatment for insanity or having attempted suicide, and others served for years while suffering from significant symptoms of derangement. This paper considers the collision of prejudice and tolerance of mental instability in naval society and how this essential disunity of practical and societal expectation fed into wider scientific ideas about insanity in the long eighteenth century.

Martins Marcos, Patrícia (University of California, San Diego)

Making the Material Body: Religion and Medical Professionalization in the Long Eighteenth Century (1720-1808)

Eighteenth-century medicine was an eminently protean science. The naturalization of sickness and the secularization of healing extended the reach of medical analysis beyond the human individual. Concerned not just with bodily disease, the practice and theory of medicine provided diagnostic and therapeutic methods for pressing issues of statecraft. Focused on Portuguese Empire, I demonstrate how physicians detailed ways of engaging with the cause of medical, social, economic and imperial reform. This effort hinged on these physician's ability to redefine the body as entirely material and physical – and thus medical. The idea of the natural body, therefore, displaced theology from the realm of healing and progressively medicalized the management of the body politic. My work explores how Luso-Brazilian physicians embarked on this "medico-political" mission and details their growing political ambitions for medicine as a science of all bodies – individual, royal, political, social, imperial. Specifically, I explore how physicians utilized medicine as a practice, a vocabulary, a heuristic, and a methodology to pursue medical, political, and imperial reforms. This, I argue, constituted a means of expansion of the physician's social import, a form of legitimizing their political role, and a device to prop up their own reformist agenda. The outcome, while failing the total transformation of medical worldviews and practices envisaged, led to the gradual professionalization of the medical vocation, and the systematic secularization of government, commerce, and medical institutions, as well as a new colonial paradigm focused on converting indigenous populations into royal subjects rather than Catholic devotees.

Perez Perez, Nuria (Scientific Communication Observatory, Pompeu Fabra University, and Center d'Història de la Ciència, Universitat Autònoma de Barcelona)

The relationship between the naturalist Reverend Joseph Townsend and the surgeon Antonio de Gimbernat's family, united by common interests

SATURDAY 15 SEPTEMBER, 11.00-13.00

The Reverend Joseph Townsend (1739 - 1816), visited Spain during the reign of Carlos III (1759-1788) and left as a chronicle of his trip a well-known work entitled *A Journey through Spain* in the years 1786 and 1787. Ten years later Townsend published the second volume of *A Guide to Health* (1796) in which he included a detailed description of the surgical method for the treatment of the crural hernia discovered by the Catalan surgeon Antonio de Gimbernat (1734-1816). Traditional historiography has considered the surgical method proposed by Gimbernat as the greatest contribution to eighteenth-century Spanish surgery with international recognition. Townsend became diffuser of contributions and scientific institutions of the Spanish illustration. In turn, he met the third Gimbernat's son, the naturalist and geologist Carlos de Gimbernat (1768-1834), author of *Geographical Plans of the Alps and Switzerland with their descriptions* (1803), the first geological map of Switzerland and one of the first European maps of these characteristics. Townsend and Carlos de Gimbernat had common interests for gas chemistry, geology, fossil mollusks and paleontology. This communication will try to demonstrate that both scientists, Townsend and Antonio de Gimbernat actually established a solid friendship.

Vermeir, Koen (SPHERE (CNRS/Paris7))

Charlatan epistemology

In the spring of 1697, wonder-workers cured many citizens of Rotterdam by what was called "piss-work". Instead of attending to the patient, healers used a secret powder to treat the patient's fresh morning urine, and through a sympathetic interaction, the patient would be cured. Interestingly, the charlatans did not only draw censure from established physicians trying to draw boundaries between genuine and false medicine, but some physicians also supported the new cure, taking the charlatans in their fold. I will use this case study to discuss the epistemology of the charlatan. Charlatans have caused a historiographical headache for the history of medicine and the very category of "the charlatan" has been questioned again and again because of the intrinsic dangers of projection, anachronism and inappropriate judgment that seem to be embedded in the word itself. Instead of repeating the rhetoric of imposture and credulity, historians of medicine have recently tried to discover the "real" historical charlatan behind the polemics, focusing especially on 16th century historical actors who self-identified with the label of charlatan. In order to understand the charlatan and his role in society in different periods, however, we cannot ignore this divisive rhetoric, which often dominated the reception of charlatans, and created strong divisions between medical practitioners. Nevertheless, key notions such as imposture, credulity, imagination and deception are concepts that have to be historicized if we want to come to a better historical understanding of the charlatan. This approach will lead us beyond anachronism and will open new perspectives for the history of charlatanism, and the history of medicine more broadly. In the case of the piss-work, I will show how the traditional social disunity which divided charlatans and official physicians was often overcome in individual cases, and it was replaced by an epistemic disunity between different medical traditions.

SATURDAY 15 SEPTEMBER, 11.00-13.00

S38/2 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES: CRITICISMS AND CHALLENGES

Location: IoE – Room 731

Chair: Silva, Matheus Alves Duarte

Organiser(s): Silva, Matheus Alves Duarte (EHESS, Paris)

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945.

Cozzoli, Danielle (Pompeu Fabra University, Barcelona), and Capocci, Mauro (Sapienza University)

Italian Navy Physicians and the Circulation of Knowledge between Europe, the Americas and Africa (1885-1945)

Our paper aims to contribute to the study of the circulation of medical knowledge between Europe, the Americas and Africa, in the period between the Scramble for Africa and the end of the Second World War. We draw on Sebastian Conrad's notion of Global History understood as the study of the global connections in the light of the evolution of how the world was integrated. This approach calls for the inclusion of postcolonialism within Global History, and, therefore, it points at overcoming diffusionist models as well as a centre/periphery model. Our paper focuses on the role of Italian Navy physicians. As early as 1901, in the emigration service ships Navy physicians were in charge of controlling the health of passengers, but also of providing statistical reports on Italian emigrants. Moreover, they visited hospitals and biomedical institutions in North and South America collecting information worldwide. At the same time, military physicians worked in the African colonies. In the Nineteenth and Twentieth century the Italian colonial officials compared the peoples they met in East Africa with the poorest people of southern Italy. Our paper explores how this perspective influenced Italian physicians and

SATURDAY 15 SEPTEMBER, 11.00-13.00

medical colonialism in evaluating indigenous knowledge, and it contributed to the circulation of indigenous and Western medicine between Europe, the Americas and Africa.

Nosaka, Shiori (EHESS, Paris)

Controlling microbes at the border: Hygienic practice and bacteriological knowledge in imperial contexts around cholera epidemics in Japan (1879-1899)

This paper aims to consider a relationship between knowledge production, its practice and imperial power balance by examining cholera epidemics controls carried out by the Japanese state. The history of quarantine inspection in modern Japan is often linked to the struggle for the revision of unequal treaties imposed by western powers in 1858. Before their revision in 1899, the Japanese hygienic officers couldn't control western ships suspected of the presence of cholera patients. According to this account, Japan is represented as a passive actor, but historical records show that there were negotiations, compromises, and also conflicts between Japanese officers and foreign ship crews. This paper proposes two approaches allowing us to analyze the complexity of changing power relationship around hygienic controls of cholera. The first one is at the epistemological level and concerns the emergence of bacteriological theory. The new way of identification of cholera disease, tracking germ carriers, led to the development of epidemiological research requiring a management of information and technical devices and their rapid circulation for the prevention of epidemics. The second approach is at the political level, and focuses on foreign characters found in medical and political discourse about cholera controls. It explores a mechanism of stigmatization of cholera patients and specific area and its naturalization during the development of imperial settings. These practices and ideas will provide a reflection on the setting of circulation routes of knowledge, technics and information, and its mode of regulation in a multiple power balance of modern imperial context.

Dutra, Daniel (Universidade Federal do Rio de Janeiro)

Constructing spaces from a distance: Pierre-François Keraudren and voyage protocol in French Naval Medicine in the first half of 19th century

François Pierre Keraudren (1769-1858) held the post of inspector general of naval medicine from 1813 to 1845. Because of that, he was in charge of writing instructions to other Officers, who would command scientific expeditions, and of evaluating their accounts regarding health control abroad. Keraudren was, therefore, a key element in the shaping of the spatial range within which French Naval medicine would unfold itself. By establishing travel procedures, he set conditions through which scientific practices and cognitive appropriation of space were both institutionally and conceptually validated. This paper aims at conceiving Keraudren as a part of an ongoing process of construction of knowledge, which was inherent to the French Navy institutional framework and to French naval medicine as a field with its own disciplinary scope of subjects and practices. In order to do so, different kinds of writing are analysed, such as his manuscripts, his treatises on diseases, and his reports. Writings by Officers who have interacted with him, such as Louis Duperrey (1786-1865) and Théodore Eydoux (1802-1841), are also analysed, so that it might be possible to verify a chain of construction of knowledge in which those Officers were not passive agents who would just follow previously defined standards, but ones who provided new formulation to Keraudren himself. Being more than a 'centre of calculation' whose prime standards would eventually remain stabilized, Keraudren faced the challenge of continuously updating construction of knowledge in an institutional context defined by an increasingly wider scope of controlled maritime experience overseas.

Stráner, Katalin (University of Southampton)

Science and the Habsburg Imperial Capital City: Karl Vogt in Vienna and Budapest, 1869

As part of a lecture tour in the Habsburg Empire, the controversial German zoologist Karl Vogt gave a series lectures in Vienna and Pest in December 1869. Vienna was at this time the Habsburg imperial capital whereas the city of Pest was still a few years away from becoming Budapest, the Hungarian capital city. The marketability of controversy highlights the role of

SATURDAY 15 SEPTEMBER, 11.00-13.00

public events by established members of the scientific community. Moreover, it draws attention not only to the imbalance of political power, cultural capital, and a developmental asymmetry between the two cities, at the same time reinforcing the significance of links between the two national capitals of the Habsburg imperial space. Reactions from the audience show that there was a network of agents active in brokering knowledge and information within and between the scholarly communities and the urban publics. The role of the urban press and its readers is considered crucial when science and scientific knowledge leave the institutional context. This paper argues that in the Habsburg imperial space, the power relations of the diffusion, transfer, or mobility of science, were more complicated than Vogt's East-bound route within the Habsburg Empire. Through a focus on Vogt's audiences the paper examines if the circulation of knowledge was indeed as asymmetrical in the Habsburg Empire as it has been suggested before, proposing a case for a focus on the co-production of knowledge between various imperial and scientific elites rather than reinforcing the idea of one centre and multiple peripheries.

Secord, James (University of Cambridge)

Circulation or communication?

Circulation, a term drawn from the world of currency and commerce, has become the key concept of the so-called 'global turn'. For all its fruitfulness, however, circulation poses fundamental problems as a way of thinking about science. In this paper, I will suggest that we would be better to focus on questions of communication. On the one hand, circulation is too general, for things can and do circulate without human actors and without the issues of social power that communication necessarily involves. On the other hand, circulation is too specific. By implying the possibility of a distinction between 'making' and 'moving', an understanding of science as circulation means that diffusionist models can too easily re-enter through the back door. It is hard, for example, to see 'circulation' taking place when an observation is made or a thought recorded in a notebook. Circulation is only part of the communication process, and the part that is least specific to the problem of knowledge. In extending the bounds of history of science, an approach grounded in communication offers a better starting point for understanding encounter, negotiation, conflict, dialogue and other forms of intercultural exchange.

S43/1 WHEN SCIENCE DIPLOMACY DIVIDES

Location: IoE – Room 739

Chair: Turchetti, Simone

Organiser(s): Robinson, Sam, and Adamson, Matthew

The concept of science diplomacy has gained traction in recent years, as the foreign offices of various nations have appreciated and begun reassessing the influence and importance of the soft power of science and technology. Scientists themselves are also recognising the diplomatic roles they have played historically and how they have contributed to global relations. This symposium (divided in five sessions), focusing on the history of science diplomacy, draws together a variety of scholars exploring different aspects of science, technology, and diplomacy at the international and transnational levels. Rather than merely echoing and reifying the scientists' own accounts about the benign effects of science diplomacy, they challenge them with provocative case studies and newly proposed interpretative frameworks.

Adamson, Matthew (McDaniel College)

Science Diplomacy to Stop the Science? Nuclear Promotion and Safety, IAEA Experts, and Reactor-Building in Morocco, 1978-2008

A vital subject in the study of science diplomacy is that of international experts. From where comes the authority with which experts act, and how is expert authority exerted in evaluative and decision-making processes? This paper examines the scientists and engineers who fill expert roles in the International Atomic Energy Agency (IAEA). In particular, it examines the case of IAEA reactor experts in Morocco, who contributed in the 1980s to the demise of the project to build Morocco's first research reactor, and who, 20 years later, contributed to lifting the same project off the ground. Using sources from IAEA and Moroccan archives, the study examines not only the channels of communication between international agencies (IAEA, UNESCO) and national institutions, but also the roles assumed by various individuals involved in advocating for or warning against the building of the reactor at a particular site—and how the IAEA experts' roles reflected the role the IAEA played in establishing and maintaining international standards for research reactor safety and security. In the end, nuclear experts positioned at a diplomatic interface between an international organization (the IAEA) and a member state (Morocco), working in the framework of the research reactor nuclear safety regime provided by the IAEA, brought a conflict between two Moroccan institutions to an end, and, through their actions, triggered new national institution building in Morocco. The result was not only a functioning research reactor and an agreed-upon location to site it, but new, international institution-building which has made the now-functioning Moroccan nuclear facility an international center important in many areas of research.

Doel, Ronald E. (Florida State University)

Stimulating Natural Science Research in Cold War Buenos Aires, Santiago, and Accra: The International Geophysical Year (1957-58) in Comparative Global Contexts

The International Geophysical Year is widely recognized as one of the largest and most significant global scientific undertakings ever attempted until this time. Involving tens of thousands of scientists in over sixty nations, the IGY was at once a scientific effort—a coordinated effort to address key questions about the structure and properties of the planet—and an exercise in international diplomacy. From the start, IGY research programs were fashioned and shaped by scientists working closely with national government officials to hammer out opportunities and compromises, including locating field stations in geopolitically strategic locations and creating opportunities for transnational scientific exchanges amid the deep divides of the early Cold War. Parts of the history of the IGY are increasingly well-known: for instance, the difficult paths that leading U.S. geophysicists walked to promote innovative research programs while satisfying military patrons concerned about national security, the role

SATURDAY 15 SEPTEMBER, 11.00-13.00

the IGY played in creating the space age, and the ways that restrictions the U.S. Department of State placed on leading American scientists ultimately contributed to mainland China's withdrawal from this initiative (increasing the isolation of Chinese scientists just before the Cultural Revolution). Significant histories of IGY undertakings and diplomatic intrigues have been pursued in several national contexts, including China, Great Britain, Canada, and the Soviet Union. But these are only a small fraction of the 66 nations that participated in the IGY. Far less is known about the impact of this global undertaking in other nations whose scientists took part. Thus many significant questions—for the history of science and diplomatic history—remain poorly explored. For instance: how did involvement in the IGY affect the political and national standing of scientists in Eastern European nations, including Poland and Czechoslovakia? Did the infusion of funds for IGY programs help convince national leaders in Argentina and Peru to invest more in scientific research efforts, and in what ways were scientists able to articulate visions of scientific internationalism to state leaders? This paper—drawing on archival and oral history evidence—will explore these issues and illuminate potential internationally comparative studies of recent history.

Castelo, Claudia (University of Lisbon)

Africa as a disputed site for social research in the era of decolonisation: CCTA-UNESCO competition

The end of the Second World War opened a time of great expectations for the colonial territories. Firstly in Asia and later in Africa, the decolonisation process started making its way. At the international level, United Nations pointed out self-determination and human rights as top priorities in its action. UNESCO, the UN affiliated agency for education, science and culture, brought together in 1950 a first group of experts to issue a statement on race problems, who defended that biological differences between members of different ethnic groups had no relevance to problems of social and political organisation. In Africa, the European powers responded to the anticolonial claims, both from international and local actors and institutions, with developmental policies intended to legitimize and reinvigorate empire (Frederick Cooper). Science and technology were mobilised by the imperial and colonial states as never before to support economic and social development (Joseph Hodge; Helen Tilley). Trans-imperial coordination at the regional level was intensified. The Commission for Technical Co-operation in Africa South of Sahara (CCTA), created in 1950 (and established at an international convention in 1954) embodying the “cooperation spirit of all powers with responsibilities in Africa”, was a intergovernmental body (of Belgium, France, the Federation of Rhodesia and Nyasaland, Portugal, South African Union and United Kingdom) dedicated to the promotion of joint action and practical aid “for the benefit of all the peoples of the sub-continent”. Besides its rhetorical aims it was a pragmatic response to the increasing international involvement in the technical and scientific aspects of African development (John Kent). CCTA followed with concern the US initiatives regarding regional studies in Africa and set up a research program tailored after the UNESCO's one, to emulate its ideas of development but also to question its positions on racial difference and colonial situation. CCTA General Secretary attended with observer status the Conference about Regional Research in Africa held at Princeton University (USA) under the auspices of the Carnegie Foundation (October 1953), and the UNESCO Expert Conference on Social Aspects of Industrialization and Urbanisation in Africa South of Sahara (Abidjan 1954). CCTA had an implicit diplomatic agenda of countering the critics addressed to the imperial and white supremacy powers in Africa South of Sahara and to promote a public image of joint commitment – its recommendations should be adopted by unanimous decision of all member governments – with the enhancement of urban and rural African populations' well-being and the defence of West civilisation interests at large. Against that backdrop, and taking into account the history of the social sciences entanglements with colonialism, this paper intends to assess CCTA motivations, initiatives (namely the Inter-African Social Sciences Conference held at Bukavu in 1955), and recommendations regarding social research in Africa; the internal discussions between the member governments' delegates (that represented

SATURDAY 15 SEPTEMBER, 11.00-13.00

different national interests and points of view); the dilemmas of the member governments that attended both organisations (such as France and United Kingdom); and the interactions between CCTA and UNESCO.

Saxena, Manoj (KCL)

A Scientist of Consequence: Case Study of the AQ Khan Network in Pakistan

Pakistani scientist Abdul Qadeer Khan — better known as AQ Khan — is among the most significant proliferators of nuclear technology in history. Khan first rose to prominence after he departed for Pakistan in 1974 to meet the country's Prime Minister Zulfikar Ali Bhutto while serving as a senior scientist for the Urenco Group in Netherlands. After the meeting with Bhutto, Khan eventually joined the Pakistani nuclear program and served as a distinguished functionary of the state in successive military and civil regimes in Pakistan. During his tenure as a scientist in Pakistan, Khan managed to find common ground with several 'rogue states' and conducted clandestine science diplomacy in defiance of global norms as an instrument of the Pakistani state in order to aid his country achieve credible nuclear weapons capability. He was involved in nuclear proliferation to countries such as Libya, Iran and North Korea. His network was partially responsible for drastically altering the balance of power in Western, South and East Asia. Khan is now remembered as 'The Father of the Pakistani Nuclear Program' and has gained a status as a national hero in the country. Khan's case is notable in the context of science diplomacy since he, his network and the Pakistani state were quite actively involved in pursuing closer nuclear ties with a number of states but were also involved in hiding the true extent of their clandestine activities from other states and intergovernmental organizations. The true extent of Pakistani nuclear program was hidden even from the United States of America, which was an ally and a major provider of economic and military aid to the country. Khan traveled freely to countries such as China and even published scientific research through reputable publishers until he was finally subjected to international sanctions. His back-channel activity was aimed at providing his country with a competitive advantage vis-a-vis perceived rival India, which had overt nuclear weapons capability since 1974. The research will examine how AQ Khan — and his network — pursued science diplomacy for aiding the Pakistani state in a quest for gaining parity against India. It will also examine how the scientist and his network managed to enable other countries gain access to privileged nuclear information on a transnational and ideological basis. The selective nature of science diplomacy, and its subservience to national interests, is taken into account in the research.

Luciano, Erika (Department of Mathematics, University of Turin)

Jewish Intellectual Emigration from Fascist Italy: global aspects and individual fates (1938-1948)

The racial laws of 1938, which determined for Italian Jews the loss of civil and political rights, and the complete banishment from scientific and academic arenas, deeply impacted Italian mathematics, which suddenly lost outstanding figures like Levi-Civita, Volterra, Castelnuovo, Enriques and many others. Their dismissal triggered a series of institutional, epistemic and social changes in culture and scholarship, whose dynamics can be read in two perspectives: the global one, which views scientific change as a 're-organization of resource ensembles', trying to move beyond the classic discourse of cultural loss and gain, and the individual perspective, that of personal and professional destinies. With regard to this second perspective, we have to deal with a large and nuanced spectrum of experiences of purged mathematicians who decided to emigrate in Great Britain, Switzerland, US and South America looking for a space of intellectual survival. In this talk we will provide an overview on the biographical and professional experiences of some mathematicians belonging to the Italian school of algebraic geometry (G. Fano, B. Levi, G. Fubini, B. Segre and A. Terracini), who succeeded in fleeing Italy and in reconstructing their lives and scientific careers abroad, through the help of Jewish aid organizations and thanks to the international network of personal and diplomatic relations (the so-called migration chains). The aim is to point out - in the plurality of individual fates - some

SATURDAY 15 SEPTEMBER, 11.00-13.00

characteristics that identify in its entirety the phenomenon of Jewish intellectual emigration from fascist Italy after 1938.

1106 ASTRONOMY, SPACE AND PHYSICS

Location: IoE – Room 709a

Chair: Reeves, Nicky

Mathieson, Stuart (Queen's University, Belfast)

'I do not well see how scripture and science properly understood can well come into collision': Sir George Gabriel Stokes on conflict and harmony between science and religion

The nineteenth century was a period of astonishing developments in British science. Discoveries in geology and biology drastically changed how people understood the world and their place in it. Yet some of these changes had implications for other fields, including theology. Many conservative people of faith were perturbed by the apparent discord between science and religion, which had previously been understood to operate in perfect harmony, following the natural theology tradition of William Paley. This sense of discord was seized upon by a rising class of professional scientists, such as T. H. Huxley and John Tyndall, who wished to see their disciplines professionalised and secularised. Yet not all of Britain's prominent scientists shared this approach. Three of the most prominent Victorian physicists, Lord Kelvin, James Clerk Maxwell, and Sir George Gabriel Stokes, were vocal in their belief that science and faith coexisted harmoniously. Stokes, a Cambridge professor, was president of both the Royal Society, and the anti-evolutionary Victoria Institute. As one of Victorian Britain's leading scientists of faith, Stokes was the public face of science and religion in unity. This paper examines Stokes's work as a public scientist, with the Royal Society, at the Victoria Institute, and as a lecturer on natural theology. It uses Stokes to examine the processes of professionalisation and secularisation of the sciences, harmony between science and religion, and philosophical issues of what constituted science, 'properly understood', in Victorian Britain.

Andretta, Maria Giulia (University of Bologna)

The space race: from the first divisions to shared objectives

On the 3rd of October 1942, the A4 rocket stands on its ramp, ready for its first launch. These missiles, renamed V2, will be fundamental from a strategic point of view, and Adolf Hitler, thinking that they could change the fate of the World War II, will declare the projects of the Peenemünde base, coordinated by Wernher von Braun, of top priority. The rockets that bombed London in 1944 mark the beginning of the space age and on the ashes of the war, the winners recover the pieces of that technology and the human resources that will allow man to leave the Earth. The long journey that leads man on the satellite plays a strategic role in the history of the Twentieth century. Scientific and technological primates become the new tools of political propaganda in a climate made even tenser by the Cold War. The lunar challenge, with the first stages of Russian supremacy, with the contradictions of the German protagonists and with the rapid US run, begins to reshape the international world. The successes and failures prepare mission after mission the most extraordinary event in human history, the conquest of the Moon. The spirit of those years and the space race atmosphere reflect all the differences between United States and Russia above all in the methodological, technical and investment choices. However, starting from the Seventies, a series of collaborations for international projects will be inaugurated in a real reunification under the banner of scientific and technological progress.

Bukovskaya, Natalia (Tomsk State University)

The Development of Science in Russian "Atomic Closed Cities": 1950-1992

The Soviet government created system "closed administrative-territorial units" (43 units) with a secrecy order in the 50s – 60s of the 20th century. They weren't marked on maps the USSR. It was the political strategic decision. There were tasks: to develop of military industrial complex of the country, to create a nuclear branch and nuclear weapon. High technologies and advanced science were necessary for this purpose. There were "atomic closed cities" (Ural, Siberia). They started to create new technologies and the chain "science-technology –production". The unity of fundamental and applied scientific research was an important factor. The variety of sciences

SATURDAY 15 SEPTEMBER, 11.00-13.00

and experts was also necessary for the development of the nuclear industry, including physicists, nuclear physicists, chemists, mathematics and other. The closed cities became a platform for integration of scientific knowledge, for interdisciplinary research. The research laboratories, institutes, schools were created. How was the problem of specialists solved? At first, there were specialists from Moscow. Then, there was an educational system in closed cities created. The branches of the Moscow and the region institutes were opened. Two levels of specialists (scientists and engineers) were prepared there. Thus, the chain “science-education-production” was adjusted. On the one hand, there was higher standard of living, high concentration of intellectual resources in the closed cities. On the other hand, freedom of scientists was limited by the secrecy order; the population was exposed to dangerous influence of radiation and risks for health from accidents at the nuclear enterprises.

Bonifácio, Vitor (University of Aveiro), and Ferreira, João (Independent Scholar)

British Astronomical Association and Société Astronomique de France 19th century members database

Professionals started to take hold of research and technical positions during the 19th century. Simultaneously the number of those interested in science and technology increased due to palpable new technological “wonders”, expanding educational systems and dynamic science popularization efforts. Associations catering for the needs of these amateurs mushroomed. The astronomical case is of interest because, in our opinion, the problems and solutions then encountered by these associations are still relevant today. In astronomy the growing expense of state of the art astronomical equipment led amateurs to specialize in niche areas left vacant by the professionals. In order to allow a better understanding of amateur astronomical interests, research, instruments, co-operation/competition with professionals and social networks a database was built to include all British Astronomical Association and Société Astronomique de France members and their scientific production in in-house publications until 1900. The database provides personal data, cross-identifications, bibliography, equipment and locations. It may be queried by person name or article text. It offers information visualization methods and analytics. It will interface with other online databases and it's planned to be able to feed other online databases through a web service. All modules and components are being developed using open source technologies. The platform is being developed in PHP programming language and the database system used is MySQL. The whole application is being developed using Object Oriented Programming and Model/View/Controller development paradigms. In this paper we present the database implementation, current status and discuss future developments.

Forstner, Christian (Goethe University Frankfurt)

A forced unity leading to disunity: The reform of the East German Academy of Science and the Institute for Magnetic Materials in Jena

In the course of the reform of the East German Academy of Science in 1968/69 all academy institutes were forced to conduct only contract research. The aim of the reform was to increase the transfer from academic research to industry, to form a unity of research and production. It was tried to close the separation of fundamental and applied research in an innovation process, that was understood in the linear model. In my analysis I will focus on the effects of the reform on the Institute for Magnetic Materials (IMW) in Jena. The Institute was founded in 1951 and became a part of the German Academy of Science in 1954. Until the end of the 1950s the IMW was reorganized and core memories for computers became the central research topic of the institute. During the high time of the core memory a close collaboration with industry, especially the Ceramic Factory in Hermsdorf next to Jena (KWH) was established. The KWH was one of the central companies of the GDR for the production of ceramics. In 1962 a laboratory for magnetic research was founded at the KWH as a basis for science driven industrial production of magnetic memories. The end of the magnetic laboratory came when all computer related research and development was transferred to the Dresden area at the end of the 1960s.

SATURDAY 15 SEPTEMBER, 11.00-13.00

Therefore, the forced unity in the course of the GDR science policy led to the separation of successful cooperation between science and industry.

I121 EARLY MODERN 1

Location: IoE – Room 777

Chair: Alfonso-Goldfarb, Ana Maria

Buyse, Filip (Descartes Centre, Utrecht University)

Spinoza on the Agreement and the Distinction between Bodies: a New Hypothesis

According to the monist Spinoza (1632-1677), very fundamentally, there exist only one absolutely infinite being and all existing things are modes of that unique and eternal being. Furthermore, in his view, there is no real distinction between mind and body. On the contrary: mind and body are one and the same thing. Consequently, the question arises: how does the Dutch philosopher conceive the distinction between bodies in this new metaphysical context? In one of his earliest writings (CM II/6) already, Spinoza categorically expels the peripatetic idea that there is an immaterial soul which functions as a principle to distinguish among bodies. Instead, Spinoza introduces a physical relation as a principle of distinction: the so-called ratio of motion and rest of the body's parts. The Dutch philosopher applies this concept in his definition of the body in his Ethics (IIp13s Def.). However, he seems to apply another definition in his Letter 32 (1665) to the secretary of the Royal Society. Firstly, this paper analyzes this explanation and compares it with what Spinoza writes in the Physical Interlude of his Ethics. Secondly, this paper argues that, in his answer to a question of Robert Boyle, Spinoza applies the principle of synchronization, discovered by Christiaan Huygens. As this paper shows, this would resolve the otherwise paradoxical phrases in Spinoza's letter. Christiaan Huygens (1629-1695) had made his spectacular discovery only a few months earlier. And, in that period, Spinoza was in contact with the famous author of the *Horologium oscillatorium sive de motu pendularium*.

Guzzardi, Luca (University of Milano)

Boscovich and the Newtonians: Converging Divergences

According to a common view, Boscovich's Theory of natural philosophy (1758/1763) is a typical expression of the "dynamical corpuscularism" flourished during the 18th century, which was in turn a *moyenne durée* effect of Newton's insights in the *Queries to the Opticks*. Newtonian dynamical corpuscularists viewed the natural phenomena as the result of an interplay of attractive and repulsive forces. An often-quoted example is Stephen Hales: in his study of airs, he distinguished between an elastic state, by which particles tend to distance from one another, and a fixed state, whereby the elasticity gets lost and repulsion between particles is superseded by attraction. Analogous mechanisms occur in later Newtonians. In the same vein, Boscovich would reduce all kind of interactions to a "unique law of forces" alternately attractive and repulsive according to some function of the distance. When distances tend to zero, repulsive force grows asymptotically, preventing contact between bodies and their constituent particles; when distance grows, the force becomes strongly attractive (meaning cohesion), then alternately repulsive/attractive for other interactions. I will challenge this unitary, continuist narrative insisting on fundamental differences between Boscovich's conception and the dynamical corpuscularism. Basing on chronology and documental evidence, I show that Boscovich and the Newtonian dynamicists have developed their views independently. I also argue that, whereas the inclination to theorize about forces and matter were a distinguishing trait of the Newtonians, Boscovich's theory of matter conformed to a "mathematical strategy" that was deep-rooted in his education as a Jesuit mathematician and dispensed with such theorizations.

Morfouli, Meropi (Observatory of Paris)

The apparent unity of time in the 17th century Natural Philosophy

In the service of the description of natural phenomena, mathematical time emerges within the Galilean work. Nevertheless Galileo's notion of time can be the source of much confusion. Galileo's time is often considered by historiographical literature as if it were the *t* variable of the mechanical equations of physics in a Newtonian theoretical background. But this unified view of

SATURDAY 15 SEPTEMBER, 11.00-13.00

time seems inadequate. The two scholars, Galileo and Newton, made a different use of geometry, and it is this difference that implies a different notion of time in each case. What we propose here is to show that time, in a Galilean theoretical background, is not a variable as it becomes later within the Newtonian construction of the world. In order to do so we will base our study on two crucial elements of Galilean geometry: - the (mathematically) unsolved infinity problem and - the status of the "moment" as an external (and not an internal) element of time. This study reveals a notion of time radically different. As the main interest of Galileo was the geometrical description of motion, by introducing time he makes a theoretical choice in order to mathematize, or rather to geometrize motion. Time has no function in his theory and it is definitely not a variable in this context. Galilean time can thus be called precautionary as a description "parameter".

Babes, Ovidiu (IRH-ICUB, University of Bucharest)

Science and Simple Machines: Descartes and Roberval on the Center of Oscillation

This presentation concerns the interaction between Descartes's and Roberval's mathematical treatment of physical phenomena in a particular problem: establishing the center of oscillation of a composite pendulum. I argue that the problem meant different things for each of the two research programmes, and this difference can be traced back, to their mathematical procedures developed for this problem. Descartes's mechanics does not deal with physical causes, and this has been acknowledged in the literature (see Gabbey, Garber, Schuster). His mixed-mathematics rages from an Archimedean-inspired science of simple machines to a mathematical method aimed at solving Stevin's hydrostatic paradox. Nevertheless, Descartes's mixed-mathematics is in a negative way informed by his metaphysics, as mixed-mathematical accounts should be successful regardless of the hypotheses concerning the nature of, e.g. gravity. The problem of the composite pendulum is different for Roberval: His ambition is to create an Aristotelian-minded science of simple motions and their natural effects. Natural causes are gradually deduced from observable effects. Each identified cause has a tentative status until another more corroborated one takes its place in the causal chain. Roberval has two objections to Descartes's mathematical solution to the establishment of the center of oscillation: (1) it does not consider the agitation of every part of matter in the composite pendulum; and (2) the action of the center of gravity is ignored. Both objections can be explained appealing to Roberval's science of motion: Every cause should be believed to be active, as long as no better one is proved.

Gulizia, Stefano (California State University, Sacramento)

Unity and Discord in Gian Vincenzo Pinelli's Papers

The reading circle of the Paduan virtuoso and bibliophile Gian Vincenzo Pinelli (1635-1601) offers an ideal opportunity to discuss issues of collecting and scribal training within the scientific culture of Counter-Reformation Italy; moreover, his library, now housed at the Ambrosiana in Milan, displays an intricate mosaic of documents, pet projects, and marginalia that have rarely been mined other than for their protocols of storing and abridgment. Within this framework, this paper takes a fresh look at the interplay between coherence and disarray in Pinelli's papers, by paying specific attention to three sets of data: 1) a core collection of Aristotelian treatises which came to Padua via Byzantine scriptoria in Crete, 2) a neglected list of mathematical instruments contained in MS S 94 sup., and 3) the unfinished commonplace on colors and Plinian metals for which Pinelli enlisted the help of antiquarians, doctors, and scientist-engineers. In the examination of these materials, the purpose is both internal and external: on the one hand, to reassess the importance of note-taking in a prime scholarly network of Galileo's Padua, but also to argue for the currency of scientific cooperation from the point of view of paper technology rather than as a result of correspondence and courtly culture.

SATURDAY 15 SEPTEMBER, 11.00-13.00

S44/1 SCIENCE IN TRANSLATION: LOOKING AT IT FROM EAST ASIA

Location: IoE – Room 826

Chair: Wu, Huiyi

Organiser(s): Wu, Huiyi, and Brazelton, Mary Augusta

Translation played a crucial role in history of science in East Asia by putting ideas and practices in circulation across linguistic and cultural boundaries, while highlighting the very existence of these boundaries. Throughout the centuries, translation has happened between cultures and languages near and far, within the East Asian sphere (China, Japan, Korea, Vietnam...), between East Asia and its Inner Asian, South Asian and Middle Eastern neighbours (Sanskrit, Persian, Arabic, Tibetan, Tangut, Mongolian, Manchu...), and since the 16th century, increasingly between East Asia, Europe and America. Translation of science has involved a wide array of actors, both men and women, locals and foreigners, from career translators and technical experts to monks and missionaries, not to mention rulers, dignitaries and officials who acted as patrons. These actors promoted translation in accordance with their broader personal, political, cultural and religious agendas which, in return, shaped the ways translations were conducted. In recent years, there has been an ever-increasing interest among historians of East Asian science, technology and medicine in charting this mosaic of peoples and knowledge, revealing numerous hitherto unknown connections. Translation involves both circulation of ideas and shifts of meanings: how historians identify, assess and interpret these phenomena is often revealing in how they strike a balance between unity and disunity in situations of cross-cultural contacts. In the modern period in particular, questions of scientific translation have been deeply entangled with narratives of modernity and globalization. Perceived failures of translation have long been instrumental in constructing theses of cultural incommensurabilities between scientific traditions in East Asia and in the rest of the world. While these issues continue to be hotly debated, more recently, drawing on insights from broader developments in history of science, historians of East Asia have also become increasingly interested in the material aspects of translation. Attention has been paid to how oral and written practices intermingle in acts of translation, how the interplay between manuscript and printing affects the contents of texts, and how translation has been inextricably linked to other non-verbal means to produce practical knowledge, including diagrams, maps, specimens and instruments. This symposium will seek to bring together not only expertise on different languages, regions, periods and fields of knowledge, but also different historiographical approaches, to enable comparison and cross-fertilization between them. Last but not least, we bear in mind that for today's historians, writing about East Asian history of science is in itself an act of translation, between the classical languages our sources are written in, and the modern (often Western) languages we use to interpret them. We have also witnessed in these years a fruition of initiatives for translating sources of East Asian science into Western languages. We welcome reflections on our own translation practices, in order to lend greater critical nuances to the stories we tell and to continue building bridges with history of science in East Asia with the broader community of scholars.

Khan, Mujeeb (University of Tokyo)

Translation and the Medicine of Neighbors in Medieval China and Japan: The Transposition and Transference of Foreign Knowledge from the Islamic World and China

This paper addresses the issue of translation within the East Asian Sinitic linguo-cultural sphere. It takes two case studies to examine the complex nature of translation between linguo-

SATURDAY 15 SEPTEMBER, 11.00-13.00

cultural spheres, and the effect of translation upon the interpretation of knowledge. These two case studies explore China, in its consumption by the medical bureaucracy of tenth-century Japan and its consumption of medical knowledge from the Islamic world during the Yuan dynasty (13-14th centuries). Both incorporate Chinese as the main language of consideration: The first study employs translation from the perspective of transposition to examine Japan, which had adopted the written language of its continental neighbor China and utilized that same language to create its own medical literary tradition. Examining Japan's earliest extant medical work *Ishinpō* ("Essential Medical Methods"), this case study illustrates the nature of translation in the form of transposition of medical knowledge from Sinitic sources. In the second, China, although the geographical origin of native East Asian traditions, is the central focus through consideration of *Huihui yaofang* ("Islamic Formularies"), a work that transferred medical knowledge from the Islamic world into Chinese. These two medieval case studies demonstrate the different forms of translation evidenced in the history of East Asia and also shed light on transmission through translation within a single linguo-cultural sphere (Sinitic cultural sphere) and between different linguo-cultural spheres (the Sinitic and Islamic worlds).

Cullen, Christopher (Needham Research Institute, Cambridge)

Translating Chinese astronomy: cross-cultural communication and transformation

The complex astronomical systems known as *li* 曆 were a distinctive feature of premodern Chinese reflection on the non-human world. Their analogues in the ancient and medieval cultures of western Eurasia, such as the *Almagest* of Ptolemy of Alexandria, were frequently translated into other languages - principally Arabic and Latin. In looking at the process and results of such translations, we can learn something about the assumptions and understanding of the translators, but also about the source texts themselves. It is only recently that full translations of Chinese astronomical systems have begun to appear in modern western languages - interestingly at the same time that a full version of the *Almagest* is finally about to appear in Chinese. This paper will sketch the deeper historical background of such translations, and reflect on some of the problems and opportunities that have arisen in connection with them.

Isahaya, Yoichi (The Hebrew University of Jerusalem)

The Yuan Era, the Period without Translation: Naṣīr al-Dīn al-Ṭūsī (1201–1274) as a Cultural Pivot in the "Mongolian Moment"

The historian of science Abdelhamid Sabra described the translation movement in the 'Abbasid dynasty as "naturalization" – a series of appropriation rather than mere reception. In the astral sciences, such naturalization also happened in Eastern Eurasia, when "Western" horoscopic astrology was embedded through the initial translation in the Tang period (618–690, 705–907) and the subsequent congruence with indigenous practices until the Song period (960–1279). This produced some important texts, such as the *Futian li* 符天曆 [Astronomical System Tallying with Heaven]. However, despite of these exchanges, horoscopic astrology in Western and Eastern Eurasia basically developed independently until the Mongol Yuan empire (1206–1368). At this "Mongolian moment," the Muslim polymath Naṣīr al-Dīn al-Ṭūsī (1201–1274) active in the Iranian Plateau was informed of East-Eurasian astral sciences by a Daoist physician, Fu Mengzhi 傅孟質. Al-Ṭūsī incorporated into his *Zīj-i Īlkhānī* [Ilkhanid Astronomical Handbook] a "Cathay calendar" – the aforementioned *Futian li*. Thus elements of horoscopic astrology transmitted from Western Eurasia to Tang China returned westward during the Mongol period after a long process of naturalization. However, al-Ṭūsī considered Fu's knowledge out of date, no more than knowledge for "beginners". The reading of a Chinese sage by a Muslim polymath in Mongol Iran did not lead to the integration of two Eurasian traditions. The unification of Eurasia by the Mongols was too short to allow the process of naturalization which could have enabled such texts.

Lotze, Johannes (University of Manchester)

SATURDAY 15 SEPTEMBER, 11.00-13.00

Translating Astronomy in Early Ming China: The Tianwenshu 天文書 [Book on Heavenly Patterns] (1383), Its Translators, and the Eurasian Context

Multilingual skills had symbolised universal rule since antiquity and across cultures. Imperial libraries collected knowledge of various origins and emperors commissioned translations, thus negotiating between unity and diversity. These observations apply even to China's Ming dynasty (1368-1644), often conceptualised as monolingual, whose founders addressed their multi-ethnic populations in many tongues. This paper looks at the imperially commissioned Tianwenshu (1383), a Persian-to-Chinese translation of an astronomical treatise, to discuss questions of unity and diversity in the crucial moment between the demise of the 'centripetal' Mongol Empire around 1368 and the entrenchment of 'centrifugal' post-Mongol polities throughout Eurasia. Who were the translators in this project and why did all bilinguals stem from a non-Chinese background? To what extent should we believe the official rationale (lack of foreign language skills amongst early Ming scholars)? Did Chinese scholars never conceive of a similar ideal as their Ottoman counterparts who strove to master Turkish, Arabic, and Persian? The paper argues that, unlike Europe, where an awareness of the 'foreignness' of tradition had long since encouraged translation, in Ming China the remotest source and contemporaneous speech could basically be imagined as the same language. While this might explain 'monolingualism', the appropriateness of the term will be questioned. Was Ming China steering towards a 'monolingual' or a 'multilingual' space and what does this mean for science in translation?

Zhou, Liqun (Northwest University, China) (in absentia)

Changed and Unchanged Elements in the Early Translation of Buddhist Astrology from India to China

Ancient Hindu astrology arrived in China as a result of the transmission of early Buddhist canon translations from India. A few early manuscripts discussing divination using nakṣatra (lunar mansions) have been excavated along the Silk Roads of Central Asia, such as Śārdūlakarṇāvadāna ("the story of Śārdūlakarṇa", Sanskrit manuscripts collected mainly from Khotan, 5th century A.D., Chinese manuscripts mainly from Dunhuang, 9th century A.D.), Mahāvaiṣṭya-mahāsannipāta-sūtra ("The Great Collection Scripture", Sanskrit Manuscripts excavated from Nowadays Xijiang, 5th century A.D; Chinese Manuscripts excavated from Dunhuang, the Northern Dynasties, no later than 581 A.D.) and 27 Nakṣatra-Divination Texts from Turfan, etc. Comparison of these manuscripts with their Chinese translations and relevant Hindu texts can suggest insights into the circulation of ancient astrological knowledge. These texts preserve the major elements of Hindu lunar mansions astrology, including the terminology, the arrangement of chapters, the design of the instruments, etc., while making adaptations that reflect the natural environment and social culture of Tang China. Some texts add local place names, and some use local data. This paper tries to analyze the changed and unchanged elements of these texts to show how specialist knowledge was translated from India to China in ancient times.

S36 THE IMAGE OF SCIENCE IN RUSSIA AND THE USSR

Location: IoE – Committee Room 2

Chair: Samokish, Anna

Organiser(s): Samokish, Anna

The panel will be devoted to the topic of how an image of science is formed through the perceptions of society. The means and mode of acceptance of science by society is one of the most important research areas for historians. Science cannot exist in a vacuum; its fate depends on how it is perceived by society, how it is governed by authorities, and the success of its practical applications. We propose that the panellists address the question of how the development and achievements of the natural sciences were perceived by society in Russia, the Soviet Union and East European countries under the Soviet rule. Of particular interest is how scientific achievements were presented in periodical press, fiction books and in school and university textbooks. How the authorities reacted to different scientific theories, thus revealing how the image of a scientific theory can divide or unite not only specialists but members of the general public. Textbooks and curricula are of special interest since they reflect the evolution of ideologies at certain periods of time. Especially vital were the methods of education in the natural sciences and the perception of scientific knowledge during the tragic periods of the first post-revolutionary years and the period of Lysenkoism. Of interest are also attempts to adapt certain scientific theories to various cultural and political environments. The “German Darwin” Ernst Haeckel is best known not only for advocating Darwinism on the Continent, but also for his attempts to convert Darwinism into a universal worldview. Yet, Haeckel’s scientific and philosophical heritage found its way into the curricula of as different environments as USA, Nazi Germany, GDR and the USSR. The examination of figures like Haeckel and of their influence in various socio-political systems contributes to the understanding of relationships between science and the state. The image of science in literature, first of all, in science fiction, will also be considered. The fiction books have always been much freer from pressure by soviet authorities than the periodical press. At the same time, authorities tried to use the influence of especially popular fiction writers for constructing an image of science that would serve the needs of dominating ideology. An important link in the connection of science and society has always been environmental protection. Discussion of reserves, conservation issues was at the soviet time an opportunity for scientists to bring their point of view to the broad audience. The analysis of periodicals is crucial for the reconstruction of this discussion. In sum, this panel will cover the diverse aspects of public image of science in the USSR and its satellite states.

Shaffer, Elinor (University of London)

Variations in Literary, Cultural and Scientific Reception within One Nation

Our extensive studies in reception have for the most part crossed national boundaries; but they also throw light on internal differences through a variety of factors, including historical period, class and education, and political controls. While science is received and controlled through different procedures and authorities than is literature, our studies of the reception of Newton (3 vols.) and Darwin in Europe (4 vols) (London: Bloomsbury) throw fresh light on the receptions in physics and mathematics on the one hand and in the biological sciences on the other. The role of the church as well as the state is important in these receptions, while the role of scientific bodies and professional groups is gradually being formed as independent sets of standards and powers.

Roll-Hansen, Nils (University of Oslo)

SATURDAY 15 SEPTEMBER, 11.00-13.00

The rise of Lysenkoism in the light of science policy

I will try to analyse how theory about science, its knowledge and practice, conditioned the rise of Lysenko. Rather than a closely integrated theoretical system it was a set of ideas more or less shared by various actors like N. Bukharin, N. Vavilov, B.M. Zavadovskii, A. Kolman, Ja, Jakovlev, V.I. Stalin, M. Mitin, I. Zhdanov etc. that shaped the discourse on science and its social role, in the public sphere as well as in academic, government and Communist party fora. The close intergration of theoretical (academic) science with Technology, and emphasis of practical technological and economic achievements, as a criterion of good science was a common characteristic of the discourse. There is an interesting continuity in epistemic ideas from Bukharin's speech at the 1931 history of science congress in London, through the agricultural/genetics conferences of 1936, 1939 and 1948, and beyond. For instance, N. Vavilov's World Collection of Agricultural plants, arguably the first large scale gene bank in the World was also an early example of so-called Big Science.

Levit, Georgy (Kassel University)

Ernst Haeckel in Germany and Russia: Two Ways of Radicalizing Darwinism

Ernst Haeckel is one of the crucial figures in the history of Darwinism and is known as "German Darwin". Haeckel is also known for his efforts to radicalize Darwinism and to make it into a universal worldview (monism). In his *Generelle Morphologie der Organismen* (General Morphology of Organisms), published in 1866, Haeckel, for the first time, started to formulate his basic concepts. Yet, General Morphology was never translated into other languages, and reached a limited audience even in the German-speaking lands. The promotion of Haeckel's ideas followed the publication in 1868 of a collection of lectures titled *Natural History of Creation*. This popular science book became a bestseller and was also translated into many different languages including Russian. Haeckel's another bestseller *The Riddle of the Universe* (originally published in 1899) was translated into Russian as well, but both books experienced serious troubles with the censorship in the tsarist Russia, because of their emphasis on the "animal origin of man". Later in the 20th century both Nazi Germany and the USSR tried to adapt Haeckel to their needs. Certain groups of Nazi ideologists attempted to use his authority to substantiate the racial theory. On another side, Haeckel's scientific heritage found its way into the school curricula in the USSR, where his Darwinism and, especially, his "embryos" were used to substantiate the "materialist" view of nature. The examination of Haeckel influence in various socio-political systems contributes to the understanding of relationships between science and the state.

Kolchinsky, Eduard (Russian Academy of Sciences, St Petersburg)

Sacralization of Conflict N. I. Vavilov and T. D. Lysenko in the Literature and the Press

Conflict of N.I. Vavilov and T.D. Lysenko in the literature and the press is reflected in several sacral dichotomies: "the genius-evil", "scholar-quack", "the patriot-traitor". Depending on the authors' views and social contexts, both parties are described as innocent victims, and their opponents as the incarnation of evil. Their biographies, like the lives of saints, nourish myths about some hostile powers interfering the science like in the kingdom of truth and goodness. Comparative historical research of the evolution of the narrative about Vavilov and Lysenko shows that the origins of such sacralization date back to the 1920s. The concept of "heroes" and "villains" of Russian science dominated in the years of perestroika, and Lysenkoism became a symbol of pseudoscience. In contrast, soon Vavilov and Lysenko were portrayed as representatives of the unified "Stalinist science", who competed hard for finance, for the attention of the powers, for dominating their schools, and for creating their own "scientific empires". The conflict of late years has acquired a new sacral meaning. Some depict Vavilov as a great scientist, the forerunner of the "green revolution" that saved humanity. Others continued to accuse him of scientific barrenness, of cosmopolitanism etc. He is opposed to Lysenko as a patriot and a true Orthodox, a defender of the identity of Russian science and a brilliant agronomist. Lysenko is credited with foreseeing epigenetic and prions.

Samokish, Anna (Russian Academy of Sciences, St Petersburg)

The struggle of scientific theories in school textbooks

Teaching a school subject is usually closely related to the development of a scientific discipline. However, various non-scientific factors often interfere with this process. In Russia and the USSR it was especially difficult. After the October Revolution (1917) all the obstacles, religious and political, burst and natural science became one of the main school subjects. The first post-revolutionary years teachers in Petrograd sought to bring school textbooks closer to the real development of biology, even the basics of genetics were taught. But in the middle of twenties the "complex" programs appeared and the natural science was replaced with the agronomy classes. During that time evolutionism existed in school as a general idea only because it was very convenient for the political situation. As soon as the era of Lysenkoism began, textbooks immediately reacted to this. In 1938 curriculum along with a detailed description of the basics of genetics one can see the description of Lysenko's work. In 1948 the scientific foundations of textbooks merely disappeared and were replaced by "fantastic knowledge" on the basis of Lysenko's ideas. After the fall of Lysenko and the rehabilitation of genetics, new textbooks had to be prepared urgently. Otherwise, the ideas of Lysenkoism lasted much longer in the students' minds. The book by Yuri Poliansky and his colleagues was prepared in a very short time. None of the authors was a schoolteacher, although almost everybody actively participated in the life of the secondary school of that period.

Nikolavenko, George (Saint-Petersburg Branch of the Institute for the History of Natural Science and Technology RAS), and Evsikova, Ekaterina (Saint Petersburg State University)

Analysis of the Science Image Forming Factors: School Education

Nowadays the most comprehensive mechanism for disseminating information about science is the system of school education. However, how important is its impact on the image of science and are people whose knowledge is limited to information from the school curriculum operate only with concepts and personalities from textbooks? This question is the main research problem in the framework of our study conducted in several schools of St. Petersburg (Russia). Moreover, the main issue was expanded by several indirect ones, that made it possible to include a number of additional factors, namely: the effectiveness of the state policy that is "emphasizing" the significance of Russian science, the influence of gender attitudes, etc. Thus, we tried to distinguish what schoolchildren considered significant from their a priori amorphous image of science. Further, we carried out a correlation analysis of student survey results and tables of content analysis, compiled on the federal basic school subjects' textbooks. This allowed us to determine which of the significant elements penetrated into the consciousness of students from the school curriculum, and which came from outside. To estimate the effectiveness of state propaganda in the sphere of science, we differentiated the question of significant researchers and inventions on the basis of "citizenship", which allowed us to obtain separate lists of "domestic" and "foreign" sciences. As for the significance of gender, our hypothesis was not confirmed - the answers of boys and girls did not have significant statistical signs of difference.

S27 UNITY AND DISUNITY IN METROPOLITAN SCIENCE: OVERLAPPING KNOWLEDGE-COMMUNITIES IN LONDON, c. 1600-1800

Location: SciM – Dana Study

Chair: Higgitt, Rebekah

Organiser(s): Moxham, Noah

Commentators:

Bennett, Jim (Science Museum, London)

Higgitt, Rebekah (University of Kent)

The scholarship of the past twenty years has done an immense amount to recover the social, cultural, organisational and epistemic variety of knowledge communities in early modern London (from the shadow cast by the Royal Society in particular). Developing the conference theme of unity and disunity, this symposium seeks to extend that work by examining the social and spatial overlaps, as well as the boundaries, between communities of natural knowledge and technical practice; to examine perceived conflicts of interest within knowledge communities (assayers for the Mint or the Goldsmiths, for example) who were required to work across disparate organisations, and how these were challenged or resolved; to explore possible tensions in the uses of knowledge within particular communities (e.g. monopoly trading companies, within which certain categories of natural knowledge were used to burnish public reputations while others were treated as sensitive and proprietary commercial information); to show how technical knowledge and practical experience could determine planning and practice in urban contexts, to the extent of transcending rank; or to explore an amphibious world of official and unofficial interactions between projectors, the docks, and the navy. More broadly, our aim is to inquire how London, as a geographical, political, commercial and conceptual entity, signified in early modern knowledge-making, and accounts of knowledge-making. This panel is organised by the Leverhulme Trust-funded Metropolitan Science project at the University of Kent.

Kilburn-Toppin, Jasmine (University of Kent)

‘A place of great trust to be supplied by men of skill and integrity’: assayers and knowledge cultures in early modern London

The assayers employed by London’s Goldsmiths’ Company were said to occupy ‘a place of great trust to be supplied by men of skill and integrity’. Technical ability and trustworthiness were essential attributes, and sixteenth- and seventeenth-century treatises on metallurgy stressed the importance of technical precision and honourable behaviour. This paper takes us beyond civic ideals to explore the institutional, social, and spatial contexts within and through which the city’s assayers generated ‘legitimate’ material and technical knowledge. The knowledge cultures of the city’s assayers were highly complex, both intrinsically and institutionally. First, throughout their working lives assayers were typically employed by the Goldsmiths’ Company and the Royal Mint, some by both simultaneously - a point of considerable tension. The Goldsmiths’ Company and the Mint had separate spaces and equipment for material assessment, and highly codified systems of skills-exchange. Second, the assayers’ work was understood to be highly secretive, a protected ‘mystery’, yet open to intense public scrutiny; their assessments directly impacted upon the quality of the specie and the livelihoods of all gold- and silver-workers, and their judgements could thus be highly controversial, and contested. Bringing together institutional and autobiographic sources, this paper uncovers the social and the physical ‘place’ of the assayers’ working practices within the urban environment; both their occupational and institutional identities, and the material sites of their labour.

Tierney, Elaine (Victoria and Albert Museum)

Design on the Ground: ‘Middlemen’ and the Production of Festivals in London and Paris,

1660-1715

This paper explores the critical role of ‘middlemen’ in designing and making urban celebrations. It uses two case studies, the Office of Ordnance’s involvement in major fireworks displays in London, and the intermediary role of the maître d’oeuvres in Paris, to show how events depended on organisers with wide-reaching social and professional networks. These ‘middlemen’, with broad-based expertise encompassing design, making and project management, are at the heart of my redefinition of the relationship between celebrations and urban environments, and between the centres and peripheries involved in their production. Notably, the efforts of ‘middlemen’ demonstrate that festival ‘designers’ had expertise going well beyond personnel with ‘creative’ credentials (poets, painters, sculptors). Scrutinising practices of mediation, including surveillance, management, liaison and quality assurance, the paper rethinks early modern festival in several important ways. First, it foregrounds practices and personnel often neglected in discussions of early modern celebrations and of early modern design more broadly. Second, it shows the necessity for ‘middlemen’ to have broad social and professional networks, which underpinned their ability to assemble celebratory events on time and to spec. Third, relatedly, it reveals the extent to which the realisation of events was the product of multiple types of knowledge and knowledge-makers, far more varied than the creative practitioners hitherto credited in scholarship. Ultimately, looking to the middle shifts how we understand authority and ‘authorship’ in the production of major royal occasions in London and Paris.

Hellawell, Philippa (University of York)

Engines and elixirs: projecting and experimenting in the naval sphere, c. 1690-1700

From the late-seventeenth century, the demands of large-scale warfare in Europe were met and supported by a range of administrative and fiscal innovations in what has been termed the ‘fiscal-military state’. In particular, the expansion of England’s naval operations throughout the seventeenth century, especially the development of an effective naval administration, played a crucial role in consolidating English state power. The commercial culture that facilitated these mechanisms also nurtured numerous projectors, who offered lucrative or useful projects in service of the state and the wider public good. Their projects included numerous naval inventions, such as engines for distilling water and elixirs to improve the health of seamen, that illustrate the wider intersections of knowledge, commerce, and the state in this significant period of state-formation. This paper explores the naval offices and dockyards of late seventeenth-century London as important sites of knowledge and practice. It examines how naval administration responded to projects submitted by individuals within and outside the naval community and the attendant issues surrounding attitudes to invention and innovation. It details how the Admiralty and Navy Board often relied on experiment in trialling new technologies, showing the ways experiment was appropriated into the business of naval governance and used as a tool of validation in a professional setting. By presenting the navy as a dynamic community of experimental knowledge, it seeks to raise larger questions concerning the spatial dimensions of experimental culture and the role of technological knowledge in processes of state-building.

Moxham, Noah (University of Kent)

The uses of useless knowledge: public cultures of science and the East India Company, 1750-1800

This paper examines the management of scientific and technical information, specimens, and objects by the London administration of the East India Company during the second half of the eighteenth century, following the acquisition of a territorial empire. I argue that the complexity of the Company’s administrative position produced similar complexities of information management. In particular, I endeavour to show that the various pressures on the Company – to exploit its territories, to maintain public goodwill, and to assert its authority over its servants in India – produced varied and sometimes contradictory approaches to the collection, storage, and

SATURDAY 15 SEPTEMBER, 11.00-13.00

use of scientific and technical information. Much of this was commercially or militarily sensitive and correspondingly tightly controlled. In other cases there was a national interest to be considered. Finally, I investigate cases in which the Company embraced a more disinterested notion of the pursuit of natural and useful knowledge, and assisted organisations such as the Board of Trade, the Royal Society, or the Society of Arts. I suggest that this – leading up to the formal establishment of the Company's Museum in 1800 – was part of a strategy for appealing to a broader notion of the Company's value as its function and conduct faced increasingly strict scrutiny, and investigate what place it found in defences of the Company and debates over its legitimacy in the late eighteenth century.

I104 ASIAN ASTRONOMY AND MATHEMATICS: MATERIAL CULTURE AND PRACTICES

Location: SciM – Dana Studio

Chair: Wills, Hannah

Sam An, Sethykar (Independent Scholar)

On Archaeoastronomical Interpretation of Angkor Wat

In 1976 a paper titled “Astronomy and Cosmology at Angkor Wat” was published in one of the most influential journals, the *Science*, by three authors, Robert Stencel, Eleanor Morón, and Fred Gifford. Soon this paper became one of the most cited sources among publications on archaeoastronomy of medieval Cambodia. According to the paper, the structure of Angkor temple contained information about a number of astronomical phenomena (movements of the Sun and the Moon, calendar, large “cosmic cycles”, etc.). In 1985 one of the three authors, Eleanor Morón (who changed her last name to Mannikka in 1978) defended a dissertation on this topic and later (1996) published a monograph presenting her analysis of Angkor Wat; in the latter work she added a large number of details to the initial interpretation of the temple presented in the paper she co-authored in 1976. My paper is not aiming at approving or disproving the “astronomical” interpretations of Mannikka; instead, I would propose a brief historical analysis of the “archaeoastronomical” interpretation of Angkor. I will focus on the main claims found in the seminal paper of 1976 and in the book of Mannikka of 1996 and will briefly analyze the works of Mannikka’s opponents, but will not make a final decision concerning reliability of her work, since my goal is elsewhere: I would like to show how a scientific discipline (in this case, archeoastronomy) or its branch (in this case, archaeoastronomical study of Angkor) was born and developed.

Han, Qi (Institute for the History of Natural Sciences, Chinese Academy of Sciences)

The Royal Society of London and China in the Seventeenth and Eighteenth Centuries

The Sino-British scientific relation in the seventeenth and eighteenth centuries is an interesting chapter in the history of science. In this paper, the author discusses the exchange between the Royal Society of London and the Jesuits of China mission, and analyses the roles of the secretaries of the Royal Society of London in contacting the Jesuits in China. Based on the archival documents in the Royal Society of London and the publications in English journals, the author analyses the English views of Chinese science and discusses the scientific investigations made in China in a broader historical context.

Choi, Go-Eun (Korea University of Science and Technology/Korea Astronomy and Space Science Institute)

Analysis of Astronomical Almanacs of Manchukuo

We investigate the astronomical almanacs of Manchukuo, a Japanese puppet state that lasted for 14 years from 1932 to 1945. In this study, we explore Manchukuo almanacs for the years from 1934 to 1945 except for 1941. From examination of the contents, we find that the reference location of the time data was Xinjing (nowadays Changchun) and that the standard meridian was changed from 120° E to 135° E since the almanac of 1937. In addition, we observe that sunrise and sunset times are recorded on only the days of 24 solar terms but for several cities, while moonrise and moonset times are recorded daily but only for Xinjing. Moreover, only days are recorded (i.e., the hours are not recorded) in the almanacs of 1934 for 24 solar terms. In order to estimate the accuracy of the time data, we extract eleven kinds of time data from the almanacs: solar term, four phases of the Moon, rising and setting of the Sun and Moon, and eclipses of the Sun and Moon. Then, we compare those time data with the results of modern calculations obtained using the DE405 ephemeris. We find that the mean absolute deviation value for all kinds of time data is approximately 0.33 min, while the maximum deviation is 0.45 min for the times of lunar eclipse. In conclusion, we think that our findings will contribute to the study of astronomical almanacs of Korea, China, and Japan that were published during the similar period.

SATURDAY 15 SEPTEMBER, 11.00-13.00

Wang, Jinrui (Northwest University, Xi'an)

On the research of the Celestial Perimeter Parts and High Epoch Accumulated Years in the Resplendent Heaven System (A.D. 1064)

The Resplendent Heaven System (Ming tian Li 明天歷), which compiled by Zhou Cong (周棕) in the Song 宋 dynasty, shows the highest-level algorithm formulation in Chinese traditional astronomical systems. The Celestial Perimeter Parts (Zhou tian fen 周天分) is a very important constant in the ancient Chinese systems, which is the foundation to construct the algorithm for the motion of sun, moon and the five planets. The makers of Chinese astronomical system always fix them by the High Epoch Accumulated Years (Shang yuan ji nian 上元積年). In this talk, we will show how the Resplendent Heaven System fixed the Celestial Perimeter Parts without the High Epoch Accumulated Years, analyze the rationality of Zhou Cong's new method by making use of the rule on the motion of sun and moon. I will also discuss the specific way to obtain the High Epoch Accumulated Years in the Resplendent Heaven System, make a comparison between the Resplendent Heaven System and the other contemporaneous systems, and discuss whether the Celestial Perimeter Parts was involved in the the process of calculating the High Epoch Accumulated Years. The result shows that the methods to fix the Celestial Perimeter Parts and High Epoch Accumulated Years in the Resplendent Heaven System is unique and innovative, which optimized the procedure of mathematical calculation extremely.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S55 SYNTHESIS OR SYNTHESSES?: UNITY AND DISUNITY IN 20TH-CENTURY BIOLOGY

Location: IoE – Room 802

Chair and Commentator: Sleight, Charlotte
(University of Kent)

Organiser(s): Herring, Emily

The modern synthesis, a grandiose unification in evolutionary studies which supposedly emerged in the years 1930-1950, is currently at the centre of active debate in the biological sciences. Should we stick with the neo-Darwinian orthodoxy this synthesis yielded? Should we 'extend' it by incorporating epigenetic phenomena, niche construction, and other such phenomena neglected by the original synthesisers? Or perhaps we should scrap it altogether and start again. In these ways, the very foundations of the modern synthesis are presently undergoing critical examination. In this symposium, we are not only concerned with critically examining the modern synthesis as a scientific achievement and organising framework for ongoing research, but also, and more particularly, with exploring its utility as a historiographic category in studying the life sciences in the twentieth century. A huge body of scholarly literature has been amassed on the guiding assumption that there was a (singular) synthesis in evolutionary biology in the early-mid twentieth-century. Historians of the life sciences purport to know when this synthesis occurred, who was involved, and which conceptual, practical and institutional resources they drew upon in unifying biology. The historiographical result is the ultimate 'unity' story, as competing (read mistaken) mechanisms of evolutionary change were crushed by the advances of a hard-fought and newly forged Darwin-Mendel axis. This tapestry is ripe for unpicking. We suspect there persisted a great deal more disunity than standard narratives suggest. Partly this is due to the fact that the majority of histories centre upon the Anglo-American context. Emily Herring's paper on the French case will highlight certain disunities across national boundaries and examine different ways in which the very notion of "synthesis" was understood within different intellectual traditions. In addition, we suspect that myriad syntheses were in fact being forged, not only amongst various disciplines and in different national contexts, but also in the 'personal' syntheses negotiated and achieved in the minds of individual scientists. Alex Aylward's paper on British statistician and geneticist R. A. Fisher examines a case in which the 'community-wide' and the 'personal' conceptions of synthesis come into contact. The remaining two papers, from Maurizio Esposito and Joe Cain, step back somewhat relative to Herring and Aylward's fine-grain case studies. Esposito uses the themes of unity and disunity in twentieth century biology to ask what it is historians are, or indeed should be, doing when they propose labels to order and unify scientific movements, traditions or cultures. What work do categories such as 'modern synthesis' do for the historian, and is it good work? Cain's paper will suggest that it is not, and that the very unit concept of the evolutionary synthesis should be abandoned. Its propensity to obscure the vibrant heterogeneity of twentieth century evolutionary studies – a heterogeneity well documented by the contributions to this symposium – render the label rather unhelpful. Parallel, then, to present debate surrounding the extension or ejection of the synthesis as scientific framework, there is much to consider regarding the synthesis as a category employed by the historian of science.

Aylward, Alex (University of Leeds)

Getting personal in the pre-synthesis period: R. A. Fisher, selection, and the new genetics, 1910-30

SATURDAY 15 SEPTEMBER, 14.00-15.30

Increasingly, historians of biology are paying attention to the various ‘personal syntheses’ achieved in the early to mid-twentieth century. This period, which has traditionally been viewed as one of synthesis, is becoming one of many syntheses, as we ask how individual evolutionists brought together and negotiated the assorted scientific, conceptual, practical and other resources at their disposal. The present paper explores a case in which these two perspectives intersect. The synthesis in evolutionary studies, traditionally conceived, amounted to a reconciliation of Darwin’s theory of natural selection with the burgeoning field of Mendelian genetics. In accounts of this synthesis, Ronald Aylmer Fisher (1890-1962) routinely takes centre-stage. His celebrated paper of 1918 represents for many the first successful attempt to mathematically reconcile Darwinism and Mendelism, whilst his role in the emergence of theoretical population genetics underlines his significance in unifying genetics and natural selection. If we are to take the standard accounts at face value, the synthesis of Darwin and Mendel was, somewhat paradoxically, the achievement of a community of scientists and of one man. By way of disentangling the above difficulty, this paper follows Fisher through the formative years between his time studying on the Mathematical Tripos at Cambridge in the early 1910s, and the publication in 1930 of his lastingly influential *Genetical Theory of Natural Selection*. In particular, I ask: how did Fisher synthesise Darwinian selectionism and Mendelian genetics? From which resources did he gain his knowledge of each? And why he set himself this synthesising task?

Herring, Emily (University of Leeds)

French Naturalists vs Darwinian Specialists: Albert Vandel and Pierre-Paul Grassé’s “True” Synthesis

Twentieth-century French evolutionism is often seen as something of an oddity. While British, American and German Darwinians were developing what came to be known as the Modern Synthesis, the chair for Evolution at the Sorbonne was held by anti-Darwinians until 1967. This prompted Ernst Mayr to retrospectively write: “France is the only major scientific nation that did not contribute significantly to the evolutionary synthesis”. I argue that, while it is true that most French life scientists rejected the Modern Synthesis well into the twentieth century, this did not mean that French biology was synthesis-free. Two of the leading French zoologists, Pierre-Paul Grassé and Albert Vandel proposed a different vision of what it meant to synthesise inspired by Lamarck, Bergson and Teilhard de Chardin. According to Vandel and Grassé, there were two kinds of syntheses: an inferior Darwinian synthesis in which badly coordinated specialists looked at biological phenomena from the very narrow perspective of their own speciality, and their own “true” synthesis, in which erudite naturalists strived to embrace in their own mind as many aspects of the living world as possible in a multidisciplinary approach integrating palaeontology, embryology, zoology but also philosophy and psychology. Close attention to Vandel and Grassé’s published work, as well as never before used archive materials, will challenge the idea of a singular, Darwinian, and mainly Anglo-American evolutionary synthesis and offer valuable insights into a little studied case of institutionalised Lamarckism, in mid twentieth-century Europe, distinct from the better-known case of Lysenkoism.

Cain, Joe (UCL)

Rethinking the Synthesis Period in Evolutionary Studies

I propose we abandon the unit concept of “the evolutionary synthesis”. There was much more to evolutionary studies in the 1920s and 1930s than is suggested in our commonplace narratives of this object in history. Instead, four organising threads capture much of evolutionary studies at this time. First, the nature of species and the process of speciation were dominating, unifying subjects. Second, research into these subjects developed along four main lines, or problem complexes: variation, divergence, isolation, and selection. Some calls for ‘synthesis’ focused on these problem complexes (sometimes on one of these; other times, all). In these calls, comprehensive and pluralist compendia of plausibly relevant elements were

SATURDAY 15 SEPTEMBER, 14.00-15.30

preferred over reaching consensus about the value of particular formulae. Third, increasing confidence in the study of common problems coincided with methodological and epistemic changes associated with experimental taxonomy. Finally, the surge of interest in species problems and speciation in the 1930s is intimately tied to larger trends, especially a shifting balance in the life sciences towards process-based biologies and away from object-based naturalist disciplines. Advocates of synthesis in evolution supported, and were adapting to, these larger trends.

Esposito, Maurizio (Universidad de Santiago)

Synthesis, Syntheses or just bad categories: On the historic concepts and the histories of biology in the twentieth century

Many write stories, few reflect on how to do it. The histories of biology of the 20th century are a telling example. Swinging between whiggish fashions and over-focused “antiquarian” accounts, many life science’s narratives have often suffered from a lack of historiographical insights and awareness. Exploring different instances taken from “modern synthesis” studies, the talk fosters reflexion on the way historical categories have been used, can be used and should be used. While historians should not be necessarily afraid of historical general notions such as “rationalism” or “modernism”, they should be wary of empty, anachronistic or misleading generalizations. Without the intention to propose a fixed Decalogue of wise rules, the talk explores how some categories can be justified and bad generalizations could be eventually avoided. The main questions that I will consider are: what an historical category is and what it really does (or should do). Then, what are we really assuming when we use labels that should unify, order, organize or describe movements, traditions or cultures? (ej. Neo-darwinism, neo-Lamarckism, modern synthesis, etc.). And finally, how to handle disagreements, inconsistencies, contradictions that constantly threaten the apparent coherence and unity displayed by an historical category? (E.g. Neo-Darwinians accepting some neo-Lamarckian ideas, or organicists upholding mechanistic explanations). In conclusion, I will argue that good historical revisionisms should be also paralleled by an explicitly stated philosophy of history.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S06 THINKING COMPUTATIONALLY: THE MAKING OF COMPUTER SCIENCE BETWEEN LOGIC, SEMANTICS AND COLD WAR RATIONALITIES

Location: IoE – Room 804

Chair: Priestley, Mark

Organiser(s): Nofre, David

Algorithms and computer programs, together with complex computational techniques, currently shape many aspects of our lives, including the sciences. Yet we know little about the origins and development of the discipline behind today's digital society. Computer science has received little attention in the history of science compared with other equally important technosciences like biotechnology and material sciences. This session seeks to redress this situation by building upon the recent work by a number of (mostly European) historians of computing who aim at advancing the historical study of computer science.¹ In addition, the session seeks to engage with historians of science on a discussion about broader patterns of discipline building relevant for the history of science, such as consensus on intellectual agendas, relevance of legitimacy questions, and patterns of institutional consolidation. The background of this session is the shift in the focus of research in computing that took place in the United States in the early and mid-1950s, at the height of the Cold War, when the design and production of computers moved from the university research labs to industry. This new patronage had profound (and probably unintended) consequences for the conceptualization of computer programming. The resultant proliferation of commercial computer models, each one with its own programming notation, made evident the need for free-standing programming notations. The development of these new 'programming languages' encouraged the move toward the study of abstract computational structures and models, and an engagement with the fields of mathematical logic and linguistics. Hence, one important part of the questions this session seeks to address has to do primarily with the nature and consequences of this foundational shift. What accounted for this move toward abstraction? What institutional and cultural circumstances made it possible? What were the benefits and downsides of this move? What went lost? And what were the cultural and political values attached to the new emphasis on "thinking algorithmically", or "computationally", to use today's expression? This session also seeks to explore how some of computer science's foundational notions and exemplary problems, like the so-called 'halting problem' and the notions of algorithm and language, are subject to an ever-present process of recasting and reinterpreting. Raising awareness of the historical nature of computer science's most fundamental building blocks also leads us to reflect upon the ways the conceptual and institutional development of computer science have relied upon, and contributed to, the adjacent fields of mathematical logic and linguistics. This session thus aims to contribute to an historical understanding of the rise and development of computer science as a proper field of knowledge. To do so, the contributions here build upon and engage with a diversity of approaches, ranging from the new scholarly field of 'critical code studies', with its focus on the mystifying nature of computer programs, to the sociological analysis of Janet Abbate and Nathan Ensmenger, whose respective works have probed the gender assumptions, professional insecurities, and institutional tensions that have shaped computer science.

De Mol, Liesbeth (Université de Lille) and Daylight, Edgar

Halting problem(s): a historical reading of a paradigmatic computer science problem

Computer science's most celebrated theoretical result, the 'halting problem', conveys an

SATURDAY 15 SEPTEMBER, 14.00-15.30

impossibility result about computation. Since the early beginnings of computer science as an academic discipline, the 'halting problem' has been compared to impossibility results in adjacent (and more developed) fields, such as the impossibility to trisect an angle using only a ruler and a compass, and the impossibility to build a perpetual motion machine. From a historical perspective, "the" halting problem is often and misleadingly attributed to one historical actor (Alan Turing) and, at the same time, given a contemporary interpretation. In reality, several scholars have re-casted and appropriated logic-mathematical notions pertaining to computability, leading to various versions and interpretations of the 'halting problem'. The aim of this talk is to put the different versions of the halting problem, as used within the computer science context from the 1960s and 1970s (by, for instance, Hoare, Dijkstra and Strachey), into proper historical perspective. We provide a critical analysis of these recast versions and offer insights into how computer science has been shaped by, and has reshaped, the history of mathematical logic.

Tatarchenko, Ksenia (University of Geneva)

Thinking Algorithmically: From Cold War Computer Science to the Socialist Information Culture

Cold War competition shaped the process of computerization during the second half of the 20th century. This paper combines insights from Science and Technology Studies, which brought the analysis of Cold War technopolitics beyond the nation-state, with approaches of Critical Algorithm Studies, to question the algorithm's role in the global "computer revolution." It traces the algorithm's trajectories across geographical, political, and discursive spaces to argue that its mutable cultural valences made the algorithm a universalizing attribute for representing man-machine interactions across the ideological divide. It shows that discourses about the human capacity to devise algorithms, a practice central to computer programming, became a site where different versions of modern subjectivity were negotiated. The paper focuses on two related episodes to demonstrate how the notion of "algorithmic thinking" became explicitly associated with a range of politicized agendas. On one hand, the coupling of "algorithm" and "thinking" was used to describe a naturalized cognitive capacity shared among the members of the international scientific community and projected backward to the medieval scholar Al-Khwarizmi. On the other hand, the universal spread of "algorithmic thinking" became the educational goal of a late Soviet computer literacy campaign under the slogan of "programming, the second literacy," a metaphor and a political agenda conceived to bring about the Socialist "Information Age."

Astare, Troy K. (Newcastle University)

Origins and Impacts of Formal Semantics

The emergence of high-level programming languages that began in the late 1950s brought great advantages to the programming community in terms of programmer productivity, ease of design, and the ability to use programs on different machines. However, the additional abstraction created new problems: how can a programmer be certain of the meaning of constructs in a programming language? How can a designer reason about the correctness of a program? How can one have trust that a compiler correctly reflects the semantics of a programming language? Beginning in the 1960s, a school of study developed to address these concerns: the formal specification of programming languages. The most interesting aspect of this work concerns the semantics, or meaning, of the languages concerned. At first, the proponents of formal semantics were full of enthusiasm and ambition about their techniques. Yet, over time, the expected penetration of this work was not achieved despite continued theoretical study.

This talk will situate the field of formal semantics within the history of computing. It will explore the various motivations and expectations of the historical actors involved in formal semantics. It will then consider how well the various different proposed solutions to the semantic problem achieved these goals, before examining the other ways in which work on

SATURDAY 15 SEPTEMBER, 14.00-15.30

formal semantics impacted computing generally.

Nofre, David (Independent Scholar)

The appeal of invisible structures: Computationalism and the foundations of computer science

What computer science is and should be is a question which is still today the subject of an active debate. The prominent place that the study of abstract structures of computation continues to play in computer science research and education often weighs heavily on these debates. Yet, little is known about the factors that contributed to this preference for abstraction in computer science. In this talk, I will try to make some progress in this question by focusing on the views of a small group of American computer programming specialists that in the mid-1950s started to adopt fundamental research attitudes toward programming. Some of them, like John W. Carr, John McCarthy, Saul Gorn, and Alan J. Perlis, would play a significant role in establishing the first university programs and curricula in computer science.

Over the last years historians of computing have identified several factors that fed into this shift in the focus of research on computing away from the physical machine, not the least important of which was the proliferation of different computer models, each with its own programming notation. Yet, as I will argue in my talk, this transformation also stemmed from the epistemological presupposition that computers, brains, programming languages, natural languages, and the formal languages of logic, are all fundamentally equivalent systems defined by their common abstract structures.

Historian of science Hunter Heyck has shown how this assumption was part of a broad church logical-positivism that thrived in the United States during the early Cold War. In my talk, I will argue that this assumption was also part of a loose form of computationalism that appealed to many in the early computer science community, and which predated the rise of the 'algorithm' as the fundamental building block of computer science. In short, this talk aims to raise questions about the ways in which the computationalist mindset have shaped the discipline of computer science.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S22/2 SCIENTIFIC PERSONAE AND THE (DIS-)UNITY OF MODERN STATISTICS IN COMPARATIVE PERSPECTIVE, c. 1860-1960

Location: IoE – Room 822

Chair: Vogt, Annette B.

Organiser(s): Mayer, Jochen F. (Independent Scholar)

Following Daston and Sibum's (2003) collection of essays, there has recently been an efflorescence of scholarship on scientific and bureaucratic personae (Becker and von Krosigk 2008; Paul 2014; Algazi 2016). Understood as an intermediary between the individual biography and the social institution, the persona concept explores processes of scientific knowledge making by looking at the interdependence between the subjectivity of the scientist and historically distinct cultural templates to which scholars were invited to conform: context-bound habits such as the 'learned forgetfulness' among married early modern scholars (Algazi 2003), or generic types of thinking, speaking, and working such as the impersonal observer 'from nowhere' in the case of 20th-century physicist Heisenberg (Carson 2003). Recent contributions, in turning to the Humanities around 1900, deploy a more narrow understanding of personae to emphasize discipline-specific virtues and skills deemed necessary to engage in scholarly practice (Paul 2013). Others still focus on the dynamics between the credibility of assertions in science and the ways in which scholars performed and embodied their identity as reliable and trustworthy (Bosch 2016; Shapin 2008). Against this background, this session explores the validity and usefulness of personae accounts for biographical research in the history of statistics during the period 1860-1960. By comparison to the Humanities or modern physics, statistics seem a particularly unpromising field for such a project. During this formative period, generations of statisticians, under the impulse of the 'probabilistic revolution' in science and public life, pushed the field further towards neutrality and technicality, and sought to produce statistical results and methods that were allegedly more 'impersonal' and 'objective' than the outcomes of any other scientific endeavor (Porter 2011). Yet the culture of statistics shapes and is shaped by the people who practice it. Exploration of how statistical credibility was secured beyond the recourse to the authority of the state or the epistemic powers of methods and numbers or, indeed, how statisticians attached moral value to their work, seems particularly timely now, as the very personae of the 20th-century government statistician or public expert – and the authority of the data they produced – have come under attack both from anti-democratic ideologies and developments in electronic database technology and the internet (corporate 'Big Data'). While there is a rich body of work on the institutional and epistemic histories of (governmental) statistics, scholarship (excepting Porter 2004) has only tentatively begun to explore the wide-ranging categories of people that around 1900 became involved in statistics, and the multiple moral and political visions implied. In contradistinction to claims, in numerous biographical encyclopedia, to the unity of statistics and a quasi-linear evolution of statistical science, this session explores the resources – moral, cultural, and epistemic – that had to be mobilized in the making of a 'successful', and 'good' statistician across various national scientific cultures, and how these demands changed during the early twentieth century. Papers may adopt a broad perspective on scientific personae (as outlined above) thereby further probing whether there can be discerned anything like 'statistical personae' in the first place.

Mamak, Wojciech (Polish Academy of Sciences)

Declaring scientific independence: Ludwik Krzywicki and the creation of modern statistics

SATURDAY 15 SEPTEMBER, 14.00-15.30

in Poland 1912-1926

The first wider-scale adoption of statistical thinking and methods in Poland occurred from the early 20th-century - a unique yet so far virtually unexplored episode in the history of quantification. Entering the period of independence, Poland faced the challenge of reconciling diverse statistical traditions (Austrian, German, and Russian). Also, a severe shortage of professional statisticians and a feeble statistical milieu, exacerbated by public mistrust towards state numbers (particularly in Congress Poland) in the late 19th century meant that efforts at quantification were mostly undertaken by, partly unofficial, scientific circles of disciplines other than statistics – economists, historians, anthropologists, physicians, etc. Additionally, when long-lasting stagnation within the scientific community in Poland to-be is taken into account, it is surprising to see a considerable leap in both quantity and quality of statistical work from around 1918, further illustrated by major scholarly (e.g. Kumaniecki and Krzyżanowski's 1915 *Statystyka Polski* [Statistics of Poland] or Eugeniusz Romer's 1916 Geographical and Statistical Atlas of Poland) and institutional (establishment of the highly influential Główny Urząd Statystyczny [Central Statistical Office] in 1918 and Instytut Gospodarstwa Społecznego [Institute of Social Husbandry] in 1921) achievements. To fill this explanatory gap, two hypotheses are offered – scientists' motivation for national state-making and the activity of locally prominent scientific personae. The case of Ludwik Krzywicki – an eminent sociologist-turned-statistician and a revolutionary turned into a top state official is discussed in detail as an exemplary figure in both of these processes.

Ros, Ruben (Utrecht University)

Nineteenth-Century Statistical Personae beyond Boundaries: The Case of Marie Matthieu von Baumhauer (1816-1878)

This paper explores the formation of scientific personae in the nineteenth-century Dutch scientific and bureaucratic context by investigating the practices, idea(l)s and institutional environments of Marie Matthieu von Baumhauer (1816-1878). This bureaucrat-statistician was engaged in numerous activities, such as the coordination of Dutch censuses as head of the short-lived Dutch Statistical Bureau, the organization of the fifth international statistical congress in the Hague and the international promotion of penitentiary reform. In the wake of Daston's and Sibum's seminal work, the "personae" has become a popular concept to illuminate the complex history of science between the individual and the institution. However, historians too often limit their studies of the emergence of personae to relatively clearly demarcated scientific disciplines (Daston and Sibum 2003; Huistra and Wils 2016; Algazi 2016) or bureaucratic institutions (Becker & von Krosigk 2008). This paper will show how Von Baumhauer's progressive ideas on statistical science and methods, and their application in governmental practices, led to the development of a persona that transgressed disciplines and institutions. Moreover, a close examination of the statistician's involvement in international networks of like-minded reformist statistician-bureaucrats such as Adolphe Quetelet, William Farr and Ernst Engel will reveal how this statistical persona maintained an explicit transnational face, and cannot be confined to exclusive institutional, political or spatial categories. Therefore, it will be argued that the persona-concept can fruitfully be amended by the inclusion of multiple contexts and actors in order to enhance its explanatory potential as an intermediary between the individual and the institution.

Lenel, Laetitia (Humboldt-Universität Berlin) (in absentia)

Measurement without Theory? Competing Concepts of the Scientific Persona in Business Forecasting in the Interwar Period

The paper explores the contested ideals and practices of scholarly selfhood as expressed by American and European business forecasters in the interwar period. The recognition of the key importance of economic stability after World War I sparked interest in business forecasting on both sides of the Atlantic. A quickly developing infrastructure of economic statistics seemed to allow for a new, "scientific" approach to business forecasting, which, until then, had often been

SATURDAY 15 SEPTEMBER, 14.00-15.30

dismissed as charlatanry. The move toward statistics and measurement came along with a new commitment to the ethos of mechanical objectivity. Aiming at 'self'-elimination, forecasters applied rigorous procedures to analyse statistics as a means to discover economic "laws." The Great Depression challenged this ethos. A future that was increasingly perceived as malleable demanded for new practices of knowledge production, as embodied in the emerging practice of modelling. As this paper argues, the change in practice came along with the development of a new template for the economist's persona that cherished the brilliant individual as expert in public policy and favoured imagination over measurement, thereby reevaluating the role of statistics in economic reasoning. Tracing the debates between the economists of the Harvard Committee on Economic Research and the National Bureau of Economic Research as well as the group around the Dutch economist Jan Tinbergen, I show how business forecasters navigated between these competing scientific personae, and how this was not only an indicator, but also a factor in the transformation of what we have come to call "the economy."

SATURDAY 15 SEPTEMBER, 14.00-15.30

**S01/2 UNITY AND DISUNITY OF THEORY AND PRACTICE IN RESEARCH ON
ECONOMICALLY SIGNIFICANT SPECIES**

Location: IoE – Room 828

Chair: Klemun, Marianne

Organiser(s): Fedotova, Anastasia, and Mueller-Wille, Staffan

This symposium will be devoted to economically significant species as research objects and their impact on research agendas, methods, strategies, and institutional frameworks in natural history and biology. The topic is deliberately conceived as a very broad one that could potentially encompass a vast array of disciplinary fields within the life sciences. The panellists will consider research on such objects as crops, officinal plants, domesticated animals, fish and wildlife game species, insect pests, and species transmitting contagious diseases. It makes sense that economically significant species have always enjoyed better chances to become privileged research objects; however, there are numerous examples also when some of these species remained under-researched for a long time. The economic, ecological or medical significance of a given species may considerably vary from one national or regional context to another and from one point of time to a different century or decade. Technological changes, in particular, would inevitably lead to enhancing the importance of some species that previously never attracted focussed attention, while other species would cease to be treated as a valuable resource or commodity deserving such attention. Geographic location and economic conditions exercise a powerful influence upon what counts as a biological resource, and thus might affect the making of specific institutional, regional or national traditions and ‘schools’ within specific fields of study. The focus on economically significant species may have provided a convenient strategy to legitimise and enhance the credibility of a particular research agenda in the eyes of academic administrations and private and public sponsors. But even if the choice of some of these species as principal research objects was thus often pragmatically motivated, it could still lead to substantial changes in the institutional and methodological landscapes of science. In earlier periods in the history of life sciences, for example, local agents – farmers, craftsmen and entrepreneurs, hunters and healers, etc. – would usually have had vastly more substantial experience in dealing and working with a specific species than travelling naturalists who produced first scientific accounts of these species. Growing awareness of the economic importance of such species by the state would thus have pressured metropolitan scholars into changing social and institutional arrangements to tap into these knowledge sources at the periphery, forcing them to leave their familiar environment and relocate to new, often challenging and potentially dangerous milieus. At the same time, knowledge gathered in this way needed to be reported back and systematized, often causing major changes in the material culture and publication regimes of science. By looking at the history of research on economically significant species, we hope to arrive at a better understanding of the entangled histories of supposedly ‘pure’ and ‘applied’ research in different regions of the globe and what unites and separates different national and regional traditions in the history of the life sciences from the early modern period to the present.

Mueller-Wille, Staffan (University of Exeter)

Walking in Linnaeus’s Footsteps

In July 2016, I followed the footsteps of Linnaeus through Lapland, together with an artist, ornithologist and local tourism representative. To our genuine surprise, we were able to retrace the most unlikely things in the surrounding landscape of Lapland from the descriptions

SATURDAY 15 SEPTEMBER, 14.00-15.30

contained in Linnaeus's travel journal of 1732. Through a close analysis of the content of this journal, as well as the way it was compiled, I will argue that the reason for this déjà-vu effect turns out to be that Linnaeus, just as we almost three hundred years later, did not travel on his own, but was on a guided tour. Especially his famed descriptions of how Swedish settlers as well as nomadic Sami interacted with animals and plants to support themselves economically were built on what the people he encountered pointed out to him as notable, and what they told him about the peculiarities and uses of plants and animals. Linnaeus himself already promoted the idea that Lapland was "entirely foreign"—as stagnant as it was remote—in order to bolster his credentials as an objective naturalist and to project his own visions of Lapland's economic future. Yet a close reading of his journal reveals that he was on a guided tour, eagerly collecting information provided by people that helped him find his way.

Dugatkin, Lee (University of Louisville)

The Silver Fox Domestication Experiment

For the last six decades a dedicated team of researchers in Siberia has been domesticating silver foxes (*Vulpes vulpes*) to replay the evolution of the dog in real time using a species that, because of its fur was, and is, of great economic significance. The idea was the brainchild of Dmitri Belyaev, and Lyudmila Trut has been the lead scientist on this work since 1959. Belyaev's theory was that all domestication events in human history began with our ancestors choosing the calmest, most pro-social to human, animals. In practice, Belyaev and Trut tested this idea by selecting the tamest silver foxes, generation after generation. Not only did they produce a domesticated fox in a matter of decades, but there is a unity to traits associated with domestication, as in addition to tamer animals, the foxes in this experiment show many morphological, anatomical and hormone traits seen in other domesticates (despite the fact that Belyaev and Trut only selected on behavior). Having spent seven years working on a book about this long-term study with Lyudmila Trut, I will discuss not only how this experiment has led to major advances in our understanding of the science of domestication (genetics, developmental biology, anatomy, endocrinology, physiology and behavior), but will also touch on the politics and intrigue behind this work.

Bont, Raf De (Maastricht University)

Conservation by Slaughter: Socio-Technical Imaginaries for Africa, 1955-1965

In the late 1950s and early 1960s leading figures in the international conservation circuit – such as Julian Huxley, Frank Fraser Darling and Barton Worthington – successfully propagated new visions about the value of undomesticated African mammals. Rather than as integral parts of a natural equilibrium that should be left untouched, they framed wild mammals as a highly efficient source of protein for a growing African population. The non-interventionist ideal of 'integral nature protection' was challenged, and proposals for active management through game 'ranching' and 'cropping' increasingly became *en vogue*. In my paper I will explore how the various reasons behind this shift, highlighting the importance of changing networks, changing scientific conceptions and changing geopolitics.

The new focus on wildlife as a source of protein, I will argue, ties in with a gradual change in leadership in the leading international conservation organization of the time: the International Union for the Conservation of Nature (IUCN). The rising influence of British and American scientists with an interventionist conception of wildlife management challenged the French and Belgian preservationist ideals of non-intervention, which had been dominant in the early days of the organization. Leading voices within IUCN, furthermore, believed the economic rationale of the more interventionist approach would benefit the organization on a strategic level. A focus on feeding human populations carried the promise of fostering contacts with the special agencies of the United Nations – in the hope of strengthening the shaky financial foundations of the Union. Organizational changes coincided with shifts in scientific thinking. In line with the technocratic optimism of the post-war years, ecologists moved away from an organicist interest in 'climaxes', while more utilitarian concepts such as 'carrying capacity' and 'biomass' gained

SATURDAY 15 SEPTEMBER, 14.00-15.30

traction. Studying wildlife as a source protein nicely fitted the new paradigm. Finally, and probably most importantly, looming decolonization was seen by western conservationists as a major threat that necessitated a rhetorical adjustment. The new African leaders, so it was believed, would be uninterested in the spiritual values of science, while they might be convinced with materialist arguments about proteins. Ultimately, only a combination of organizational, scientific and geopolitical factors, I believe, can explain why eating game came to be seen as a promising project for the international conservation community.

Gago, Maria do Mar (Institute of Social Sciences, Lisbon)

Robusta Empire: Coffee, Agency and Power in the Making of Colonial Angola (1898-1961)

Coffee cultivation has been presented in the historiography of colonial Angola as a paradigmatic case of retrograde imperial rule, and the coercion and violence of European controlled plantations relying on forced African labour as main reasons for the economic success of coffee. This paper uses the lens of scientists to offer an alternative picture pointing at the actual forests where the plant was cultivated, and where also Africans were growing their own coffee. Moreover, it unveils a hidden imperial strategy aimed at modernizing both European and African coffee production systems. The key to this neglected history is how scientists engaged with Angolan coffee: not as coffee in general, but as a specific type of coffee: *Coffea canephora*, an indigenous species to Angola, also known as Robusta coffee. By following the challenges of producing Robusta coffee in this particular colonial space, this paper revisits the history of Portuguese colonialism in Africa and highlights the importance of considering Robusta coffee's environmental history to make sense of colonial dynamics in Angola.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S13/2 THE HISTORIOGRAPHY OF SCIENCE AND RELIGION IN THE CONSTRUCTION OF MODERN EUROPE

Location: IoE – Committee Room 1

Chair: Navarro, Jaume

Organiser(s): Navarro, Jaume

“Science and Religion” is a popular category in the Anglo-American world, both among academics and the public at large. In a 2006 seminal paper, Peter Harrison challenged the historical origin of this three-word category. In his work, Harrison historicises the modern origins of “science” and of “religion” as we understand them today and concludes that their relationship is a result of the evolution of both notions. But the story he tells, we would argue, is one that focuses mainly in the Anglo-American Protestant world. The separation between religion qua “virtue” and religion qua “the content of faith”, which he traces back to the conflicts between Catholics and Protestants in the Early Modern period, would be the seed of the long tradition of a specifically Protestant natural theology. In this session we suggest to explore the limits of this historiographical notion in other Christian and non-Christian traditions, and the ways in which “science-and-religion” has spread throughout different European contexts. The emphasis on mysticism in the Orthodox world, for instance, or the neo-Thomist notions of reason (not science) and faith (not religion) in some Catholic worlds, are but only two examples that may challenge the usual historiography and current relationships between science and religion. Papers in this session cover a broad geographical spectrum: from Turkey and Greece over to Italy, Germany and Spain and focus majorly in nineteenth and early twentieth case studies of Orthodox, Muslim and Catholic milieus, as well as non-denominational and alternative views on religion and knowledge.

Yalcinkaya, M. Alper (Wesleyan University)

Science, Religion, and “Science-and-Religion” in the Late Ottoman Empire

In this paper I discuss how “science and religion” acquired the status of a valid topic of debate in the late nineteenth century Ottoman Empire. I explore how Muslim Ottoman authors debated the nature of the new sciences of the Europeans and the meanings of civilization and progress, in the meantime developing ways of talking about Islam that rendered it a “religion” comparable to the religion European authors referred to in their texts on religion and science. These texts were commonly of an apologetic nature; Ottoman authors’ texts were in effect responses to European critics who portrayed Islam as a religion that hampered progress. I show that in many cases where Ottoman authors made the opposite argument, they were able to use as ammunition the works of other European authors who offered more positive views on the qualities of Islam. Yet this move itself further contributed to the representation of Islam as a “religion” with an identifiable essence and clear boundaries, as a cultural category that could and should be distinguished from the category “science,” and as an institution generating knowledge claims that may or may not conflict with those of science. I analyze the writings of the authors Ahmed Midhat, Namik Kemal, and Semseddin Sami, and illustrate how their representations of science, civilization and progress were simultaneously arguments about the nature of Islam as a religion. “Science and religion” became a valid and relevant topic of debate in the Ottoman Empire through such texts that reified “science” and “Islam.”

Tampakis, Kostas (National Hellenic Research Foundation)

[Greek-speaking Orthodox apologists of the 19th and early 20th centuries]

This paper proposes to analyze the relationship of science and religion qua categories in the discourse of a specific category of actors, that of Greek-speaking apologists. Many case studies within History of Science focus on science, and treat religious discourse as a reaction. What kind

SATURDAY 15 SEPTEMBER, 14.00-15.30

of narrative emerges if we reverse the historiographical point of view? Moreover, Orthodox apologetics in the Greek-speaking world preexisted the establishment of the University of Athens' School of Theology in 1837. In fact, many of the most famous Orthodox apologists, like Panagiotis Trempeles and Ioannis Skaltsounis, were not in fact affiliated with the University, or the formal Church itself. This paper will look at the most prominent Greek-speaking apologists of the 19th and early 20th centuries to discover what issues they were addressing when they talked about Orthodoxy and science. Were the terms themselves unambiguous? What did they include and exclude, as actor categories? In fact, within Orthodoxy, theology itself as a category is still seen as problematic exactly because it came from the West, and in many cases, the academia was seen as suspicious for the same reason. How were then apologetic writings framed? Finally, the paper proposes to move away from discussion of Darwin and the calendar, whose powerful historiographical attraction in some cases obscures the existence of other themes. If we instead focus on the works of Greek-speaking apologists, treating them not as reactions against an advancing scientific practice, but as self-contained oeuvres of discourse, what themes may present themselves?

Cantor, Geoffrey (University of Leeds)

Personality: The missing link between Science and Religion?

Faraday's attitudes to both science and religion can be understood within the larger framework of his personality. Put simply, he felt profoundly threatened by disorder of any form; for example, political revolution was an anathema to him. His scientific activities and his participation in the Sandemanian Church can both be understood as ways of guarding against incipient disorder. The laws of nature and the Bible provided the fonts of order that underpinned Faraday's life. His drive to live in an orderly universe was central to his personality and his personality was both affected by and underpinned by his science and his religion. (Query: What is the psychological meaning of the "argument from design"?) Henry Cavendish had a very different personality. He was, as Russell McCormmach has argued, on the autistic spectrum. Like many high functioning autists, he was drawn to science as a domain where he could exercise his caution and his drive for accuracy. By turning to science he could also minimise contact with others. Unlike most of his contemporaries, however, Cavendish had virtually no contact with religion and seems to have rejected it outright. (Query: Are those (moderns) with autism likely to embrace scientism, reject religion and adopt the conflict thesis?). This paper, then, raises questions about whether and how the study of personality can play a role in helping us appreciate how individuals construct their understanding of both science and religion and the relationship between the two.

Le Roux, Benjamin (University of Bordeaux)

Science and Religion in the secular France of the early 20th century, the case of Henri Devaux (1862-1956)

In this study, our purpose is to describe how, in the secular France of the early 20th century, a figure of the scientific world could assume a public religious activism, even in a religious fundamentalist community. We will focus on the case of the French physiologist Henri Devaux (1862-1956), member of the Académie des sciences and professor at the Faculty of sciences of Bordeaux, like Pierre Duhem. Despite the fact that Devaux was openly involved in the activities of the local Evangelical community, he also became an exemplary figure in the French scientific world, even for some advocates of the *laïcité à la française*. Throughout his career, Devaux showed a willingness to transgress the classical disciplinary boundaries. Trained as a botanist, he achieved an international reputation thanks to his work on physicochemistry of surfaces and played a role in the molecularization of life sciences. Devaux extended this supradisciplinary logic to the religion itself. Following a "complementary" approach, he conceived science and religion as two components of a unique whole: the Science complète. Devaux made multiple religious references in his laboratory notebooks, he underlined his religious faith in scientific papers and he participated, through conferences and publications, to a popularization of

SATURDAY 15 SEPTEMBER, 14.00-15.30

sciences in service of Christian apologetics. Without neglecting the numerous conflicts between science and religion throughout the history, we intend to study the modalities of a dialogue that took place in Devaux's work, as well as its reception in the scientific world and in his religious community.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S25/2 CIRCULATING GENDER IN CONTEMPORARY SCIENCE

2. GENDERED RESEARCH OBJECTS

Location: IoE – Room 739

Chair and Commentator: Opitz, Donald L.

Organiser(s): Romero de Pablos, Ana

This pair of sessions presents contributions about travels and shifts experienced by woman scientists as well as by gendered scientific objects in the history of science during the long, influential twentieth century. The aim is to investigate the concepts of circulation for a feminist epistemology of the sciences that focuses on the permanent movement and travels of women and gendered objects in history of science. We are interested in tackling the issue of exploring experiences in the laboratory, the field and the factory. By following the movement of women's scientific practices from one place to another, from one time to another, we aim to demonstrate their permanent presence in the contemporary sciences, institutions and laboratories, in teaching duties and academic practices.

Stamhuis, Ida (Vrije Universiteit, Amsterdam)

[Gender and International Conferences in the Emerging Science of Genetics]

In the emerging science of genetics, research objects and people travelled from the beginning. Research objects, like grains and fruit flies, were exchanged; researchers visited each others' institutes. They travelled to the international conferences that started in 1899. During these meetings, which were essential temporary nodes in these international networks, knowledge was exchanged and the exchange of research objects and people was prepared. The scientific work was adapted to international trends. I will compare the men and women traveling to those conferences. To which extent were the roles they played at these conferences gendered? I will especially concentrate on the fifth conference in Berlin in 1927 and demonstrate that, although the success of this conference was largely dependent of the organizational capabilities of women connected to the Berlin genetics institute, these female researchers were less visible than their male colleagues. I will show that some of them did nevertheless succeed to lay the foundation for later exchange of people and objects, while further developing an own research niche which was within reach of their gendered opportunities.

Richmond, Marsha L. (Wayne State University)

Women in the Field and in the Discipline: Sally Hughes-Schrader and the Shaping of Cytogenetics

From the early days of genetics, work on the cellular basis of heredity progressed alongside the breeding experiments in service of revealing knowledge about the cellular mechanism associated with inheritance. Such studies were important both for geneticists and cytologists alike, but the new "hybrid" field of cytogenetics developed over time. Cytogenetics, according to its modern definition, is a field "concerned with the structure, number, function, and movement of chromosomes and the numerous variations of these properties as they relate to the transmission, recombination, and expression of the genes" (Schulz-Schaeffer 1980, 2). But the shaping of cytogenetics as we understand it today first began in the first decades of the twentieth century, and reflected attempts to combine the interests, methodology, and results of two originally separate disciplines.

One of the leading figures in the rise of this new field was the American Sally Hughes-Schrader (1895-1984), who obtained a Ph.D. in cytology in 1924 under the renowned cytologist E. B. Wilson at Columbia University. Following in the footsteps of Wilson's earlier student, Nettie Stevens (1861-1921), Hughes-Schrader gained an international reputation for her long-time study of insect chromosomes and their hereditary importance, largely carried out in collaboration with her husband, Franz Schrader (1891-1962), another of Wilson's protégés and

SATURDAY 15 SEPTEMBER, 14.00-15.30

his eventual successor.

This paper focuses on an early period in Hughes-Schrader's long and distinguished career, specifically, her early study of the irregular cytogenetics in Coccids (minute scale insects that parasitize different plant species) in the late 1920s and early 1930s. During these years Sally spent much time in the field collecting species, in the laboratory preparing specimens, and at her desk contemplating her findings. The end result, in addition to papers on various aspects of her work, was an important theoretical paper published jointly by the couple entitled "Haploidy in Metazoa" (1931). The present paper will explore how Sally transitioned from identifying with cytology to the field of study that in 1930 she characterized as "cytological genetics." I argue that her field study and breeding experiments led her to envision herself as a practitioner of this new line of work.

Velasco Martín, Marta (Instituto de Filosofía, Consejo Superior de Investigaciones Científicas)

Women geneticists and gendered flies circulation in the practices of *Drosophila* population genetics

Travels and shifts were key for *Drosophila* research and evolutionary studies. Theoretical and methodological knowledge travelled in different formats: in papers being part of journals, books, institutional documents, telegrams, business cards, research notebooks, diaries, postcards, and letters; in research objects like microscopic slides, etherizers, incubators, nets and flies; and through people. Women and men geneticists literally moved from one place to another for conducting research, attending congresses, being trained and being the trainers. Spanish geneticist María Monclús, from the Institute of Genetics in Barcelona travelled to collect and classify *Drosophila* flies. As her colleagues, she chose female flies for being brought to her laboratory and to be sent to others by post in tubes or vials containing laboratory food and information on names and capture locations and on optimal conditions for growing and breeding them. At destiny, they were used to furnish living populations in laboratory culture bottles. In this paper, I explore flies as gendered research objects which condensed knowledge in their bodies, in those of their offspring and in the papers that accompanied them along their travels. I propose flies also as living objects for transferring not only knowledge between the field and the laboratory, between houses and institutional places, between countries and between geneticists, but also gender and authority.

Santesmases, María J. (Instituto de Filosofía, Consejo Superior de Investigaciones Científicas)

Gendering the bacterial shape: Emmy Klieneberger-Nobel and the L-forms

As historian Christine von Oertzen (2012) has described, in 1934 the German-born microbiologist, Emmy Klieneberger-Nobel, returned from visiting her mother and sister in Jena, Germany, to her laboratory at London's Lister Institute and accommodation in Crosby Hall, funded by the British Federation of University Women. Klieneberger was carrying a new research microscope, paid for with her savings. Combining this advanced optical instrument with her bacterial knowledge, the following year Klieneberger detected unusual bacterial shapes. As she noted in her research records, these forms lacked the wall that gives bacteria their particular morphology; she described these bacteria as amorphous and named them L-forms. L-forms became one of the bases of the bacteriology of infection and cancer.

Klieneberger, recognized as a pioneering microbiologist even today, had few facilities in her modest laboratory, only the microscope and her expertise in preparing the slides that enabled these bacterial forms to be observed. Klieneberger has been praised for her meticulousness in these preparations, a gendered skill she acquired during her years in Frankfurt, when preparing for her Habilitation. I will discuss the circulation of her gendered research skills, shared with contemporary woman colleagues, which constructed her scientific and social identity as a researcher and expert microbiologist.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S15/2 TOWARDS A CURRICULUM OF POLITICAL EPISTEMOLOGY: THEORY AND CASE STUDIES

Location: IoE – Room 780

Chair: Wittje, Roland

Organiser(s): Omodeo, Pietro Daniel

Political epistemology brings into focus the praxis of science, in its collective and oriented character. It programmatically aims to reach a unified cultural understanding of the apparently disunited strands and dimensions of science. Its historical-epistemological approach considers that science emerges from the historical terrain of the human activity and work that bring together the hand and the mind within collective spaces of interaction. It specifically looks at science as mediating between the socio-economical and the cultural-ideological. On the one hand, it evidences the function of science to secure the production and reproduction of societal formations. On the other, it takes into account the ideological dimension of science insofar as it provides for ways to justify and criticize social order and helps reorient, transform and imagine alternative ways of living. In accordance with these premises, we propose that historians of science explore cases that enable us to contend with the political economy of knowledge in its making. In particular, we would like to emphasize the following entangled themes: * The political dimension of cognition as alienated (extracted, codified, abstracted, externalized) practical knowledge should be investigated through the ways in which science historically reflects (mirrors, parallels, reinforces) social difference and power relations. * Further research in history of science should consider how political structures and ethos (in democratic republics, authoritarian states, court society etc.) informs science at the level of contents, epistemic values and methodologies (argumentation, demonstrative procedures, reasoning, styles for instance). * Political epistemology thirdly requires to study the political directedness of science, that is, to study it as contested fields of ideological struggles for cultural hegemony.

Badino, Massimiliano (University of Verona)

French Celestial Mechanics and British Natural Theology: A Troubled Relation Revisited

During the eighteenth century celestial mechanics attained some impressive scientific achievements, which rapidly earned it the title of “queen of physical sciences”. In the capable hands of D’Alembert, Euler, Clairaut, Lagrange, and Laplace the application of Newtonian theory to heavenly bodies spectacularly succeeded in describing several celestial phenomena. These feats reinforced the belief that the universe was an autonomous, self-contained mechanical system. This view was bringing scientists a step beyond Newton’s conception of God as an intelligent clockmaker. It was leading straightforwardly to Laplace’s quip about the superfluousness of the “hypothesis of God”.

In revolutionary France, the cultural consequences of this development were momentous. For an entire generation of intellectuals, the results of celestial mechanics represented a source of metaphors and arguments to justify a profound social, political, and philosophical renewal. In this perspective, particularly remarkable was the “proof” of the stability of the solar system which demonstrated that the world behaves like an autonomous system. This result quickly became part of a new conception of society inspired by the “Science of Progress”.

When these ideas crossed the Channel, in the 1830s, they unavoidably impacted heavily on English culture. Certainly, the outcomes of celestial mechanics could not simply be dismissed, nevertheless they posed challenging philosophical and social problems to the British tradition of Natural Theology and above all to its education policy. In the Prison Notebooks Gramsci writes that “every relationship of hegemony is necessarily an educational relationship,” thus in

SATURDAY 15 SEPTEMBER, 14.00-15.30

this paper I discuss how William Whewell reacted to the counter-hegemonic threat from France by reorganizing Natural Theology to encapsulate argumentation techniques originally deployed in celestial mechanics. Focusing especially on the restructuring of the argument from design using the proof of stability, I analyze some aspects of the cultural struggle between Natural Theology and Science of Progress for the establishment of a “common-sense” discourse on the natural world as a basis for educational policies.

Freyberg, Sascha (MPI, Berlin)

Metapolitics and History of Science in Marburg Neo-Kantianism

While the so-called Marburg school of Neo-Kantianism today is known for its epistemological works and is now also recognized as important resource and instigator for the history of science, its political program of an ethically grounded socialism is largely forgotten. In his introduction to Friedrich Albert Lange's *Geschichte des Materialismus* Hermann Cohen gave a concise presentation of this idea taking up the concept of metapolitics. My contribution presents a reconstruction of the relationship between the political and the epistemological program of Marburg Neo-Kantianism. In order to analyze the role history has in this relationship, I will focus on the works of Hermann Cohen and Ernst Cassirer. Although the overtly political motivation seems to be absent in Cassirer, it can be shown that it was inherent in his historiographical perspective. The leading question for my presentation is, in how far the Marburgian program of closely connecting epistemological, historical, ethical and political issues may be a model for political epistemology as integrating the history and philosophy of science.

Bougleux, Elena (University of Bergamo)

Hegemony, Subalternity, Political Claims: Knowledge and Production Processes in a Multinational Corporation

Modern technology is revealing of global disequilibria and asymmetries in power relations between social subjects, collectivities and world areas with different access to technological capabilities. Power imbalances have emerged between new global players that variously interact with traditional hegemonic groups. The emerging actors of the global economy appear to be committed to a severe competition that aims to achieve a model of development, the ‘western model’, which is instead proving all its limitations through repeated financial crises, with unsustainable impacts, through exacerbation of conflicts on primary resources (Crouch 2011). Strong conflicts therefore emerge between those who hold and control the bodies of knowledge and those who aspire to acquire them, interpreting them as drivers of development and potential agents of social transformation (Gupta 2012). The new quality of such power asymmetry uncovers a kind of deliberate participation to the condition of subalternity, that large world areas put in place at their own damage, with the objective aim to ensure an access to knowledge and technology. These practices of emulation and competition provide examples of complicity with the hegemonic rhetoric (Spivak 2008), and help strengthen pairs of opposites (us/them, emerging/advanced, technological/intuitive, hegemonic/subaltern) increasingly polarized and increasingly less dialectical. My paper discusses the dialectic between hegemony and subordination when this is incorporated and shaped in practice by an economically powerful subject like a multinational corporation. Starting from the ethnographic analysis of the Research and Development Department (R&D) of a western corporation located in India, the research outlines the asymmetric relations between groups with different powers and authority involved in the production processes.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S32 SOLAR ENERGY TECHNOLOGIES: UNITY AND DISUNITY OF LOOSE EUROPEAN MEMORIES

Location: IoE – Room 784

Chair: Arellano-Escudero, Nelson

Organisers: Arellano-Escudero, Nelson, and Roca-Rosell, Antoni

Since at least the 1970s, after the first oil embargo, some historians focused on energy. After this, scholarship on energy studies has developed and matured through analyses ranging from fine-grained studies of specific energy sources and technologies to ambitious broad surveys of energy across history, for example, Vaclav Smil, *Energy in World History* (1994). This historical interest at least in part reflects current concerns about oil supplies, nuclear uncertainties, environmental pollution, geopolitics, global climate change, and other energy-related issues. Energy vitally determines the quotidian choices of households, businesses, and countries. The rise of interest in energy stories is a very interesting phenomenon that attracted historians from different fields as economics, environment, science, and technology. Nevertheless, the most relevant source of energy for life on the earth planet, Solar Energy, has not attract enough attention. In some periods, the uses of solar energy seems to be discarded. In other circumstances, solar energy recuperate the attention, but usually for a short time. Archives in several European countries, USA and Latin America contains memories about the research and development of Solar Energy Technologies. Exploration of thermosolar and photovoltaics between XIX and XX centuries open a discussion about the technological fix and the problem of technocracy. Those loose memories of Unity and Disunity remain fragmented and require a kind of narrative against silence and oblivion. We need to go in-depth with biographies, events, social structures, experimentations, and larges organizations, some of them active from the XIX century. We hope to contribute with an interdisciplinary approach to a build narratives of the non-linear co-evolution of Technology and their eventual impact on sustainability, and then to strengthen a position that demonstrates that the environmental questions are not exclusively a scientific, technological or social matter, instead of an entangled problem of the great acceleration era. This symposium proposes a critical vision trying to join scientific, technological, environmental, economic, and political history and/or some of them with a dialogue between humanities, social science, and arts. These relationships allow us to understand viable alternatives to technologies, their energy source, and their path. George Basalla's theoretical model for understanding how technology evolves explains that there is a selection process between continuity and innovation, while David Edgerton's vision about innovation contributes arguing, among others, that the winning technology selected is not always the most economical, and many times Creole Technology is the core of the relationship between innovation and tradition. This panel seeks to stimulate discussion about energy and civilization, the same title for Basalla's paper in 1981 and the Vaclav Smil's book in 2017, hoping this will be a proper way to think about the challenges to sustainability focusing on the cultural, political, economic, geographical, and environmental dimensions from a transboundary perspective for re-unified some disunities.

Arellano-Escudero, Nelson (Universidad de Tarapaca)

Chilean circulation on solar energy technologies: unity and disunity between South America and Europe

Between 1950 and 1980, 4 Chilean engineers went to Europe and get international connections and interchange with European researchers and experts on solar energy technologies. Julio

SATURDAY 15 SEPTEMBER, 14.00-15.30

Hirschmann, Orly Alcajaga, Angelo Filippini, and Roberto Corvalán participated at different conferences in different countries: Spain, France, and Italy. The international projection of Chile is well documented especially thanks to the relevance of Atacama desert and the devices used by solar energy applied there since XIXth century. Archives in Fondazione Luigi Michelletti in Brescia, Universidad Santa María from Valparaíso, Chile, and several testimonies give us access to letters, pictures, drafts, and papers thanks to which we could collect information about the circulation of Chilean researchers in Europe inside international organizations and conferences. Those events did link the Mediterranean countries, the United Kingdom, Germany and the Americas. This evidence contributes to develop a critical re-read about the global North-South relationship and demand a deep discussion around the methodological nationalism, science frontiers, birth and death of organizations, and creole technologies. Here we can conclude that the loose memories can bring a new direction to narratives about the co-evolution of the technology and, that we need understand more deeply the myths of energy and civilization. This work is included in the research project Fondecyt Postdoc 3160197.

Roca-Rosell, Antoni (Universitat Politècnica de Catalunya)

Maria Telkes and Giorgio Nebbia and the promotion of an International network of Solar studies (c. 1955)

By 1953, Giorgio Nebbia (born in 1926) wrote a letter to Mária Telkes (1900-1995) to ask her for information about solar distillation of water. After this, an interchange of papers and letters was generated, including the preparation of the first international congress on solar energy, which took place in 1955. Nelson Arellano met professor Nebbia in September 2014 and, as one of the results of the meeting, he got a copy of the correspondence between him and Telkes. In addition, we have explored some other archives and sources. In the 1950's, solar energy seems to be considered again as an alternative source of energy, after some decades of a certain oblivion. The congress of 1955 represented a maximum of interest, after which there was a new period of shadow. In this paper, we propose an analysis of origin of an international network of solar research through the correspondence Nebbia-Telkes. Our aim is also to enhance the role played by these two prominent researchers. Nebbia is a scientist with a long career, being also an activist and a politician involved in the claim for green energy. Telkes was a highly respected engineer, who was the first to receive the Society of Women Engineer's Award for Meritorious Contribution to Engineering in 1952.

Bouvier, Yves (Paris-Sorbonne University)

[Solar energy research in R&D departments shaped for nuclear energy]

Few months after the first oil shock, most of the industrialized countries took political decisions in the field of energy. Energy saving and energy conservation were one part of this policy, rooted in the necessity of reducing the oil imports. The second part of this attitude was the development of new energy sources. In fact, nuclear energy and renewable energy sources (but also coal in some countries, like Germany) were the two technologies promoted to reduce oil-dependence at a national level and at a European scale. Of course, these technologies were not new fields in 1974. This paper study how solar energy research was conducted in R&D department shaped for the nuclear energy. In France, the CEA (Commissariat à l'énergie atomique – Atomic Energy Commission) and EDF (Electricité de France, the national operator of the nuclear power plants) decided to study solar energy and were the leaders of some projects. Building solar houses in some cities, using photovoltaic panels in French Oceania in the 1980s, designing the thermosolar power plant Thémis in 1983... are few examples of realization made by these actors. The focus will be put on the capacity of big laboratories to integrate researchers, which could be in competition with the main field of research (here nuclear energy). PV or thermosolar technologies were also associated with the social and political contests of nuclear power. But it was also a crucial stake for the nuclear actors to be able to promote other technologies as an alternative.

Cardoso de Matos, Ana (Universidade de Évora)

SATURDAY 15 SEPTEMBER, 14.00-15.30

The Portuguese engineers and the solar power in the international context (from 1955 to 1970)

While being bound by the mobility movement of “experts” and by the knowledge and technology transfer, Portugal was not oblivious from world movement and The National Laboratory for Civil Engineering (LNEC) developed a series of initiatives to increase research in solar area. In this way, foreign engineers had been invited to deliver lectures, as it was the case of Engineer G. Remenieras who started a series of trials on various types of solar distillers. In 1960, in collaboration with the National Meteorological Service, LNEC organized a Colloquium on the Use of Solar Energy, which contributed to develop the interest and the studies on this kind of energy. Among Portuguese engineers who stood out on solar energy research during these decades, we can mention Joaquim Laginha Serafim, (1921-1994), Chartered Engineer in dams and Head of LNEC Service of Dams between 1948 and 1963, who made several trips abroad and played an essential role in studies development on solar energy in Portugal. This engineer was joined by several others, such as António Gouvêa Portela, professor at the Industrial Institute of Lisbon, or José Maria de Quadros Costa, engineer at the National Electricity Company. This paper aims to analyze the initiatives that were carried out in Portugal to develop the research and solar power applications, as well as the engineers who have been associated to these initiatives, framing them in an international context. This work was developed within the frame of the project CIDEHUS - UID/HIS/00057/2013 (POCI-01-0145-FEDER-007702) and of the Spanish project HAR2016-75871-R.

I147 SCIENCE AND HUMAN AGENCY

Location: IoE – Room 790

Chair: Fyke, Robert

Calvo-Monreal, Xavier (Centro de Ciencias Humanas y Sociales. Consejo Superior de Investigaciones Científicas. Spain)

From Primates to Humans: Josep Egozcue and the Beginnings of Cytogenetics in Barcelona

Josep Egozcue (1940-2007) became interested in genetics while he was studying medicine in 1958 at the University of Barcelona, while attending the classes given by the physician turned anthropologist Santiago Alcobé and with Antoni Prevosti, chair of genetics at the University of Barcelona. In 1965, after writing to several research centers, Egozcue was appointed head of genetics at the Oregon Regional Primate Research Center in Beaverton (United States). While working in the description of the chromosomal characteristics of primate species, his aim was to use the techniques and knowledge in order to study the human species. His publications between 1966 and 1967 mainly dealt with primates, but his doctoral thesis, consisted in the study of the effects of LSD on human chromosomes. Back in Spain, 1969, he worked with Gerónimo Forteza, hematologist and Spanish pioneer in human cytogenetics, at the Center for Cytological Research in Valencia and published a paper about the identification of the Philadelphia chromosome in bone marrow cells using autoradiography techniques. After eight months in Valencia, Egozcue returned to Barcelona. In 1970, he joined the Basic Biology Institute at the Universitat Autònoma de Barcelona (UAB) focusing his research in human cytogenetics without abandoning the primates and the effects of LSD. The aim of this communication is to show the first years of his research career and how techniques and instruments moved with him to new spaces, his change from primate to human cytogenetics and the establishment of the discipline in Barcelona during the 1970s.

Duck, Francis (University of Bath)

Edith Stoney (1869-1938): A journey from mathematical physicist to medical engineer

Edith Stoney's life, from Newnham College, Cambridge, through physics lecturer at the London School of Medicine for Women (LSMW) to managing radiology departments in the Scottish Women's Hospitals (SWH) during WWI, epitomises the challenges that faced women scientists and engineers in the early 20th century. This paper sets out her challenges, and how she overcame them. Her upbringing as daughter of the physicist G Johnstone Stoney drove her interest in science. She was unable to convert her outstanding ability in applied mathematics, giving advice to Sir Charles Parsons on marine turbine stability and astigmatic searchlight beam design, into paid employment. Later, as head of physics at the LSMW, she was arguably the first woman in Britain to run a university physics teaching laboratory. Both there, and in her later role managing x-ray units for the SWH in France, Serbia and Salonica during the war, she was limited both by her gender and by her medical colleagues' refusal to treat a scientist as an equal. Her leading work as a war-time radiographer contributed to the x-ray diagnosis of gas gangrene, and the precise radiographic localisation of foreign bodies, both vital for the successful management of the wounded. She was unflagging in her assertion that women were equal to men as scientists and as engineers. Her legacy remains in the Johnstone and Florence Stoney Studentship, in memory of her father and sister, and still available to support women in medical training.

Elina, Olga (Institute for the History of Science and Technology, Russian Academy of Sciences, Moscow)

Ladies in the Fields: Education and Career Development of the first Women Agronomists in Russia, early 20th century

Since the late 19th century, the Russian civil society was campaigning to include the issue of women's higher education on the agricultural agenda. However, for a female candidate to receive an agricultural degree, she would require special permission from the Ministry of

SATURDAY 15 SEPTEMBER, 14.00-15.30

Agriculture. This paper addresses the social, psychological, and bureaucratic obstacles for women's higher agricultural education in the late 19th - early 20th century Russia. In particular, as the practice of agriculture in Russia was traditionally seen as a male career, this paper will explore unity and disunity between male and female agricultural discourses. The paper explores the crucial role of the Association for the Advancement of Women's Agricultural Education (1899), which united both female activists and male professors, and already in 1904 launched the project of the non-governmental higher educational courses for women. I will examine motivations, higher educational experiences, and career development of the three female pioneers in agriculture: Josephine Kossko-Sudakevich, who became the first woman agronomist at the zemstvo's service; Lidiya Breslavets, a famous Russian cytogeneticist; and Vera Velikanova, a graduate from the private Golitsyn Women's Courses, and a plant breeder. My argument is that, despite the perception of Russian higher education as a state institution, in women's education public initiatives proved to be no less important. I also argue that those women, who managed to receive higher education in agriculture, were rather successful in their careers. There was the 1917 revolution, however, that influenced the socio-economic aspects of women agronomists' practices, but not scientific achievements.

Yang, Liqiong (Sorbonne Université - Faculté des lettres)

La théorie de la 'tripartition de l'âme' dans la médecine grecque et la théorie des 'cinq airs' dans la médecine chinoise pendant la période classique: approches comparées

Dans le Classique de la Médecine Interne de l'Empereur Jaune, l'air est divisé en 5 catégories : âme, esprit, conscience, énergie, et volonté. Il est établi que ces cinq types d'air forment chacun un objet complet, nommé esprit. Quand il reste dans le corps, il se répartit dans les cinq viscères - le foie, le coeur, la rate, les poumons et les reins - et y déploie les fonctions physiologiques correspondantes. Les cinq viscères constituent les bases matérielles, et les cinq types d'airs constituent la force motrice de la vie. L'âme au sens étroit est le coeur abstrait, du fait qu'il possède la fonction de la réflexion, qu'il domine les cinq airs au centre et qu'il se situe dans le coeur (coeur figuratif et coeur des viscères): il devient l'essence des cinq viscères et le 'roi du corps'. Jusqu'à présent, aucune comparaison n'a été faite entre la théorie de la tripartition de l'âme et celle des cinq airs.

**S38/3 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES:
CRITICISMS AND CHALLENGES**

Location: IoE – Room 731

Chair: Raj, Kapil

Organisers: Silva, Matheus Alves Duarte (Ecole des Hautes Etudes en Sciences Sociales)

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945.

Dierks, Dennis (University of Jena)

[Circulation of the concept of *medeniyet* (civilisation) in Russian Crimea and Habsburg Bosnia]

Discussions of Muslim Modernity often focus on its leading figures in the cultural centres of the Islamic World. Focusing on Russian Crimea and Habsburg Bosnia, two regions that were not affected by a process of radical de-Ottomanisation, this paper adopts a different perspective, analysing processes of knowledge circulation between centre and periphery. The analysis of the Bosnian Muslim and Crimean Tatar press before World War I demonstrates a keen interest in and close observation of the Muslim brethren. This paper will concentrate on such processes, which the study of Muslim modernisation has neglected so far. Focusing on the travelling concept of *medeniyet* (civilisation) the paper investigates how a key concept of the Ottoman reform discourse was negotiated in a translocal communication process and then translated into local contexts. Being appropriated by the intellectual elites of the Bosnian Muslims and Crimean Tatars it became melted with other concepts of civilization and progress. In a last step, it had to be translated into the specific local contexts in order to get popularized and to be understandable for the illiterate masses. Retracing this complex process of transimperial communication, the paper strives to discuss the validity and feasibility of the concepts of

SATURDAY 15 SEPTEMBER, 14.00-15.30

translocality and cultural translation for the investigation of processes of knowledge production and circulation.

Nahmias, Noa (York University)

A Space for Popular Knowledge: Images, the Global and the Local in China ca. 1930

In August 1933, the China Science Society published the inaugural issue of *Science Pictorial*, a popular science publication for non-professional readers. The image on its cover depicted two children surveying a scene of scientific wonders. This was an adaptation of the cover of a British book series. While the case of the adapted image seems like another one in a long list of how actors in colonial settings borrowed and translated Western science, looking more closely at the journal reveals deeper tensions in negotiating the popularization of scientific knowledge. This paper asks how science popularization can further complicate the notion of circulation. Scholars have highlighted the problems of using circulation as a framework and metaphor, noting that it creates a false sense of uninhibited flow and ignores the asymmetry of power inherent in colonial contexts. I suggest shifting the focus from how knowledge circulation occurs to what are the motives that drive local actors to participate. The concerns which shaped *Science Pictorial* were rooted in debates about the relationship between modern science and modern China. Its editors belonged to an elite group of Chinese that saw themselves both as bridges connecting China's citizens to new scientific knowledge, and as responsible for cultivating a Chinese science. The paper shows that the work of science popularizers constructed borders as it sought to transgress them, and attempted to balance an idealized global vision of science, the political sentiments and responsibilities of its authors and the changing demands of a growing print market.

Poskett, James (University of Warwick)

Lost in transit: failures of circulation in nineteenth-century science

Phrenology was a science with global aspirations. In the nineteenth century, skulls were collected in China and South America, societies cross-circulated journals between Edinburgh and Calcutta, and translations of French phrenological texts were imported into Melbourne and Boston. Phrenology therefore presents an ideal case study for what James Secord describes as "knowledge in transit". However, this transit was not always smooth, nor was it a process in which everyone could participate. In Calcutta, Bengali phrenologists waited months in vain, hoping to obtain a pair of callipers from Scotland. In Boston, working-class readers complained that they could not access Samuel George Morton's expensive folio volume *Crania Americana*. In Kentucky, phrenological busts sent from Edinburgh arrived smashed to pieces. In St Petersburg, books dispatched from New York were lost in the post. And in the Arctic, Inuit skulls disintegrated in the hands of collectors. This paper sets out what we can learn, both analytically and politically, from a closer study of such episodes.

Linkiewicz, Olga (Polish Academy of Sciences)

Terrains of Colonialism: The Interchange of Knowledge between East Central Europe and the USA, 1918-1958

Until the mid-twentieth century studies of ethnicity and race were a source of an epistemological and political competition between scientific schools across Europe and the United States. As a result, the ubiquitous notions developed in the post-World War One period, such as ethnic and racial differences, civilization, national character, culture areas and cultural patterns traveled across borders. I am interested in understanding how these notions were integrated, domesticated, and altered to fit into debates on a complex relationship between science, modern society, and the state, especially how they interplayed with the local-level ideas of assimilation, citizenship, and patriotism on the one hand, ideological and geopolitical threats on the other. This paper is an account of the transnational circulation of social scientific knowledge, its dissemination, and translation of ideas for policy-relevant applications of research to societies. More specifically, it traces links between epistemologies and practices of

SATURDAY 15 SEPTEMBER, 14.00-15.30

applied anthropology in the Second Polish Republic and related social scientific endeavors conducted in the United States between 1918 and 1958. My paper probes the idea of scientists as knowledge intermediaries and attempts to understand knowledge circulation and dissemination through activities of Polish and Polish Jewish scholars who operated along transnational networks. The work of my protagonists raises numerous questions about the ways knowledge operates and shows the contingent nature of scientific trajectories as well as often competitive and multidimensional character of the interchange between “the West” and “the East”.

S02 TELEGRAPHY IN MIND, BODY, AND SPIRIT

Location: IoE – Committee Room 2

Chair: Shuttleworth, Sally

Organiser(s): Johnston, Jean-Michel

Notions of connection, transmission, and instantaneity associated with the technology became a crucial means for scientists, authors, and the general public to conceive of the mechanisms through which these components of the self operated and related to one another. Emilie Taylor-Brown will focus upon the medical discourse surrounding digestive health during the period, and the growing realisation that the most visceral of human processes too, depended upon a process of quasi-telegraphic coordination. Jean-Michel Johnston will investigate the impact of rapid communication upon the mental well-being of telegraph users in Germany, the benefits and anxieties which derived from a developing 'need for speed'. Melissa Dickson will highlight the appeal of the technology to spiritualists as a—literal and metaphorical—tool with which the Victorians could seek to re-connect with the souls of their dearly departed. There was considerable overlap between the questions and concerns of the protagonists in each of these fields, as contemporaries sought to understand the structure underpinning the relationship between mind, body and soul. The nervous system was a possible candidate for this role, and was described, once again, using a telegraphic metaphor. Telegraphic communication was characterised by interruption as well as connection, however, and both themes are central to the topics explored in these papers. Just as Europeans discovered the material limitations of their new favoured technology, the delays and faults which interfered with their exchanges, so too did scientists, businessmen and spiritualists note the glitches in the physical, psychological and spiritual worlds. The papers in this panel thus engage directly with the conference's theme of 'unity and disunity', highlighting the ways in which a revolutionary new technology helped to reconceptualise both the remarkable coherence and the potentially frightening division of the modern self. The panellists are all postdoctoral researchers on the ERC-funded 'Diseases of Modern Life' project at the University of Oxford.

Johnston, Jean-Michel (University of Oxford)

Media and the Mind: Telegraphy and Social Acceleration in Nineteenth-Century Germany

Across Europe during the nineteenth century the laying of mile after mile of telegraphic cable, both on land and at sea, led many to celebrate the 'annihilation of space', as individuals could communicate ever further, ever faster. At the same time, fears were expressed that the rapidly increasing pace of modern life was contributing to an epidemic of anxiety throughout society. In 1869 the American neurologist George Miller Beard famously blamed telegraphs, among other factors, for this modern disease, which he termed 'neurasthenia', and which was soon being diagnosed by doctors across Europe. Whether viewed positively or negatively, all seemed to agree that the modern world was witnessing a process of 'acceleration'. This paper will investigate the notion of acceleration, and its association with telegraphy, in the context of nineteenth-century Germany. It will do so by considering how telegraphy came to underpin new methods of time measurement, management and perception, by allowing for the synchronisation of clocks, railway transportation and commercial exchanges. Using archival and published sources, it will then explore the psychological impact of rapid communication by considering how this technology was used by different social groups, and how it interfered with existing social rhythms and business practices. Attention will be given to the ways in which 'normal' and 'pathological' attitudes to time and speed were represented in the popular press. It will also uncover both the exhilaration which individuals derived from their new-found

SATURDAY 15 SEPTEMBER, 14.00-15.30

capacity for quasi-instantaneous communication, and the frustrations which they felt when the service failed.

Taylor-Brown, Emilie (University of Oxford)

The Telegraphic Body: Digestion, Modernity, and Gastric Communication in the Nineteenth Century

In 1853, Sydney Whiting published his hugely popular mid-century novel *Memoirs of a Stomach*, an it-narrative, which purported to be the autobiographical musings of a stomach. The novel used the autobiographical genre to discuss the central position of the organ within digestive and wider constitutional health by imagining Mr Stomach as part of a fully connected body. Mr Stomach asserts that between himself and Mr Brain, 'there was established a double set of electric wires', invoking telegraphic technologies as a framework for thinking about the function of the pneumogastric nerve. This confluence between the telegraph and what we would now call the 'gut-brain axis' was also invoked by medical writers, including Edward Johnson, who in 1849 had asked his readers to imagine telegraphic wires stretched between London and Bristol that corresponded to the brain and the stomach. These metaphors drew attention to the importance of bodily communication and aligned the body with a modern connected society. While the telegraph collapsed time and space with its promise of almost instantaneous global correspondence, the nervous and gastric connections that for many writers underpinned gastrointestinal health too framed the body in spatial and temporal terms. However, as the telegraph often failed to cleanly and efficiently foster connection, so too did the gastric body often fail to operate smoothly, a failing that was attributed to a disunity between stomach and mind. This paper will explore the use of telegraphic technologies as proxies for talking about the body & problematising modern selfhood.

Dickson, Melissa (University of Birmingham)

Telegraphing the Spirits

In 1848, reports of the strange rappings of a supposedly ghostly presence occupying a small farmhouse in Hydesville, New York spread throughout the countryside. Crowds flocked to Hydesville to witness the mysterious communications with the spirit that had supposedly been established by the farmhouse's youngest residents, Kate and Maggie Fox. The sisters declared themselves to be media through whom disembodied spirits deigned to speak, and their séances gave rise to experiences beyond normal consciousness and corporeality. Literal and metaphorical connections between the spiritualist movement and emergent communications technologies have been delineated at length by scholars such as Steven Connor, Jeffrey Sconce, Richard Menke, and Roger Luckhurst. While the practices of spiritualism were frequently conceptualised as telegraphic operations between material and spiritual worlds, cultural histories of these communications have tended to focus upon the disembodied, dematerialised nature of spirit presences and the technological appropriations or extra-sensory sensitivities necessary to access them, while overlooking the profound social, emotional, bodily, and sensory experiences associated with, or indeed induced by, the intimate and enclosed spaces of the Victorian séance. Revelations from the spirit world were, this paper will argue, largely imperfect, partial, and open to interpretation, and experiences often varied dramatically amongst those present. Like the telegraph, the need for an intermediary presence to facilitate this process emphasised the profound separation and often physical yearning of communicating bodies, while expressing a desire to obviate the need for telegraphy by realising the actual physical and intellectual intimacy that both spiritual and electrical telegraphy could only simulate.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S09/2 (Dis-)CONTINUITY BETWEEN THE EAST AND THE WEST: THE HISTORY OF METEOROLOGICAL KNOWLEDGE TRANSFER IN COLONIAL CONTEXTS

Location: IoE – Room 709a

Chair and Commentator: Janković, Vladimir
(University of Manchester)

Organiser(s): Williamson, Fiona; Jankovic, Vladimir; and Hall, Alexander

While histories of meteorology have increasingly begun to consider global and non-Western perspectives, the distinction and/or continuities between Western and Eastern approaches to meteorology and the networks that have historically transferred knowledge across diverse geographies and cultures have to date been understudied. These two linked panels aims to address this gap by exploring the dynamism of material, institutional and intellectual engagements between the 'local' and 'metropolitan' constructions (and uses) of atmospheric knowledges and various forms of meteorological cultures that have defined the colonial scientific space through the processes of domination, appropriation, resistances and hybridity. Our panels are sponsored by the International Commission for the History of Meteorology (ICHM)

Adamson, George (KCL)

Imperial Oscillations: Gilbert Walker and the construction of the Southern Oscillation

Recent scholarship that seeks understand the spatial imaginaries created by climatic knowledge production has predominantly focussed on the unified changing climate, or the place-specific and embodied experiences of weather. This enquiry has largely overlooked the bounded, spatially-connected world of climate teleconnections and oscillations. This paper seeks to historicise the climate oscillation by exploring the life and work of Gilbert Walker. The paper argues that the Southern Oscillation emerged out of two distinct geographical imaginaries. The first came from Walker's background, an epistemology that gave primacy to robust mathematics over all other forms of knowledge production and that was cultivated during his formative career in late-nineteenth century Cambridge. The second was more overtly imperial: the disciplining of the Indian atmosphere through the particular practices of colonial observatory science.

Kenworthy, Joan (Independent Scholar)

Meteorology in colonial East Africa

The transfer of local knowledge to European intruders and developments in the understanding of climate in the Kenya highlands from the 1880s to the establishment of a Meteorological Department in 1929.

Parolini, Giuditta (TU Berlin)

Networks of knowledge exchange in agricultural meteorology: The IMO commission for agricultural meteorology

During the 1910s, the International Meteorological Organisation created an *ad hoc* commission for the study of agricultural meteorology. Meteorologists and agronomists working in Europe, Asia and America took part in the commission's work sharing their national experiences in the collection of meteorological and crop data and in the determination of weather forecasts tailored to the needs of farmers. The commission also promoted the creation of international schemes of observation and experiment in agricultural meteorology and explored ways to communicate relevant results in international publications. The paper will investigate the work of the commission in establishing networks of knowledge exchange between East and West. It will address the challenges faced by the commission in harmonizing national strategies in agricultural meteorology and the tensions that emerged due the highly localised nature of agriculture.

SATURDAY 15 SEPTEMBER, 14.00-15.30

SATURDAY 15 SEPTEMBER, 14.00-15.30

**S33/2 STABILITIES AND INNOVATIONS IN THE ASTRAL SCIENCES: PERSPECTIVES
FROM CHINESE, SANSKRIT, ARABIC, AND LATIN SOURCES**

Location: IoE – Room 777

Chair: Husson, Matthieu

Organiser(s): Husson, Matthieu

It is often a tacit belief in the study of history of science that habitual and customary practices are of lesser interest than innovations and novelties. The agency and creativity of historical actors are supposed to chiefly required for innovations, whereas the stability of their practice implied some sort of passivity. This view also usually implies that innovation need to appear against or in spite of conservative forces. In contrast, we want to explore a more dialectic interpretation of stabilities and their relations to innovations, by investigating questions such as: • What are the particular knowledge elements that remained stable in given context of scientific practices? • What kind of active choices and concrete actions endorsed by historical actors allow those knowledge elements to remain stable in a given context of practices? • How do these efforts to maintain stability of specific knowledge elements allow historical actors to investigate reconfigurations of other aspects of their scientific practices? We hope to substantiate the view that there is a plurality in the ways of a scientific practice to select and retain a specific set of knowledge elements as stable within a given context; and to use them to explore other possibilities of reconfigurations and innovations. For instance in Alfonsine astronomy, during the late medieval period in Europe, astronomical parameters remained stable for almost two centuries while the layout and organisation of tables varied a lot. We expect to address these general methodological issues in the history of science from case studies in the development of the astral sciences in Arabic, Sanskrit, Chinese and Latin sources. While astral sciences is not the only field of exploration for these questions, it certainly offer a promising start to this endeavour. For instance Astronomical practices involve a range of knowledge elements from fundamental mathematical ones like numbers or geometrical objects to more global ones like epistemological values expressed, for instance, in cosmological theories, observations, or reasoning practices. The material cultures of astronomical practices are also quite diversified. Multiple different kinds of instruments are known to be used and various different form of texts are available to us, for example: oral texts (prose or verse), numerical tables, technical diagrams, iconography, etc. Moreover, the practices of astral sciences were often socially distributed across various milieus. These ranged from highly specialized individuals working in intellectual, political or religious institutions to more modest practitioners engaged with astronomy in some specific and limited way. In this way, the field of astral sciences offers a choice of relatively well-connected historical contexts necessary to explore these issues, while at the same time, it provides a topical focus to compare various case studies in a meaningful and effective manner.

Misra, Anuj (Paris Observatory)

The distribution and organisation of astronomical ideas in Sanskrit canonical texts

Looking at the contents of most canonical texts (siddhānta) in Sanskrit astronomy (jyotiḥśāstra), we notice a relative systematic arrangement of topics into various chapters (adhyaḃya or adhikāra). Each of these chapters addressed particular aspects of mathematical astronomy like mean and true positions, eclipse computations, terrestrial geography and cosmography, spheres, etc. and in most instances, the arrangement (ordering) of these chapters in the siddhāntas remained fairly uniform and standard. It is in this context that I explore how

SATURDAY 15 SEPTEMBER, 14.00-15.30

early seventeenth century Sanskrit astronomers like Nityānanda (Sarvasiddhāntarāja 1639 CE), Muniśvara (Siddhāntasārvabhauma 1646 CE), and Kamalākara (Siddhāntatattvaviveka 1658 CE) discussed, distributed, and organised newer Islamic (Ptolemaic) 'knowledge elements' within the topical framework of siddhāntic chapters.

Chemla, Karine (SPHERE, CNRS & University Paris Diderot; MPIWG, Berlin)

Mathematical practices in the astral sciences in early imperial China: A historiographic and historical approach to *The Gnomon of the Zhou* (周髀)

In the European historiography of ancient sciences in China, *The Gnomon of the Zhou* has mainly been treated as an astral sciences treatise. When publications about the history of mathematics mentioned it, they mainly focused on mathematical bodies of knowledge to which it attested. More recently, the date of composition of *The Gnomon of the Zhou*, and the modalities of its composition (with parts dating from different time periods to be determined) became a subject of contention. Cullen's *Astronomy and mathematics in ancient China* (1996) centers on these issues. My presentation adopts another approach to this document, which, from at least the 7th century, was considered a mathematical classic, concentrating on mathematical practices to which it attests. This approach yields a fresh perspective on the book and sheds light on unsettled issues and new ones. From this perspective, I show one can distinguish parts in this classic that fit quite well with the third century commentator Zhao Shuang's testimony. Accordingly, some parts appear to adhere to older mathematical practices, whereas others reflect new practices. I rely on this fact to discuss issues of stability and innovations. Moreover, I argue that looking at *The Gnomon of the Zhou* from the perspective of mathematical practices highlights mathematical practices in the astral sciences of ancient China that underlie the li 曆 literature. This remark also points out elements of continuity to be discussed.

Miolo, Laure (Paris Observatory)

Stabilities and innovations in John of Genoa's *Opus astronomicum*

This paper aims to situate John of Genoa's astronomical treatises in the Parisian scientific practices of the first half of the 14th century and its intellectual context. Little is known about John of Genoa, he was probably a disciple of John of Lignières to whom he borrowed a lot of material. Several evidences indicate that he was a scholar of the University of Paris in the 1330's. He was certainly involved with the group of astronomers comprising: John of Lignières, John Vimond, John of Saxony and John of Murs. This period can be considered as a time of development and innovation in the field of Alphonsine astronomy. Of course, Alphonsine astronomers continued to be deeply indebted to older theoretical and practical sources. The case of John of Genoa is quite significant. He wrote several astronomical works mainly related to eclipses and the motion of the Sun, the Moon, based on Alfonsine tables for the meridian of Paris. His best known treatise is a canon on eclipses dated to 1332, extant in six manuscripts. It is based on three important astronomical works, which constituted sources for pre-Alfonsine astronomers: the *Almagestum parvum*, Albategni, *De scientia astrorum* and John of Sicily's commentary on Toledan Tables. Likewise, his short canon on Solar and Lunar motions is based on Albategni's zij. A close study of John of Genoa's works should lead to encompass what was the intellectual background of this scholar and in which milieu he was included.

Knudsen, Toke (University of Copenhagen)

Continuity Amidst Change in India ca. 1500 CE

When Jñānarāja wrote the Siddhānta-sundara, a Sanskrit astronomical treatise, around 1500 CE, three-and-a-half centuries had gone by since Bhāskara II wrote the Siddhānta-śiromaṇi in 1150 CE. In the treatise, Jñānarāja presents a critique of his astronomical tradition, rejecting certain ideas, such as that the earth is its own support and that down is relative to your location on the earth, connecting his treatise to a group of obscure astronomical texts claiming divine origin. But even with Jñānarāja's attempts at revising the foundations of the science of astronomy, the basics of its execution remained unchanged. The talk will examine the points of

SATURDAY 15 SEPTEMBER, 14.00-15.30

Jñānarāja's critique with an eye to the elements of the tradition that remained stable in his treatise.

Samsó, Julio (Universitat de Barcelona)

Tradition and innovation in Western Islamic astronomy

Although depending on an Eastern input which arrived to al-Andalus until ca. 950, a moment in which the connection with Eastern Islam was interrupted, Andalusian astronomy became highly original in the 11th century. My talk will deal with the following topics: • A correct determination of the length of the Mediterranean, through the use of the water meridian. This took place towards the end of the 10th c., probably as a result of an observation of a lunar eclipse in Córdoba, which was compared to a computation of the same eclipse using al-Khwārizmī's zīj. • The theoretical innovations introduced by Ibn al-Zarqālluh (Azarquiel) (d. 1100): trepidation theory, motion of the solar apogee, solar model with variable eccentricity, correction to the Ptolemaic lunar model. All these innovations were introduced and developed in the Maghrib in the 13th and 14th c. • The survival of a Khwārizmian tradition which used sidereal mean motions, as opposed to another tradition of tropical astronomy, both in the Iberian Peninsula and in the Maghrib. The introduction in the Maghrib of tropical Eastern zījes from the 14th c. onwards.

SATURDAY 15 SEPTEMBER, 14.00-15.30

S44/2 SCIENCE IN TRANSLATION: LOOKING AT IT FROM EAST ASIA

Location: IoE – Room 826

Chair: Brazelton, Mary Augusta

Organiser(s): Wu, Huiyi, and Brazelton, Mary Augusta

Translation played a crucial role in history of science in East Asia by putting ideas and practices in circulation across linguistic and cultural boundaries, while highlighting the very existence of these boundaries. Throughout the centuries, translation has happened between cultures and languages near and far, within the East Asian sphere (China, Japan, Korea, Vietnam...), between East Asia and its Inner Asian, South Asian and Middle Eastern neighbours (Sanskrit, Persian, Arabic, Tibetan, Tangut, Mongolian, Manchu...), and since the 16th century, increasingly between East Asia, Europe and America. Translation of science has involved a wide array of actors, both men and women, locals and foreigners, from career translators and technical experts to monks and missionaries, not to mention rulers, dignitaries and officials who acted as patrons. These actors promoted translation in accordance with their broader personal, political, cultural and religious agendas which, in return, shaped the ways translations were conducted. In recent years, there has been an ever-increasing interest among historians of East Asian science, technology and medicine in charting this mosaic of peoples and knowledge, revealing numerous hitherto unknown connections. Translation involves both circulation of ideas and shifts of meanings: how historians identify, assess and interpret these phenomena is often revealing in how they strike a balance between unity and disunity in situations of cross-cultural contacts. In the modern period in particular, questions of scientific translation have been deeply entangled with narratives of modernity and globalization. Perceived failures of translation have long been instrumental in constructing theses of cultural incommensurabilities between scientific traditions in East Asia and in the rest of the world. While these issues continue to be hotly debated, more recently, drawing on insights from broader developments in history of science, historians of East Asia have also become increasingly interested in the material aspects of translation. Attention has been paid to how oral and written practices intermingle in acts of translation, how the interplay between manuscript and printing affects the contents of texts, and how translation has been inextricably linked to other non-verbal means to produce practical knowledge, including diagrams, maps, specimens and instruments. This symposium will seek to bring together not only expertise on different languages, regions, periods and fields of knowledge, but also different historiographical approaches, to enable comparison and cross-fertilization between them. Last but not least, we bear in mind that for today's historians, writing about East Asian history of science is in itself an act of translation, between the classical languages our sources are written in, and the modern (often Western) languages we use to interpret them. We have also witnessed in these years a fruition of initiatives for translating sources of East Asian science into Western languages. We welcome reflections on our own translation practices, in order to lend greater critical nuances to the stories we tell and to continue building bridges with history of science in East Asia with the broader community of scholars.

Jami, Catherine (Centre national de la recherche scientifique)

Portrait of the Emperor as an Enlightened Monarch: the French translation of Kangxi's Collection of the investigation of things in leisure time (1779)

Volume 4 of the *Mémoires concernant [les] Chinois...* (Paris, 1779) contains some 'Observations of physics and natural history by Emperor Kangxi' (r. 1662-1722). These are translations of

SATURDAY 15 SEPTEMBER, 14.00-15.30

some of the jottings that form the Kangxi collection of the investigation of things in leisure time (Kangxi jixia gewu bian 康熙幾暇格物編). First printed in 1732, this collection was accessible to the Jesuits who resided in Beijing, including the translator, Marial Cibot (1720-1780). This paper will show that two criteria were applied by Cibot in selecting jottings for translation. Firstly, 'physics and natural history' (categories corresponding to the two new classes of the Académie Royale des Sciences established in 1785) include the study of the three kingdoms of nature (mineral, vegetable and animal); by contrast, the Collection, following the Chinese tradition of the investigation of things (gewu 格物), also discusses geography, history, languages and literature. Secondly, the explanations given by Kangxi that appeal to the authority of Zhu Xi 朱熹 (1130-1200), the philosopher whose interpretation of the Classics then dominated in China, have been left out whenever they are incompatible with the sciences as pursued by the Paris Académie. The 'Observations' thus contributed to the construction of Kangxi as an enlightened monarch, an image that largely prevails to the present day.

Crowther, Alice (École Pratique des Hautes Études)

"Explanations of matters investigated" (Baicaha ba be tucibume gisurehengge, 1715): the translation of contemporary European medical knowledge into Manchu as seen in a manuscript recording a dialogue between the Kangxi Emperor and the Jesuit missionary Dominique Parrenin

This paper is based on reading – and translating into English – a Manchu text that records a series of questions on medicines and poisons put to the Jesuit missionary Dominique Parrenin (1665 – 1741) by the Kangxi Emperor (r. 1661 - 1722), along with the replies of Parrenin. It is a dialogue in which, as each participant repeats and reworks the phrases and terms of the other, a new scientific vocabulary is created. It is also a glimpse of the use of the translation of scientific knowledge – and especially knowledge of the body and knowledge of healing – by a missionary to create a tie of intimacy with someone he hopes to convert, as well as the way in which in translating medical and anatomical knowledge he also transmits Christian conception of the world and the body. In his letters Parrenin acknowledged the published text of Pierre Dionis' (1643 – 1718) public lectures on anatomy at the Jardin Royal (*L'Anatomie de l'homme*, 1690) as his main source. Comparing the Manchu text with Dionis' book allows us to follow how Parrenin adapted Dionis' French text and to analyse the influence of French, Latin, and Greek terminology on the creation of neologisms for a new Manchu anatomical and scientific lexicon.

Wu, Huiyi (University of Cambridge)

What can translation tell us about the original? Tracing the Chinese "chemical" texts translated by eighteenth-century Jesuits

Early modern European translations of Chinese scientific texts raise questions not only pertaining to the non-translatability of terms. As early modern China and Europe diverged in ways of categorizing knowledge of nature, European translators often found no ready Chinese equivalence to particular areas of science, and no obvious body of texts to turn to. Therefore, they gathered information from a variety of book genres, some of which had no recognized place in the literati's learning. For historians, identifying these original Chinese texts and tracing their circulation can reveal the roles of these often overlooked texts as vehicles of knowledge. This paper takes the example of eighteenth-century French Jesuit missionaries' translations of Chinese texts on "chemistry". In the European context, these translations were made by Jesuits in response to European debates about the nature of mineral substances; once published, they were read, sometimes tested, by European savants. We were able to identify the original Chinese source texts as household encyclopedias containing information about the provenance of minerals and recipes using these substances. This leads us to broader surveys of eighteenth-century Chinese sources, revealing the many ways and settings in which such household encyclopedias were read by literati, and shed light on the knowledge of the latter about minerals. We argue that Jesuits' translations constitute a special gateway into the world of knowledge in eighteenth-century China, one that complements Chinese sources.

Strob, Anna (University of Tübingen)

Translating Aristotle to late Ming China: Alfonso Vagnone's Kongji gezhi 空際格致, c. 1633

The establishment of the Jesuit China mission coincided with a rediscovery of the importance of the physical world in the writings and the intellectual discourse among the Chinese literati elite. Therefore, at the beginning of the seventeenth century, the Jesuits undertook a systematic translation of the Aristotelian corpus into Chinese, drawing on their training that combined religious and scientific pursuits. This intercultural encounter is often characterized as a “dialogue of misunderstandings” in which both parties stood on incommensurable cosmological and philosophical grounds. However, based on my studies of Alfonso Vagnone's Kongji gezhi 空際格致, and based on my ongoing work of re-translating it into English, I propose a more nuanced evaluation of the Jesuits' translation strategy, and their approach to the cultural and intellectual atmosphere of Late Ming China. This paper will focus on the rendering of Aristotelian terminology by Vagnone and his Chinese collaborators. I will argue that they made subtle use of linguistic and cultural resources they disposed. The terms they chose to express Aristotelian concepts in Chinese not only give us insight into late Renaissance thought, but also resonates to some degree with the philosophical concerns of Chinese readers of that time. Therefore, this translation can be considered as establishing a viable exchange between two intellectual traditions.

S12 SCIENCE IN 3D: ON THE ROLE OF VERTICALITY IN KNOWLEDGE PRODUCTION

Location: IoE – Room 736

Chair: Mahony, Martin

Organiser(s): Graf van Hardenberg, Wilko, and Mahony, Martin

In this panel we want to build upon a recent observation by Michael Reidy (2017); that the spatial turn in history of science (as in history at large) has focused essentially on the horizontal dimension, and that an apparent bias against the vertical is an historiographical limitation that needs to be overcome. Scientific practices do not just occur in, and construct, two-dimensional space, but take place in three dimensions. The sciences of height, depth and volume are fundamental to the emergence of the three-dimensional, technologically-mediated world which we inhabit, but the specifics of these sciences have been largely absent from recent concerns with the spatiality of scientific knowledge. The adoption of a vertical viewpoint shows much promise in exposing invisible trends and peculiarities in the history of knowledge-production processes. What we want to do is to investigate what happens when we consider science in three dimensions, and explore how traditional perspectives are modified when adding a new dimension to the overall analysis. We want to ask: what are the particular characteristics of the sciences of height, depth and volume? How have scientists sought to overcome the epistemic, technical and bodily challenges of working at height or at depth? How have the reference frames of the vertical dimension been structured and understood? In what ways is science different when it analyses heights and depths? To do so we touch on a variety of topics, addressing first the history of ice core drilling and of other techniques, whether purposeful or accidental, of accessing the vertical (Achermann, Merchant). The Rock of Gibraltar then provides a vantage point from which to consider the intersection of views from above and from below, and of oceanic and aerial verticalities (Camprubi). Tibet then offers a new perspective on the emergence of the view-from-above in geographical exploration (Bergwik).

Achermann, Dania (Wuppertal University)

From high atmosphere to deep time: On the role of ice core drilling in climate sciences

In the 1950s, Danish Physicist Willi Dansgaard developed a method to study rain and snow samples, and identify the air temperature of the moment of the precipitation. He concluded that, with this oxygen isotope analysis, it would be possible to study the old ice in glaciers, too, and reconstruct the air temperature from times in distant pasts; the “deep time”. Until then, ice research had little to do with climate science. But the finding of Dansgaard and his Swiss and American colleagues initiated ice core drilling expeditions all over the polar, sub-polar and glacial world in search of the oldest ice. However, such ice was hidden deep inside ancient glaciers in remote, barren regions hostile to both men and technology. In order to reach it, the scientists needed to access these depths with special drills, allowing the selective admission to the interior of the glaciers and thus to their hidden information on past climate conditions. The ice core drill consequently became the technological link between glaciology with its glacial depth, and climate research with the atmosphere. In my presentation, I will analyse how the ice from the depth became one of the most important informant of climate models and what implications this had for ice as well as climate research.

Merchant, Paul (British Library)

Four kinds of verticality in oral histories of British science

This paper considers four uses of the vertical in the fieldwork of British scientists whose life stories have been recorded for An Oral History of British Science at the British Library: the vertical as depth, as spacing, as position-under, and as fall. For palaeoclimatologists, holes made by themselves and by others - including farmers and road builders - afforded views (ordered by

SATURDAY 15 SEPTEMBER, 14.00-15.30

depth) of material collected over time, under varying conditions. For geophysicists, the space between the ocean floor and their instruments (on boats) blurred detail usefully, supporting theories of sea-floor spreading and plate tectonics. At a more or less ideal position under the polar vortex, the British Antarctic Survey's Dobson Spectrophotometers (looking out of holes in the roofs of huts) found the ozone hole. And the unexpected speed of falling ice in Norway was the key to the explanation for a curious banding on a glacier. The paper makes its arguments through commentary on audio clips from the oral history recordings.

Camprubi, Lino (MPI, Berlin)

From the bottom up: The political epistemology of the Strait of Gibraltar

Straits establish very particular relationships between land and oceans. In terms of hydrography, they create particularly complex currents as they both unite and separate different bodies of water. Strategically, they provide the opportunity of controlling maritime traffic from shore through surveillance and blockade. One of such chokepoints, the Strait of Gibraltar, is also the gateway between the Atlantic Ocean and the Mediterranean Sea. At the center of the Strait, and giving it its name, stands a towery hill known to the British as the Rock. A place of contested sovereignty for more than three centuries, the strategic importance of the Rock of Gibraltar lied in its height, as it allowed to monitor – and, if necessary, bomb – all ships cruising the Strait. U-boats enlisted the deep oceans to the war effort. While their presence in the Strait was relevant to some WWI developments, the Strait became a key strategic point for submarines in WWII and then in the Cold War. The introduction of this oceanic third dimension changed the significance of surveillance performed from the Rock, since now visual methods (including radar) needed to be supplemented by underwater acoustics. This paper explores how deepness transformed prior structures of sovereignty and knowledge in the Western Mediterranean and in the wider Cold War global struggle. It also asks the broader question about the relationship between aerial and oceanic verticalities.

Bergwik, Staffan (Stockholm University)

Sensing the world from above: Geographer Sven Hedin in Tibet 1906-1909

The Swedish geographer Sven Hedin undertook four expeditions to Asia between 1893 and 1935. He became influential in international geography as well as a European celebrity. During his third expedition, he mapped parts of Himalaya, and his travels coincided with a shifting interest among European geographers from Africa to Central Asia and the highest peaks in the world. These expeditionary undertakings spoke to the ambition in geography to find a vertical way of representing the world. This paper explores how Hedin constructed elevated views through descriptions of his experiences from high altitudes, with a particular interest in the relationship between knowledge making techniques and the senses. The paper examines how Hedin's descriptions from the mountains shaped and circulated ideas about sensory modalities. Of key importance is how an alleged rational gaze was combined with emotions like vertigo, awe and fascination. How were such affective states, as well as experiences of cold climate and thin mountain air, connected to seeing large patterns in the landscape? More broadly, the paper places the Swedish explorer in cultural and scientific currents where elevated views of earth were pursued, thus reading his efforts as part of an emergence of technologies – including balloons, aircraft and satellites – for portraying the earth from above.

S40 COLLECTING REVOLUTION: UNITY AND DISUNITY IN EUROPEAN PRACTICES OF NATURAL HISTORY COLLECTING, 1760-1815

Location: SciM – Dana Study

Chair: Werrett, Simon

Organiser(s): Huenniger, Dominik

This symposium addresses natural history collecting around Europe between 1760 and 1815. As collections of material artefacts, natural history collections form an important part of European cultural heritage and the development of the sciences in Europe. By addressing natural history from the vantage point of material culture and the collecting community, we address when and why particular classifications and institutions came to represent new directions in natural history. Contemporary distinctions between ‘scientific’ and ‘amateur’, ‘artificial’ and ‘natural’ as well as other debates united and disunited practitioners of natural history in Europe. Rather than retrospectively imposing judgements about what counted as a ‘properly scientific’ way of collecting natural history specimens, the aim is to determine how (and indeed if) agreement was reached about what counted as ‘properly scientific’. We will draw upon the history of science, recent developments in art history and the history of material culture, and network theories of knowledge practice. The symposium has important geographical and political aspects. Between 1760 and 1815, Europe was in a state of heightened tension, as revolution and war led to an increased emphasis upon the nation. Natural history and collecting were caught up in these developments. Yet natural history collecting and the commercial infrastructure that accompanied it were essentially international phenomena. Specimens were sourced from different colonial voyages, maritime trade and even naval manoeuvres. Within Europe, collectors bought and sold across national boundaries. Collectors also exchanged specimens by correspondence across the Republic of Letters. During the French Revolutionary period, the French government instituted a policy of confiscating collections and cabinets. This period thus offers a unique political conjuncture which allows us to explore the relationship between space, politics, and natural knowledge at the dawn of the nineteenth century. Our symposium will highlight the tension between private ownership and public benefits of natural history collecting, between national boundaries and commercial or scholarly internationalism, and between profit and knowledge. The years from 1760 to 1815 also constituted a transformative moment for the discipline of natural history, when it moved from being predominantly a polite pursuit of individual wealthy collectors to becoming a science profoundly embedded in State priorities of national prestige, public education and colonial exploitation. This was the period when the foundations of the great museum movement of the nineteenth century were laid. The manner in which natural objects were collected, preserved and displayed offers a wonderful resource for investigating contemporary understandings of the natural world and the status of human interventions in it. As the ‘natural’ became increasingly mobilised to underpin the legitimacy of governance in the later eighteenth century, so the natural history collection became a focal point for debating human relationships with nature. The project will allow a unique focus on how contemporaries around Europe debated this tension between universalism and localism in relation to natural knowledge and cultural heritage, a debate which took place partly within the natural history collection.

Spary, Emma (University of Cambridge)

The commercial cabinet in the age of Revolution

SATURDAY 15 SEPTEMBER, 14.00-15.30

Little is known of the traders and merchants of natural history specimens and their clientèles in the later eighteenth century. This paper will use a selection of specimen merchants as a lens through which to view how the revolutionary events of the 1790s affected natural history collecting practices in France. It explores the ways in which such merchants entered the field, what goods and services they offered, and how they made links with the collecting community. When that community collapsed as a result of emigration and economic or political upheavals, the merchants adopted different strategies in response. François Gilles Gaillard and his sisters in Paris became central figures in the Revolutionary process of inventorising specimens from émigré collections; by contrast, the German merchant Jacob Forster moved to St Petersburg and his descendants ended up curating the royal natural history collection in Madrid. This paper proposes an approach based around the bio- and geographical itineraries of members of the collecting community as a way to explore the conditions of practice of natural history as a science after 1760.

Roemer, Bert van de (University of Amsterdam)

Dutch collections of nature and art 1760-1815

In the aftermath of the research project 'De Wereld binnen Handbereik' (1991), Dutch naturalia collections have gained a lot of interest (e.g. Jorink 2010, Driessen 2006, Margócsy 2014, Van de Roemer 2004, 2010). This renewed interest stayed limited to the long seventeenth century. Dutch collections of the late 18th century still remain for the larger part a terra incognita. The above-mentioned research project took 1735, the year of Linnaeus' first edition of the *Systema Naturae*, as end date. This year heralded the demise of the old cabinets of curiosities and made way to more specialized collections with a strict division between nature of art and a new way of producing knowledge about nature. But some scholars emphasized how nature and art were still firmly connected until the early nineteenth century, even though the constellation between the two fields differed (e.g. Meijers, Bredekamp). For this panel discussion I will present a short assessment of lesser known Dutch cabinets between 1760-1815, with two questions in mind: How were nature and art related in these cabinets, and in what way did knowledge production and the 'scientific' differ from their earlier counterparts. Collections discussed are: Willem Bentick (1704-1774), Sebald Justinus Brugmans (1763-1819), Petrus & Adriaan Gilles Camper (1722-1789, 1759-1820), Johannes Franq van Berkhey (1729-1812), Martinus Houuttuyn 1720-1798, Pieter Lyonet (1706-1789), Jacob & Conraad Temminck (1748-1822, 1778-1858).

Huenniger, Dominik (University of Göttingen)

Specimens, Species and Specialisation – Collecting practices in European entomology

Multi-disciplinary approaches to past experiences of humans and other species under the rubric of Animal Studies have only recently been incorporated in studies on the development of the scientific disciplines. The proposed paper will use the pan-European fascination with insects and their taxonomy and behaviour as well as the role of global specimens in these processes in order to illuminate the development of a scientific discipline, global exchange and the practices of knowledge formation. Collections and the practice of collecting will be analysed vis-à-vis European exploration and colonialism as well as differentiation processes in the academic world. The processes and preferred media differed in the German speaking lands, France, the Dutch Republic, Italy, Scandinavia and Britain but translations and the use of the vernacular are important throughout Europe. Of course the exchange with the colonies and the Extra-European world were vital resources for the creation of knowledge on insects. How did the multitude of the minuscule that was discovered at home and abroad in increasing quantities influence how systematic entomology made sense of insect diversity? What was the epistemic status of the individual specimen and how did people make sense of the Linnaean categories of species, family and genus? How did the possession of specimen influence credibility and discourse ability? What forms of knowledge were favoured, what forms were discredited? What united the field and what were the disuniting factors?

Hodacs, Hanna (University of Dalarna)

SATURDAY 15 SEPTEMBER, 14.00-15.30

Selling nature with binominal names in late 18th and early 19th century – Linnaean nomenclature in Swedish and British auction catalogues

My paper will discuss the use of binomial names in the trade with natural history specimen in the late eighteenth and early nineteenth century. Natural history specimens were typically sold at auctions. The preference for auctions is generally strong among sellers of perishable goods (e.g. fruit), or goods which are hard to price. Art objects but also natural history belong to the latter category, selling prices can typically fluctuate reflecting rapidly changing interests among buyers.

Linnaeus's new nomenclature, introduced to an international audience in *Species plantarum*, published 1753, soon became accepted across Europe. It replaced the longer and instable diagnostic names, providing a short and easy to remember nomenclature for all living things to a growing audience of naturalists. In my paper I will explore how the new nomenclature made its way into the trade with natural history specimen and collections; foremost how it was used listing and grouping specimen in auction catalogues. The paper will draw on examples of Swedish and British catalogues printed in the late eighteenth and early nineteenth centuries, including the catalogue listing the belongings of the Duchess of Portland, put up for sale in 1785. The Duchess owned one of the largest collections of shells in Europe. Shells had long been hot collectors' item, shell traders were also, as Peter Dance put it, among "the tardiest converts" to Linnaeus's new names. The catalogue listing the Duchess's collection also illuminate the tension between different consumers of natural history, between those who 'loved order' and those who 'loved variety'.

1103 POPULARISING AND COMMUNICATING SCIENCE

Location: SciM – Dana Studio

Chair: Boyle, Alison

Apajalahti, Ahto (University of Helsinki)

Three generations of Finnish science writers - their motivations and influences

History of science outside the traditional centres of research has lately become an increasingly relevant research topic, as demonstrated by the Science and Technology in the European Periphery (STEP) initiative. This line of research aims for a more diverse understanding of the history of science in Europe, including the history of popular science and science journalism. Following these footsteps, I'll present some findings of my ongoing PhD research on popularization of science in Cold War Finland. By using newspapers, other media sources and popular science literature, I'll demonstrate the motivations and influences of three Finnish science writers. Geologist Pentti Eskola (1883-1964) wrote popular books explaining the scientific worldview. Physicist Reino Tuokko (1909-1968) became the father of Finnish science journalism in the 1950s and 1960s. Chemical engineer Pertti Jotuni (1931-2007) also became a prominent science journalist, author and translator. I'll focus on these writers' work in the 1950s and 1960s. In their writings they discussed diverse topics, such as demarcation between science, religion and pseudoscience. They also wrote about the philosophical, psychological and societal implications of atomic weapons, the frontiers of space research and evolutionary and cosmological theory. While living in the northern corner of Europe, these writers were influenced by and translated the works of a diverse network of international scientific, philosophical and religious writers. These included such figures as the Indian spiritual philosopher Jiddu Krishnamurti, the British science journalist Ritchie Calder, the conservationist Rachel Carson and the originator of cybernetics Norbert Wiener.

Sava, Mircea (University of Bucharest)

Continuities and Contradictions in the Recent History of Popular Science Books

There is a long tradition of prominent scientists writing popular books for the general public, ranging at least from the "visible college" of the scientists-popularisers of the early-twentieth-century, to the scientists from the 1970s and early 1980s, such as Carl Sagan, Stephen Jay Gould, Richard Dawkins, and Stephen Weinberg. However, the last two decades of the twentieth century are a turning point for the popular science book. This paper aims to analyze the continuities and the discontinuities in this period of maximum rise of the book market for the popularization of science. The unprecedented rise of the popularization book in the 1980s coincided in Europe with the emergence of the Public Understanding of Science movement in Britain. This momentum of the popular science book market is most frequently attributed to the success of *A Brief History of Time* (1988), by physicist Stephen Hawking. An equally great success among the public and critics was also enjoyed by Brian Greene's bestseller *The Elegant Universe*, published 10 years later (1999). In this historical context, the importance of the popular science book and its centrality in the network of popular science is explained by the cultural implications that the use of this medium has. The popular science book allows for the development of a public culture of science and, at the same time, it is the medium that provides an opportunity for debates and negotiations between interested stakeholders (scientists, popularisers, popular culture producers, general public) about the cultural role of science in society.

Linguerra, Sandra (University of Bologna)

The dawn of "Scientia International organ of Scientific Synthesis": unity of science vs. disunity of disciplinary specialization

My speech focuses on the *Rivista di Scienza. International organ of Scientific Synthesis* (then *Scientia* from 1910) founded in 1907 by the Italian mathematician Federigo Enriques. The Journal, which became well known around Europe as a multidisciplinary scientific magazine,

SATURDAY 15 SEPTEMBER, 14.00-15.30

was intended to reduce excessive specialization among scientists, promoting the unity of knowledge, stressing the close ties between the philosophical and scientific environments, promoting the discussion of cutting edge scientific theories. In Enriques' intentions, *Scientia* had to contribute to a necessary synthesis of science, humanities and didactics, which was his hallmark both as a scholar and a chief editor (from 1907 to 1915, and then from 1930 to 1938). In Italy, *Scientia's* project led to an animated debate with idealist philosophers Croce and Gentile, peaking in 1911 when Enriques organized the IV World Congress of Philosophy in Bologna. Nevertheless, famous scholars wrote in *Scientia* including, just to name a few, Einstein, Mach, Michelson, Ostwald, Picard, Volterra, Russell, and Carnap. Enriques himself was closely related to the European scientific philosophy and, in particular, to the logical empiricism of the Vienna Circle. In 1937, Neurath invited him to contribute to the *International Encyclopaedia of Unified Science*. Enriques accepted but in 1938, due to the proclamation of Italian anti-Semitic (or racial) laws, he was forced to renounce the task. He had already been expelled from both the University and *Scientia*. After the war, Enriques resumed his academic position, although not returning to the editorial board of *Scientia*. He died in 1946.

Slepkova, Nadezhda (Zoological museum, RAS) and Yusupova, Tatiana

Communication through the Iron Curtain: International Relations of the Zoological Institute of the Academy of Sciences of the USSR in Europe (1950s–1980s)

Science is an international institution by definition, but political and ideological reasons can significantly limit international contacts of researchers. After the end of World War II, victorious for the Soviet Union, Soviet scientists had some hopes for more open communication with European colleagues. However, the "Iron Curtain" of the Cold War again limited it for decades. Foreign connections, as before, were strictly regulated by political and ideological factors. To regulate international contacts, a special department was created in the Academy of Sciences of the USSR – the Foreign Department, which closely interacted with the main party structures. However, despite the opposition of political systems, scientists working on similar problems on different sides of the "Iron Curtain", sought and found opportunities to interact. These scientific contacts will be analyzed – using the example of the Zoological Institute of the Academy, the main center for taxonomic research in the Soviet Union, and one of the four largest institutions of its kind in the world. The second half of the XX century proved very productive for its activities. The number of employees of the Institute exceeded 500 people. The geographical area of research stretched from the Arctic to the Antarctic. The report will examine the international connections of the Zoological with Western European researchers within the period of the second half of the 1950s through the mid-1980s in ideological and political contexts, their forms, dynamics, research areas, and key personalities.

Sastre-Juan, Jaume (Universidade de Lisboa) and Bergeron, Andrée (Centre Alexandre Koyré)

Science Popularization as Cultural Diplomacy at the League of Nations and UNESCO (1938-1948)

This paper will analyze the history and the politics of international science popularization policies by focusing on how they were seen as cultural diplomatic tools for international relations within the League of Nations and UNESCO around World War II. In 1939, the International Institute of Intellectual Cooperation (IIIC) of the League of Nations appointed a committee to work on how the popularization of science through the mass media could improve the severely damaged international relations. The committee included representatives of the Rockefeller Foundation, as well as politically influential scientists and science administrators who would play an important role in shaping the postwar international order, such as Julian Huxley and Henri Laugier. The IIIC envisioned an 'International Center for the Dissemination of Science' which never materialized due to the outbreak of World War II, but the interest in the international coordination of science popularization survived during the war within the British 'social relations of science' movement, and informed the initiatives of the first

SATURDAY 15 SEPTEMBER, 14.00-15.30

UNESCO administration. The paper will study the continuities and discontinuities in actors, approaches and policies between the League of Nations and the early years of UNESCO, and it will argue that the postwar efforts at using science popularization as a cultural diplomatic tool for international relations must be seen in the light of the interwar debates, thus contributing to the emerging historiographical interest in science and diplomacy.

1119 20TH-CENTURY BIOLOGY

Location: IoE – Room 802

Chair: Herring, Emily

Meulendijks, Max (Queen's University Belfast)

Eating Cells and the Struggles of Darwinism: On evolutionary faultlines and the translation of phagocyte theory to the British context 1890-1920

The influence of Darwinian theory on Metchnikoff's conception of the phagocytic theory of immunity has been well documented. Moreover, previous literature has shown a dividing line in bacteriology between French supporters of Metchnikoff's cellular theory, and German supporters of a chemical theory of immunity. The reception of the phagocytic theory in the British context has been less well studied. The paper argues that the use of Darwinism to deduce and support phagocytosis bolstered its use among British bacteriologists attempting to professionalise their discipline. However, Metchnikoff had considered himself not only a believer in the theory of natural selection, as he also believed in the inheritance of acquired characters. With the growing tension between Lamarckians and Neo-Darwinians in the 1890s, bacteriologists could be found on both sides, and these attempted to realign the phagocytic theory to their biological camp. To illustrate this, a comparison is made between the work of John George Adami, Professor of Pathology at McGill University, Montreal, and John McFadyean, Principal of the Royal Veterinary College, London. Both early supporters of Metchnikoff's work, their paths would increasingly diverge. Furthermore, as journal editors, they sought to promote views compatible only with their evolutionary perspective, and used networks that crossed the divide between medicine and biology. Where Adami shifted to an increasingly Lamarckian framework, McFadyean supported neo-Darwinism, until he rejected evolutionary influence altogether in the late 1900s. By tracing these developments, the paper demonstrates how Darwinian debates shaped the professionalisation of an emerging medical discipline.

Piel, Helen (University of Leeds, The British Library)

John Maynard Smith in Conflict and Collaboration: Intellectual Property, Priority Claims, and the Genesis of Scientific Ideas

In 1972, British evolutionary biologist John Maynard Smith (1920-2004) and American population geneticist George R. Price (1922-1975) were collaborating on what was to become their seminal 1973 paper "The Logic of Animal Conflict". Maynard Smith had refereed a manuscript of Price's which the latter never published; not being able to cite anything Maynard Smith had found Price in London and offered co-authorship. In the course of their correspondence, Price brought up "the Hamilton matter": fellow British evolutionary biologist William D. Hamilton (1936-2000) had been holding a grudge against Maynard Smith for nearly a decade over the publication of the latter's Nature letter "Group Selection and Kin Selection" (1964). Kin selection describes an idea very close to Hamilton's "inclusive fitness", introduced in a ground-breaking two-part paper published later in 1964 ("The Genetical Evolution of Social Behaviour"). As it turned out, Maynard Smith had refereed Hamilton's paper and suggested the split into two – which Hamilton felt had unnecessarily delayed publication and given Maynard Smith the chance to publish his letter first. This paper will re-examine the conflict between Maynard Smith and Hamilton by comparing it to the Maynard Smith-Price collaboration. It will analyse archival material and public comments as well as earlier discussions by Harman (2010, 2011) and Segerstråle (2000, 2013). Importantly, it will use the episode to address larger questions in the history and philosophy of science: intellectual property, priority claims, and the genesis of scientific ideas.

van Veen, Anne (Utrecht University)

Harmonization in animal testing: the case of the XPA-knockout mouse

Since the 1960s, a lifetime bioassay using mice has been used to test chemicals for carcinogenic effects. Despite continuous debates about the value of this test, it was used virtually unchanged

SATURDAY 15 SEPTEMBER, 16.00-18.00

for three decades. In the 1990s however, researchers started to work on alternatives tests using transgenic mice. The first viable XPA knockout mouse was created at the Dutch National Institute for Public Health and Environment in 1994 by the research group of Harry van Steeg. This mouse is genetically engineered to be deficient in DNA-repair, and as a consequence prone to develop tumors when exposed to uv-light or genotoxins. Similar mice were developed in the US and Japan around the same time. Initially these were isolated efforts, but researchers soon started to collaborate. In 1996 the ILSI/HESI ACT program was established to develop Alternatives to Carcinogenicity Testing using transgenic mice such as the XPA-knockout mouse. This program was not only an international collaboration between the US, Europe and Japan, but also a collaboration between industry, government and academics. The goal of the program was twofold: to find a better test and to harmonize carcinogenicity testing worldwide. Ten years later, the XPA-mouse test had been accepted as an alternative under certain conditions, yet the lifetime bioassay was also still regularly practiced. In this paper I discuss the case of the XPA-knockout mouse, focusing on international harmonization efforts in the field of carcinogenicity testing to analyze which factors have driven or facilitated harmonization and which factors have functioned as barriers.

Holmes, Matthew (University of Leeds)

Is the Scientific Paper a Fraud? Peter Medawar and the Contested Influence of Lysenko's Biology on Transplant Immunology

Three years after receiving the Nobel Prize in Physiology and Medicine, British biologist Peter Medawar denounced the scientific paper as fraudulent. In a 1963 BBC broadcast, Medawar claimed that the standard scientific paper wilfully ignored how pre-existing ideas and prejudices influenced the practice of science. He was able to speak from personal experience. During the late 1950s Czech biologist Milan Hašek connected the circulatory systems of poultry embryos to induce immunological tolerance. Once separated, even poultry of different species were able to accept transfusions and transplants from one another without provoking an immune response. Hašek interpreted his results as proof of the Lysenkoist doctrine of vegetative, or graft, hybridization. Yet following a series of meetings with Medawar, Hašek's subsequent publications on acquired immunological tolerance were stripped of Lysenkoism. This paper contributes to our understanding of how scientific unity occurred across the Iron Curtain at the height of Cold War. It also overturns a standard narrative of scientific enlightenment in Hašek's abandonment of Lysenkoism. Contact between Medawar and Hašek was initiated by Anne McLaren, biologist and member of the Communist Party of Great Britain, who saw their collaboration as a triumph for graft hybridization. This paper argues that even after Hašek's publications were stripped of their political language, their political connotations remained.

Kastenhofer, Karen (Austrian Academy of Sciences)

The biology that was? Generational patterns as a medium of disunity

The disunity of science, more specifically, its socio-cultural differentiation, has been the topic of various empirically grounded analyses in the past. Becher (1989) reconstructs different academic tribes within academia, Knorr-Cetina (1999) compares the different epistemic cultures within molecular biology and high energy physics research groups, Shapin (2008) sketches different historical eras of doing and being in science. This presentation aims at combining a disciplinary focus on biology / life sciences with a local focus on Vienna and a historical scope. The Austrian academic biology / life sciences pose an interesting case as they have undergone several rather abrupt and tangible changes in the recent past. Around the turn of the millennium they simultaneously faced organisational changes related to new legal settings pertaining to Austrian Universities, personnel changes related to an almost simultaneous retirement of one generation of scientists and paradigmatic changes related to the late 20th century general shift from organismic to molecular life sciences. In other words, facilitated by simultaneous personnel and organisational changes, the respective scientific

SATURDAY 15 SEPTEMBER, 16.00-18.00

community and culture changed drastically, to the extent that the legitimacy of speaking of 'them' as one entity has to be called into question. Rather, I suggest speaking of a biology in Vienna pre 2000 and life sciences in Vienna post 2000 – two cases connected more or less accidentally by geography from a phenomenological point of view. The case study builds upon documentary analyses, semi-structured as well as narrative interviews (in sum roughly 60 interviews) undertaken between 2010 and 2018.

I120 ENGINEERING AND TECHNOLOGY

Location: IoE – Room 790

Chair: Coopersmith, Jonathan

Collins, Peter (Independent Scholar)

Unity and disunity in engineering: Who speaks for engineering, 1900-1980

The engineering profession in Britain provides rich material for reflections on the theme of unity and disunity. The first organisation for engineers to which anyone with suitable experience could seek to belong was the Institution of Civil Engineers, founded in 1818. 'Civil' in this context meant simply 'non-military', and so covered essentially all fields of engineering. As the century progressed, a series of more specialised institutions came into being, often with practical help from the Civils; but the Civils always wanted recognition of their special position within the overall engineering profession.

As the engineering profession expanded and numbers of institutions escalated, the question of who could speak with authority for engineering as a whole, and be accepted in such a role by Government, by the public and by engineers themselves, became more complicated and more fraught. For much of the twentieth century the three largest and most powerful institutions – Civils, Mechanicals and Electricals – working together formally and informally claimed to be fulfilling such a role. In parallel there were various attempts to form workable coalitions of institutions, and also claims by smaller bodies covering all fields of engineering to be able to speak for the profession. This was all bitterly contested. Eventually the Council of Engineering Institutions, comprising 13 institutions including the big three, was set up with a royal charter in 1965. It succeeded, after much contentious argument, in launching the unified designation of Chartered Engineer across the whole profession, and in many ways it did bring a sense of unity to engineering. It also provided the means for bringing the Fellowship of Engineering (Britain's national academy of engineering) into being in 1976 – the first single body since 1818 to speak credibly for all engineering. The CEI itself, however, was replaced by the Engineering Council in 1983.

This paper will explore why unity was so important to the engineering profession in the twentieth century, and why it was so difficult to achieve.

Sousa, M. Luísa (CIUHCT-Nova Lisbon), Oldenziel, Ruth (TU Eindhoven), and van Wesemael, Pieter (TU Eindhoven)

Concepts of the Sustainable Mobile City on the Transnational Stage, 1850s-present

Since the early nineteenth century, the urban world has shared ideas about the ideal city and how its residents should move around. Thus far, transnational circulation of ideas on sustainable urban mobility has been haphazard, short-term, and nation-based. The paper explores how three young emerging disciplines (urban designers, traffic planners, and public officers) shaped discourses on sustainable urban mobility on the transnational stage since the 1850s. The key research site are three non-governmental organizations analyzed together for the first time: a road mobility-based organization, the Permanent International Association for Road Congresses (PIARC founded in 1909), and the city-planning based organizations Union Internationale des Villes (UIV founded in 1913) and the International Federation for Housing and Planning (IFHP founded in 1913). Together they map how technocratic internationalists framed urban mobility and (social, economic, and ecological) sustainability. Using the modal split as a frame of reference, the chapter first establishes a periodization of expert visions about urban mobilities (automobility, public transit, pedestrianism, and cycling) and their sustainability. Second, it charts how these experts positioned themselves towards particular groups of mobility users (automobile or touring clubs vs. pedestrians, public transit, and cycling), while sidelining others through projections about sustainable futures and reconstructions of the unsustainable pasts.

Canavas, Constantin (Hamburg University of Applied Sciences, Faculty of Life Sciences)

SATURDAY 15 SEPTEMBER, 16.00-18.00

The Book of the Explosive References: Repercussions of medieval scientific texts in modern literature

Historical novels develop their credibility by referring to historical events and/or persons. In the case of the novel “Kitab-ül Hiyal” published by the (post)modern Turkish author İhsan Oktay Anar in 1996, however, the historical linkage is established already by the title which refers to a classical genre of the medieval Arabic scientific literature, the books of the science of the ingenious mechanical devices (‘ilm al-ḥiyal). The term ḥiyal is used in this tradition for describing “tricky” machines, mostly automata conceived on pneumatic, hydraulic and mechanical principles. In the İhsan Oktay Anar’s novel many of these devices are conceived in a military context with an explosive outcome. The present study traces links between narrative patterns of the novel and elements of the Arabic genre as a specific tradition in the history of Islamicate science and technology. The formally common element of describing complex hydraulic-mechanical devices is transformed in the novel into a plot engaging fictional inventors in functional narratives which result in inverting the rational explanations of physical phenomena, as well as the expectations of the reader – e.g. by letting the last inventor drop his “scientific project” for the sake of his spiritual perfection. The narrative process of engendering Arabic or Ottoman terms, plots and acting figures appears at a first glance as a moment supporting the unity of continuity of the medieval scientific and the contemporary literary tradition. However, the narrative results in a tricky but hearty disunity marked by an explosive language and metaphysical, albeit ironically connoted outcomes.

Zhang, Zhihui (Institute for History of Natural Sciences, Chinese Academy of Sciences) Struggling Between Ideology and Technocracy: A Study on the Critical Decision - making Process of the Three Gorges Project between 1978 and 1992

The decision-making process of the Three Gorges project has been labeled as one democratic model for the large-scale engineering projects by the Chinese government. After the establishment of Communist China in 1949, the Three Gorges Project experienced two twists and turns during the Great Leap Forward movement and the early years after “the Cultural Revolution”. Eventually, “Three Gorges Project on the construction of the resolution” was passed by the seventh meeting of China's National People's Congress on April 3, 1992. After 12 years of construction, the Three Gorges Dam was completed in May 2006, and became the world's largest water conservancy project. Unsurprisingly, the controversy over the Three Gorges Project has never been stop. Not only the history of the Three Gorges Project’s decision-making is still a lack of systematic research, but also the debate and conflicts during the dam’s decision-making process has not been elaborated well. The paper will restore the “Ups and Downs” decision-making history of the Three Gorges Project between 1978 and 1992, a period after the “the open and reform policy” was launched and the market economic system began to be established. It will reflect the cognitive differences, values conflict and interest’s game among different interest groups around the Three Gorges’ technical, economic, social and ecological function under that special engineering context, and discuss engineer’s’ multiple identities and their self-contradiction, in order to reflect on the scientification and democratization of the decision - making of China’s large - scale projects.

SATURDAY 15 SEPTEMBER, 16.00-18.00

S45 HOW THE SOURCES OF FUNDING CAN AFFECT THE RESULTS OF RESEARCH AND CONTRIBUTE TO THE DISUNITY OF KNOWLEDGE

Location: IoE – Room 822

Chair: Chemla, Karine (SPHERE, CNRS & University Paris Diderot; MPIWG, Berlin)

Organiser(s): Chemla, Karine; Freire, Olival; and Gingras, Yves

At a time when public funding is decreasing steadily, private institutions are becoming significant funders of research. This is a general phenomenon, but in particular it affects the history of science, technology, and medicine. Is this phenomenon without any consequence for the results of research in our field? Or, can we perceive a correlation between, on the one hand, the origin and the type of funding and, on the other, the orientation given to research, and its results? How do these correlations operate for research carried out with public funding? These are questions that we think it is essential to raise in the present climate, and our symposium will address them with regard to current research and also from a historical perspective.

Durand, Antonin (École normale supérieure)

Wolves in the sheep pen? The endowment and foundation of chairs at the University of Paris from 1885 to the present

Based on novel research at the archives of the Chancellery of Parisian Universities – as well as on records at the Chancellery's offices that have not yet been archived –, this paper aims at studying the role of patronage in the creation of university chairs. Since the juridical structure allowing schools to accept donations and bequests was set in place by vice-rector Louis Liard in 1885, several individuals and entities endowed chairs or sponsored specific courses at the University of Paris (in the history of medicine, in clinical therapeutics, in the evolution of organized being, in the history of Japanese civilization). Beyond their evergetic dimension, these endowments frequently entailed the donors' expectation to have a say in the selection of the chair's holder, if not in the contents of their teaching. This paper therefore will focus on the University's (often complex) negotiations for enriching its allocation without trimming its autonomy. I will also attempt to follow chair holders in their struggles between the loyalty to the sponsor, who often named them, and the wish of being accepted by the faculty. I will pay particular attention to chair foundations from the middle of the 20th century onwards, a period in which these sorts of creation held an experimental character that allows us to study the fabrication of consensus; but I will also interrogate the echoes that these debates have in the recent renaissance of company sponsorship for the creation of industrial chairs.

Clarizio, Emanuele (Université de technologie de Compiègne)

Epistemic issues of hospital biobanks' funding in France. Public funds, public market and private market

The very object of biomedical research is never the isolated sample, but the collection it is part of. Biobankers are closely involved, together with doctors, in the process of constituting a collection, because they have to conciliate the scientific interests leaden by project handler with their own biobank's economic and budgetary strikes. Looking at the French panorama, we can point out three different kinds of possible funds. Public funds, granted as research supports called MERRI, which are allocated to all Biological Resource Centres certified (or in the process of being certified) according to NFS 96-900 norm. However, these funds aren't enough to cover biobanks' costs, so biobankers must valorise their collections, in a scientific sense and in an economic one. This valorisation takes two directions: public market, which includes other hospitals and researchers; private market with all the pharmaceutical and biotechnological companies. As a result, the kind of researches promoted is not the same: long-term studies on cohorts of patients, or studies more focused on identifying a specific biomarker, so to develop

SATURDAY 15 SEPTEMBER, 16.00-18.00

individualised drugs. After having analysed the link between each kind of fund and the epistemic object it produces or promotes, I will conclude with a broad interrogation about the implications of this cohabitation: despite the tensions that it provokes, the plurality of the actors involved is also a lever for the plurality and competitiveness of researches.

Boukacem-Zeghmouri, Chérifa (Université de Lyon)

“Agence Nationale de la Recherche”: thematic variations and auctorial foresights

The French national funding agency (Agence Nationale de la Recherche - ANR) represents since 2005 the « delegation authority » of the public science system. As being the principal national funding agency, ANR influence regarding research communities is a mix of huge prestige, when getting a grant, and a collective satiric humour shared on Twitter (Agence Nationale de l'Excellence Scientifique, @Excelleagence). In between, the fact and the fears that ANR role in shaping and reconfiguring French research priorities is regularly debated. Based on the analysis of ANR data (2006 to 2016), recently released, our proposition aims to observe how and to what extent, ANR research priorities are impacting French communities research agenda. From a comparison between ANR thematic, grants thematic and research prospective expressed then realised by researchers themselves, the analysis will provide elements to depict the way researchers are adapting to the ANR authority. Our approach is both quantitative and qualitative and takes into account the longitudinal dimension to observe the variations occurred during 2006-2016 period.

Müürsepp, Peeter (Tallinn University of Technology)

Changing Policies in Research Funding

It is interesting to compare the financial situation concerning studying the history of science in different political systems, meaning the Soviet type societies and the democratic world. Natural science, mathematics and technology were crucially important for developing a socio-economic system that based itself on heavy industry, including warfare ability. In addition, the Marxist worldview required looking at anything in the historical perspective. In the framework of historical materialist ideological setting, historians of (exact) science formed an important segment in the academia and their activities received considerable support from the state. Research results could not conflict with the official Marxist ideology and the dialectical materialist philosophy. The tables turned after the collapse of the Soviet system. In a liberal democratic society history of science has a secondary status after research in exact sciences and developing new technologies. Unfortunately, this kind of general attitude reflects directly in the priorities of public funding. Therefore, achieving a breakthrough in private funding is the major task for the historians of science in the post-Soviet societies because there are no good reasons to believe that public funding will increase considerably in the near future. Currently, it is difficult to assess the impact of private funding on the orientation of research in the field of history of science in the societies that have gone through considerable economic and political changes recently. The speaker will take the development of the Baltic Association of the History and Philosophy of Science as the reference case.

Gingras, Yves (Université du Québec) and Larrègue, Julien

The role of the Templeton Foundation in the Rise of the “history of science and religion” industry

The historian Ronald Numbers, a central figure in the field of the history of relation between science and religion, noted in 2010 that “the one generalization [he felt] confident in making [was] that during the past fifteen years or so, the so-called “science and religion dialogue” has spread around the world”. He did not go as far as providing an explanation for this sudden growth. So, we here suggest that generous grants from Templeton Foundation have played a central role in these developments. It is important to raise the question of the role of that Foundation on the development of this field for, as the historian of science Thomas Dixon insisted, “we should never stop asking whose interests a particular historical narrative serves

SATURDAY 15 SEPTEMBER, 16.00-18.00

and for what purposes it has been constructed. And we should not exempt our own narratives from those searching questions". The presentation will analyse not only the evolution over the last 20 years of the amount of grants offered by the Foundation to historians of science to study the relations between science and religion but will also look at the scientific papers published in different fields that acknowledge grants received from the Foundation.

I125 GEOGRAPHY AND EXPLORATION

Location: IoE – Room 828

Chair: Ambler, Katherine

Erman, Natalia (S. I. Vavilov Institute for the History of Science and Technology of the Russian Academy of Sciences)

Geographical studies in the Smolensk province in the XVIII - early XX centuries as a reflection of the processes of integration and differentiation of Russian geographical science

The first scientific geographical studies began to be conducted in Russia from the beginning of the XVIII century under the influence of reforms of Peter I. On the territory of the Smolensk province they were diverse and aimed, first of all, at strengthening the western borders of Russia. For example: the project of connecting the rivers Vorya and Gzhat for the development of navigation, the planning of the Gzhat pier, the creation of the abatis border. With the creation of the Academy of Sciences (1725) and the Geographical Department, geographical studies began to have not only practical but also scientific significance. Much attention was paid to different-scale mapping of different regions. The maps that were made in the Smolensk province at the end of the XVIII century included physical and economical geographical information. In the XIX century the problems of studying the connections between the components of nature already began to be posed and a dual process began: on the one hand, geography becomes differentiated into sectoral scientific disciplines, and on the other, large-scale complex geographic works were produced from the perspective of a single geography that includes nature, population and economy. This was facilitated by the formation of the Russian Geographical Society (1845). Accordingly, in the Smolensk province there were works of the general nature such as "Russia. A complete geographical description of our fatherland" by P.P. Semenov Tyan-Shansky (1905), and numerous specific studies: on orography and hydrology (by A. A. Tillo), geography of soils (by V.V. Dokuchaev), etc.

Wille, Robert-Jan (Utrecht University)

Managing Germany's position as central power in global meteorology: Hugo Hergesell's imperial atmosphere physics before and after the First World War

In 1887, the mathematician and geophysicist Hugo Hergesell (1859-1938) became the director of the new Meteorological Landesanstalt in Alsace-Lorraine, the tumultuous region taken over by Imperial Germany from France in the Franco-Prussian War. In this function, Hergesell chose international diplomacy over national power politics and soon after the institute was founded, relations with France were re-established. His policies of détente were successful: Hergesell became president of the new International Aeronautical Commission and, after unmanned balloons and kites became a trend in meteorology and atmosphere studies, started to coordinate international simultaneous balloon launches in and outside Europe between 1900 and 1914. However, when the First World War broke out, Hergesell's position changed, as Germany was isolated from the Allied powers. In 1914 he was promoted to the directorship of the Aeronautical Observatory in Lindenberg, Prussia. Here, Hergesell focused on expanding the national weather services of Germany, the Flugwetterdienst. After the War, Hergesell played an important role in the Notgemeinschaft der deutschen Wissenschaft, a new organization which centralized the science effort of German academies in order to alleviate the worsening economy and bringing back Germany in the new world order. My presentation will demonstrate the continuities of Hergesell's science in times of peace and war. Above all, Hergesell's 'conquering' of the free atmosphere was a 'trans-imperial' mission, a form of international Realpolitik, in which both Imperial and Weimar Germany had to be managed as a meteorological world power, a goal for which cooperation, competition and even war as means were co-existing realities.

Jacoby, Julia Mariko (Max Planck Institute for the History of Science, Berlin)

Global disaster preparedness? Scientific cooperation in tsunami research in the 20th century

SATURDAY 15 SEPTEMBER, 16.00-18.00

The tsunami is a global phenomenon. One single tsunami, as in the case of the 1960 Chilean Tsunami, can cause major devastation of an area as large as half the globe. Its scientific exploration was, from its beginnings, a global endeavor. From an early stage, a major concern of tsunami research was to prevent death and damage from the highly destructive waves. The possibility of issuing tsunami warnings by identifying large earthquakes under the sea in real-time was explored by Hawaiian researchers as early as the 1920s. But identifying the complex phenomenon of the tsunami required not only interdisciplinary cooperation between oceanography, geology, seismology and volcanology, but also international scientific cooperation. Attempts were made within the Pacific Science Association in the 1920s and the International Union of Geodesy and Geophysics with the Commission pour l'étude des raz de marée in the 1930s. After the Aleutian Tsunami of 1946 and the Chilean Tsunami in 1960, international cooperation in tsunami warning was finally achieved with the establishment of the Pacific Tsunami Warning System in 1965. Through the phenomenon of the tsunami, this paper asks how a natural threat that transcends national boundaries was identified and addressed, and if it led to unity between the national actors involved. Further, it will be analyzed how the nature of the tsunami influenced scientific collaboration. Finally, the structures of international scientific cooperation that are reflected in the adoption and distribution of the now common term "tsunami" will be clarified.

Myllyntausta, Mikko (University of Turku)

Differences in depicting - Circulation of differing ethnographic depictions of the New Zealand Māori in the 1830s

In the 1830s, much debate took place in British colonial politics on whether New Zealand should be colonised. One cause for this debate was an uncontrolled influx of sailors, settlers and runaway convicts into New Zealand in the early 19th century. The British Colonial Office was slow to act in reference to the situation despite reports of atrocities by British subjects against the Māori, the indigenous people of New Zealand. This inaction gave opportunities to individuals with interests related to New Zealand to promote their perspectives on New Zealand. In my paper, I argue that ethnographic depictions of the Māori played a significant part in arguing both for and against colonising New Zealand in the 1830s. Two significant actor groups, a private land company and a group of humanitarians, used ethnographic depictions of the Māori to argue for their own, opposite views on New Zealand. These depictions differed significantly in their portrayal of the Māori, the Māori's level of civilisation and capability to sustain contact with Europeans. Yet, both sets of depictions published in London were cited as confirmed knowledge validated by numerous sources from New Zealand. Even identical sources were cited for these opposing views. Examining the circulation of knowledge from New Zealand to the publications in London shows the transformation of the information and its significances as the claimed 'knowledge' was transmitted through a network of actors. Thus, I also argue that in the transmission of knowledge, knowledge was adapted to fit the interests of individual actors.

I143 ECONOMICS, SOCIETY AND SCIENCE

Location: IoE – Committee Room 1 **Chair:** Horrocks, Sally

Cheung, Tobias (Humboldt-University Berlin)

The Unity of Disunity in Herbert Spencer's System Theory of Interactive Agents

From cosmological to social, economic and organismic orders and the order of scientific disciplines, the relation of unity and disunity represents a key element in Spencer's system theory. In this paper, I focus on Spencer's agent model of the "conditions of existence" of organismic entities and on their forms and strategies of aggregation. Within the wider context of positivistic movements in the nineteenth century, I will thus discuss the physiological and economic basis of Spencer's agent model, his notion of compound individualities, the differences between various types of agents, the progressive transformation of their "conditions of existence", the different forms of aggregative orders that result from their interaction and the role of scientific knowledge within these orders.

Mann, Valentina (University of Cambridge)

Social science and the disciplining of knowledge, 1885-1904

Faced with the increasing separation and splintering of research universities into distinct departments, the turn of the twentieth century witnessed many debates concerning the possibility and even desirability of the unity of knowledge. This paper seeks to recover the importance of such debates for the history of the social sciences, which has primarily viewed the formation of disciplines between 1880 and 1910 in terms of practices and institutionalisation. Here I take a different approach, focusing instead on the different terms used by social scientists to demarcate and justify disciplinary boundaries and reconnecting these debates to a longer intellectual history rooted in the neo-Kantian response to advances in the experimental sciences. More specifically, I examine the rhetorical strategies employed by Gabriel Tarde and Franz Boas in their attempts to define the boundaries and position of sociology and anthropology respectively vis-à-vis philosophy and the natural sciences. Both took issue with some of the main formulations of the 'unity of knowledge' of their time, dissenting from the evolutionary 'tree of knowledge' as well as from the logical mapping of disciplines advocated by some neo-Kantians. By tracing their use of key terms of contention at the time, such as 'analogy' and 'abstraction', I show how they tried to redraw the epistemological landscape in ways that could admit the new social sciences as legitimate forms of knowledge without requiring their subordination to older or more established forms such as philosophy or the natural sciences.

Ward, Jacob (University College London)

Competing Approaches to State Futurity: British Economic Forecasting in the 1960s

The state's predictions for the future grab headlines: in 2017, the British government's budget both slashed growth forecasts and yet also announced that artificial intelligence will, by 2030, benefit the average household by £2,300/year. However, this attention to these forecasts' content overlooks their implicit scientific backing, and the historical processes by which various methodologies have lent the state a scientised authority over the future. In this paper, I explore the conflict between various methods for studying the future in British government in the 1960s, focussing on the Treasury and the Department of Economic Affairs (D.E.A.). These departments became the focus of a futurological crisis, as voices inside and outside government lamented Britain's apparent short-termism. Using records from Britain's National Archives, I explore these departments' different approaches to the future – the Treasury built computerised forecasting models, whilst the D.E.A. helped found the Society of Long Range Planners and its associated journal, Long Range Planning. The topic of this paper addresses an emerging and important area in the history of science and the state. There is a growing literature on the emergence of futurological sciences through the twentieth century, but these histories focus on extra-governmental actors; in contrast, I will demonstrate the importance of

SATURDAY 15 SEPTEMBER, 16.00-18.00

the scientific ordering of futurity to the state. Creating a unified, coherent future has become an essential state activity, and I will show the disunified approaches, reifications, and interpretations of futurity within the machinery of government.

Gamito-Marques, Daniel (University Nova of Lisbon)

Uniting the nation with science and politics in a time of European disunity: the role of Portuguese naturalists during the Scramble for Africa

This communication explores how João de Andrade Corvo and José Vicente Barbosa du Bocage, two nineteenth-century Portuguese naturalists, were able to reach prominent political positions in their country and implement colonial policies that aimed to reinforce its national identity in a time of intense colonialist competition. The authority they derived from their scientific activities by means of their work in botany and agriculture (Corvo), and zoology (Bocage), and the knowledge they acquired in the process, favored by their proximity to particular political quarters, were crucial for their appointment to important governmental offices. The type of colonial policies signed by Corvo and Bocage were informed by the knowledge that they had acquired, either directly or indirectly, through their scientific education and research. The importance of Portuguese colonial territories went beyond their limited economic relevance for the metropolis, since they constituted a symbol of power that reinforced the sovereignty of a small nation in a Europe dominated by the rule of increasingly vaster and stronger states, such as unified Italy and the new German Empire. In spite of Bocage's and Corvo's different scientific careers and personal interests, both naturalists played key roles in Portuguese foreign affairs and colonial negotiations of the late nineteenth century, especially during the Scramble for Africa, a time of marked disunity and competition among European states with competing colonialist interests.

Kallinen, Maija (University of Oulu)

Learning Disrupted. War and Universities in the Early Modern Sweden

Since the early decades of the 17th century, the Swedish crown paid a lot of attention in developing the educational system of the country, with a special emphasis on the resourcing of Universities. There were altogether five universities under the Swedish realm during those centuries: the 1477 founded and in the 1620's restructured University of Uppsala, the University of Tartu (1632), the University of Åbo (Turku) in Finland (1640), and the University of Lund in the south of Sweden (1666). Moreover, from 1648 on the University of Greifswald became under Swedish territory for almost 170 years. This paper concentrates on developments at the Universities of Åbo and Tartu, which suffered either removals or breaks in their action due wars between Sweden and Russia. The University of Tartu was closed in 1656 due Russian occupation; reopened in 1690, but soon removed to Pärnu to escape the ongoing war. The University of Åbo was closed in 1713 because of Russian occupation, and was reopened in 1721. It is a much overlooked topic in history of these universities, how the approaching of war, and at worst the closure and evacuation of the University, affected the learning in these institutions. In my paper I discuss the question, in what way the interruptions in the function of these Universities shaped the changes in the style of learning especially in the fields of natural philosophy and medicine; whether they either advanced or slowed down the acceptance of the new trends in 17th-century natural philosophy.

SATURDAY 15 SEPTEMBER, 16.00-18.00

S52/2 SHADOWS ILLUMINATED: INVISIBILITIES OF SCIENCE AND ITS (DIS-)UNITIES

Location: IoE – Room 736

Chair: Pérez Sedeño, Eulália

Organiser(s): Martins, Ana Cristina, and Pérez Sedeño, Eulalia

Commentator: Pablos, Ana Romero de

As is commonly the case in other historical fields, in the history of science the invisibility of actors, spaces and projects in science remains an ongoing problematic. A particular challenge is due to the types of sources essential to uncover and retrieve the names and activities that for one reason or another have been forgotten, ignored or kept away by and from historiography. Nonetheless, some progress has been made in overcoming this challenge. For instance, there is a considerable number of interdisciplinary studies published in recent years that explore the relationship between gender and science, making visible those subjects previously rendered invisible to history. There are, however, other invisibilities in the history of science that remain neglected. These invisibilities include field and laboratory assistants and collectors, museum staff, journalists, writers, tourist guides, patrons, publishers of science (non scientists) and private institutions, together with scientific authors that remain obfuscated within or completely absent from bibliographic references and end notes. Rediscovering scientific actors (individual and collective; public and private), theories and projects, and understanding the reasons for their occultation, demand a permanent and innovative interdisciplinary and comparative research endeavor. This is why, using different kinds of primary and secondary sources; combining methods used by different social sciences, such as the history of science, and gender studies; applying actor network theory and social network analysis; and uniting apparent disunities, we will identify, reveal and contextualize names, theories, practices and projects belonging to different humans and natural sciences, between late 19th century until more recently. Engaging comparative, cross-disciplinary and complementary examinations of the matter, this session will capture, for the first time, the state of the art of this fascinating, demanding and inspiring research field within the history of science, whilst making recent research results on this topic readily comprehensible to a wider public. We propose to establish a new - holistic and integrated - way of looking into the past: a new way of doing (in this case) history of science, so as to illuminate some of its persistent shadows.

Pereira, Elisabete J. Santos (Universidade Nova de Lisboa)

The archaeological collections networks in Portugal, 1850-1930

Most of the items in archaeological museum collections were once owned by collectors or scientists who provided a valuable contribution towards setting up museums at the local, regional and national level, thereby enabling public access to a wide range of private collections, also achieving recognition in their lifetime and public esteem in posterity. However, the collections and museums that were created would not have evolved without the cooperation of a number of land owners, information providers, and dozens of private collectors - people who: were interested in archaeology and kept abreast of the scientific developments of their time; collected and identified archaeological phenomena; collaborated with institutions and scientists; provided information; offered logistical support for carrying out field work; and donated items or even archaeological collections to bodies and museums. By retracing the trajectory of the objects housed in museums today, some of these individuals, largely ignored by a branch of historiography which tends to focus on institutions and their founders, can be identified. By adopting this methodological approach, we highlight the collective nature of the construction of science, in this case archaeology in Portugal.

Martins, Ana Cristina (New University of Lisbon), and Senna-Martínez, João Carlos De (Universidade de Lisboa)

Strangers in the field: archaeology in Portugal during the mid 20th century

Due to several reasons and circumstances, only lately the Portuguese archaeological historiography is trying to identify and understand various actors, theories, projects, methodologies and methods unknown for a long time. In addition to many other “invisibilities”, there were, apart from senior scholars, students and young scholars, male and female, coming from other countries to excavate in some sites as a general attempt to internationalize the science in the country. A process also led by Portuguese archaeologists aware of its relevance in the theoretical development of archaeology in the country. Nevertheless, we will focus on the role played by students and scholars, in order to answer to the following question: was the presence of strangers – as foreigners -, especially from Great-Britain and Germany, crucial in the development of this science in the country, or if it is an exaggeration or even a myth? Answering this question will demand the analysis of archives, as the ones which belong to the Association of Portuguese Archaeologists, Department of Archaeology of the Geographical Society of Lisbon, and National Museum of Archaeology. Moreover, we will cross analyze these data with the ones recognized in secondary sources. Only then we will know the name of these strangers (= foreigners), as well as their affiliations, personal and academic backgrounds, scientific networks, professional expectations. And, last but not the least; we will try to understand why they were maintained so “invisible” for such a long time.

Bujalance, Laura (Universidad de Navarra)

In the spotlight, yet hidden: the role of the media in shaping British scientific culture from the 19th to the 21st century

In 2002 Knight wrote about the popularization of Science in 19th century Britain. In 2009 Bowler dealt with the same topic covering the early-20th century. Yet, Britain should not be recognized only as pioneer in popularizing science but in making ‘science’ a prominent part of a country’s ‘culture’. This special relationship between science and culture in Britain certainly began with the appeal that technology had on the public in the 19th century, but it has continued, and it still is a trademark. The major role that science played in British culture has been attributed to its institutionalization; proliferation of museums devoted to science, and their relations with educational institutions; the Great Exhibition of London in 1851; the appearance of Journals. Yet, another key player has gained less recognition in the literature regarding this topic, that is, ‘the media’. This talk will bring to the forefront of the debate the role ‘the media’ has played in shaping the scientific culture in Britain. It will analyze several milestones in the relationship between ‘the media’ and the role of science in Britain’s culture from the 19th century to the 21st century. This analysis will focus in one dimension of the aforementioned relationship between public and science, i.e. ‘trust’; and it will show that whenever trust in science began to weaken ‘the media’ has played an irreplaceable, and not always acknowledged, role.

Godfroy, Anne-Sophie (Paris Sorbonne Université)

Relative visibility and invisibility of alumnae and alumni of the Ecoles Normales Supérieures in the history of XXth century science

Regarding history of science, the ENS are the main producers of men and women scientists in all academic fields, except medicine, even if Pasteur is a remarkable exception. In this paper we focus our study on the case of the Ecole Normale Supérieure in Paris. Between 1881 and 1985, the existence of two parallel schools for boys and girls (Ulm and Sèvres) recruiting the same numbers of students created a de facto quota system in the population. In addition, between 1909 and 1939, 32 women entered the boy’s school. It is very surprising to observe so few visible women scientists among the alumnae. What is visibility? We explored two sets of data to address this issue. First the Wikipedia page about famous alumni and alumnae of ENS Ulm and

SATURDAY 15 SEPTEMBER, 16.00-18.00

Sèvres, merged in 1985. Second academic works on French intellectual and scientific life. The paper will study hypotheses to explain the invisibility of scientists, especially women scientists, regarding whom the merging of the female and male ENSs made the memory of the former «ENS Sèvres » almost invisible and ended the de facto quota system, diminishing drastically the pool of potential women scientists after 1985. The much higher visibility of the archives of the ENS Ulm with the availability of online sources may be an additional explanation of the high visibility of Ulm compared to the invisibility of Sèvres.

Knekht, Natalia (National Research University of Electronic Technology-MIET, Moscow)

“Non-Discoverable Spaces” of Full-Fledged Socialism’s Technological Parks

After Soviet Union disintegration, what was hiding behind prudish foreside of official ideology started to manifest itself and become generally available fact. Large quantity of works, factories, industrial and power plants were built using forced labor of court prisoners. The wish to make these enterprises secret (for most part of them worked for military industry) led to appearance of many “closed” towns and cities in the country. Fenced territories under surveillance, found occasionally by amateur archeologists, alpinists, geologists, backpackers, pilgrims, yardbirds and path finding writers, acquired a metaphor of “closed nuclear cities”. “Closed cities”, nuclear power plants, radio location stations, testing facilities and other similar enterprises could influence nearby territories and the whole country; however, they were not mapped out and had no address. They were called “P. O. Boxes”. Territory deformations, “landscape disruptions” caused by these “black P. O. Boxes” were reflected in Soviet mapmaking. A Soviet map is a specific techno-scientific object located at the edge of Nature and Society. In our report we will try to trace the ways of building new, more profound ontology of Soviet Union as dynamic interaction of human and “non-human” actors creating the peculiarity of late Socialism’s “nature-culture”. Several “spaces of non-discoverability” gradually led to “mutilation” - this strange formation of moving landscapes, changing borders and vanishing territories enables to interpret USSR as extended flickering network of human and non-human, natural and socio-cultural actors.

**S29 INTEGRATION AND TRANSFORMATION: A VARIETY OF RESPONSES TO EUCLID'S
ELEMENTS IN EAST ASIA**

Location: IoE – Room 780

Chairs: Ji, Zhigang

Organiser(s): Ji, Zhigang

Jihe Yuanben, the first six books of Euclid's Elements, translated into Chinese by Matteo Ricci (1552-1610) and Xu Guangqi (徐光啟, 1562-1633) in 1607, is considered as a great encounter of the East and the West. As new knowledge, new discipline and new philosophy, Jihe yuanben had far-reaching influences on Chinese traditional mathematics in the late Ming and Qing Dynasties, and as well as on Japan and Korea. However, as an exotic text, Euclid's Elements met diverse treatments in East Asia. Xu Guanqi praised the text as "the pleasure garden of the myriad forms, the erudite ocean of hundred schools", and had such "secret hope" that "after hundred years everybody will study it." Unfortunately, Xu's hope was unfulfilled. Du Zhigeng (杜知耕, 1644-1722) thought that it was the abstrusely of Jihe yuanben that resulted in a meager readership. As a result, mathematicians in the early Qing Dynasty devoted themselves to explanation and annotation of Jihe yuanben based on their own "styles", this process was called "integrating and transforming". In 1857, Li Shanlan 李善蘭(1811-1882) and Alexander Wylie (1815-1887) completed the translation of the last nine books of Euclid's Elements, which provided a new opportunity for Chinese scholars to approach Euclid's Elements. Gu Guanguang's (顧觀光, 1799-1862) study of the tenth volume of Jihe yuanben is a typical example of "rewriting". His interpretation of irrational quantity demonstrated how to accept and assimilate the brand-new knowledge from other cultures. Dramatically, the receptions of Euclid's Elements in countries of East Asia vary. For instance, in Japan and Korea, stories of this geometrical text were different. In Japan, due to the Keichō edicts and the first Tokugawa anti-Christian edict in 1612, any activities related to Christianity were banned. Euclid's Elements also lost opportunities of development in Tokugawa age. Nevertheless, in Korea where the story of Euclid's Elements resembled in that of China, many Korean scholars from different fields such as mathematics, Confucianism, practical sciences, and religion were all interested in the Elements since the middle of the 18th century. They enthusiastically collected, read, studied, and applied the Elements, and published their writings on the subject, creating a blossoming study of Euclid's Elements in Korea. Above all, this symposium will try to present various responses of the Elements in East Asia and will show the unity and disunity of the acceptance of exotic knowledge. Such studies could be an example which illustrates the different fates of historical texts met in different cultural and historical contexts.

Ji, Zhigang (Shanghai Jiao Tong University)

Acceptation and Adaptation: The Chinese Scholars' Responses to Jihe yuanben in the Early Qing Dynasty

Jihe Yuanben, the first Chinese translation of Euclid's Elements, was a milepost of the introduction of western learning to the East. This work kicked off the Sino-western mathematics cultural-exchange and injected fresh ideas into the ancient Chinese mathematics, and aroused the Chinese scholar's upsurge to the western geometry. When facing the alien axiomatic deduction system, almost all of mathematicians in the early Qing have the same goal, that was: to read the original text and to maintain its order of arrangement, to abridge the proofs that could be abridged and to explain the argument in a different way. In such way,

SATURDAY 15 SEPTEMBER, 16.00-18.00

Chinese mathematicians wrote lots of the geometrical monographs, all of which could be examples of a remarkable acceptance and adaptation to Jihe yuanben. These efforts reveal the Chinese scholar's research enthusiasm. However, a crucial question is that, due to the distinct differences between China and the West, did the Chinese scholars understand the reasoning spirits of Euclid's Elements? This paper tries to give some answers to this question.

Guo, Shirong (Inner Mongolia Normal University)

Common Mathematical Interests of Scholars from Different Social Strata: A Korean Academic Circle of Studying Euclid's Elements Centered on Seo Hosu

Since the middle of the 18th century, many Korean scholars from different fields such as mathematics, Confucianism, practical sciences, and religion, were all interested in the Elements. They collected copies, read texts, studied how to apply the Elements into practices. They wrote some writings on the geometrical subject, which formed a more blossoming research on this subject. Seo Hosu (서호수, 1736-1799) was a high official and a famous scholar whose social position was on the highest rank in Korea. As an important astronomer and mathematician, his interest in the Elements and his guidance on its research made the Elements more popular in Korea. An academic circle was formed centered on him. The circle was consisted of Seo himself, his two sons, his younger brother Seo Hyeongsu (서형수, 1749-1824), and other mathematicians. Although from very different social strata, they are all greatly interested in the study of the Elements, and did researches together. In this presentation, on the basis of discovering a large number of Korean original historical materials, we will introduce and discuss the mathematical researches, especially their studies in the Elements, of above mentioned scholars.

Sa, Rina (Shanghai Jiao Tong University)

A Study on the Collection and Transmission of Euclidean Geometry in Japan

Based on a careful investigation, the author found many treatises of Euclidean geometry collected in Japanese libraries. Some transcripts are transmitted into Japan in the middle of Qing Dynasty. The seclusion policy implemented in Japan forbade any works related to western Christianity. However, Jihe yuanben had a great influence. As recorded in the "Clarified Catalogues of Chinese Works", Tianxue chuhan was brought into Japan in 1632. Some other materials show that Matsudaira Sadanobu, a renowned conservative shogun in Edo period, collected Chinese versions of western works such as Jihe yuanben. Thus, why did such a conservative officer keep the "forbidden books" at home? The paper will explain this from the perspective of power and science. Furthermore, Tokugawa Yoshimune, a shogun in Edo period, implemented a series of reforms in period of Kyoho. In the fifth year of Kyoho period (1720), he adopted policies that would mitigate the "forbidden order". Since then, loads of Chinese versions of western works came into Japan. People, ranging from royal to populace, began to collect these books. Then, some scholars set out to learn Jihe yuanben. In the seventh year of Kyoho period (1722), in the preface to Kikubun Tosyu, there was an account of Hosoi Hirozawa as a learner of Jihe yuanben. Then how did Hosoi Hirozawa acquire the knowledge of western mathematics? The paper will discuss the transmission and influence of the Elements in Japan.

Cao, Jingbo (Shanghai Jiao Tong University)

A Study of Gu Guanguang's Brief Explanation of the Six kinds of Binomial and Residual Lines

The last nine books of Euclid's Elements were translated into Chinese by Li Shanlan (李善蘭, 1811-1882) and Alexander Wylie (1815-1887) in 1857. The irrational quantity was discussed in the tenth volume. As a proof reader, GU Guanguang (顧觀光, 1799-1862) realized this knowledge was very strange to Chinese scholars, so he wrote A Brief Explanation of the Six kinds of Binomial and Residual Lines. In this short thesis, Gu summed up important definitions of six kinds of binomial lines and six kinds of residual lines. GU attached importance to the old algorithm when he accepted new concepts from the western learning. Gu gave six groups of

SATURDAY 15 SEPTEMBER, 16.00-18.00

numerical values, interpreted these definitions by using numerical examples and borrowed some ideas from the Gou-gu methods of Jiuzhang suanshu to calculate the area of right-angled triangle. GU showed his own interpretation style which could be called “transforming and rewriting”.

SATURDAY 15 SEPTEMBER, 16.00-18.00

**S65/2 TRIBUTE TO MASTERS: RUSSIAN AND SOVIET HISTORIANS OF SCIENCE OF THE
19TH AND 20TH CENTURIES
2. HISTORY OF MATHEMATICS**

Location: IoE – Room 784

Chair: Bayuk, Dimitri

Organiser(s): Bayuk, Dimitri, and Volkov, Alexei

The new approach to the history of physics manifested in the presentation of B. M. Hessen (Борис Михайлович Гессен, 1893 – 1936) “The Socio-Economic Roots of Newton’s *Principia*” at the Second International Congress of the History of Science in London considerably influenced the work of numerous Western historians of science. Unfortunately, for a number of reasons (in particular, the Cold War and language barrier) a number of works of Russian/Soviet authors remained underestimated or, in the worst cases, unknown to their Western counterparts for several decades. After the fall of the Berlin Wall the situation started to change, yet it can be argued that numerous publications in Russian still have not been duly appreciated (or even known) to Western historians of science.

The participants of the panel were invited to make contributions on works of the most influential Russian/Soviet historians of physics and technology, in particular, B. M. Hessen, V. S. Gokhman (В. С. Гохман), S. E. Arshon (С. Е. Аршон), V. P. Zubov (В. П. Зубов), and I. D. Rozhanskii (И. Д. Рожанский). This is the way in which the major theme of the Conference, “Unity and disunity,” will be addressed: the speakers will discuss the closeness of approaches of historians of science who worked in Russia/USSR and in Europe in the 19th and 20th centuries and the disunity related to language barrier and to the political circumstances (Russian revolutions of 1917, Second World War, Cold War).

Lyuter, Irina (S. I. Vavilov Institute for the History of Science and Technology, Russian Academy of Science)

On the Soviet school of the history of Arabic mathematics

By the middle of the 20th century, the main direction in Soviet Oriental studies was the research of geographical and historical works of medieval Arabic-writing scholars. With rare exceptions (such as, for example, the work of B.A. Dorn on astrolabes kept in Russian museums, N.V. Khanykov’s study of the *Books of the balance of wisdom* by al-Khazini, and V.V. Bartold’s work on Ulugh Beg), there were almost no works devoted to the study of physical, mathematical and astronomical Arabic literature. However, in 1948, the article of A.P. Youshkevich “Omar Khayyam and his algebra” was published in the second issue of the *Proceedings of the Institute of the History of Natural Science* of the Academy of Sciences of the USSR. With this publication began the existence of the Soviet school of the history of mathematical sciences in medieval Islamic world headed by A.P. Youshkevich for more than forty years. Almost at the same time the research and translation of Arabic manuscript mathematical treatises began in two other centers, namely, in Baku (headed by G.D. Mamedbeyli) and Tashkent (headed by T.N. Kara-Niyazov and G.D. Jalyalov). The former center of studies shaped the historical and scientific interests and preferences of B.A. Rosenfeld (his first work on the subject was published in 1951), while the latter played the same part in the work of G.P. Matvievskaia (her first publication on the subject is dated of 1962); both of them later became outstanding and worldwide recognized historians of Arabic mathematics. Subsequently, they were joined by M.M. Rozhanskaya (whose first work was published in 1966) who became a prominent historian of mechanics. The present paper is devoted to the main achievements of this branch of the Soviet history of science founded and shaped by these scholars as well as to their recognition by the world scientific community.

Volkov, Alexei (National Tsing-Hua University, Hsinchu)

Soviet works on the history of Chinese mathematics

The paper is devoted to the contribution of A.P. Yushkevich (1906-1993) and E.I Berezkina (b. 1931) to the history of traditional Chinese mathematics. The former scholar published his first work on this topic in 1955 and actively discussed a variety of related questions in his correspondence that took place with the British historian of science J. Needham (1900-1995) prior to the publication of the latter scholar's volume of his *Science and Civilisation in China* series devoted to the history of Chinese mathematics some four years later. Yushkevich returned back to the history of Chinese mathematics several times in his publications of 1960s-1980s; they included a large section of his monograph on the history of medieval mathematics (1961) and his paper on the studies of the history of mathematics in Oriental countries read at the International Congress of Mathematicians in 1966 in which he listed the outstanding problems in the field. In her turn, E. Berezkina started her career with the annotated translation of the arguably most influential Chinese mathematical treatise *Jiu zhang suan shu* 九章算術 (Computational procedures [for solution of] the Nine Categories [of problems]) (1957) to which she later added her translation of six other Chinese mathematical treatises of the first millennium AD and a monograph (1980). Unfortunately, her path-breaking works published in Russian have remained underestimated by Western historians of Chinese mathematics. In my paper I will provide an overview and an analysis of the major publications of these two outstanding historians of Chinese mathematics.

Kojevnikov, Alexei (University of British Columbia)

Social Construction of Knowledge on the Soviet Soil

The presentation will explore the origins and connectedness of three distinctive and recurring tropes in the (early) Soviet discourse regarding scientific research. The first one was the consistent criticism of the concept of "pure science," an ideal then nearly hegemonic in the international academic community, which was denounced by Soviet spokesmen as bourgeois false consciousness. Instead, they promoted the understanding and recognition of science as an intelligent response to practical problems of human societies. The second trope was often viewed as somewhat controversial, but allowed for the (limited) use of such terms as "proletarian science" and/or "bourgeois science," and considered the grounding of scientific knowledge in practices, interests, and values. Decades later, and outside of the Soviet context, that approach acquired the name "social construction of science." In the Soviet understanding, however, it was considered compatible with scientific realism, rather than with relativism. And the third, seemingly unrelated trend of "non-reductionism" assumed that different branches of scientific knowledge may be based on their own, specific, and mutually irreducible sets of fundamental categories. The discussed combination of philosophical preferences, in its own turn, can be interpreted as grounded in the values and practices of a society exposed to the simultaneous effects of political revolution, revolution in the sciences, and rapid modernization.

Levina, Tatyana (National Research University "Higher School of Economics," Moscow)

Sofia Yanovskaya: developing analytical philosophy in USSR

Sofia Yanovskaya (1896-1966) is an example of dashing courage in philosophical logic and mathematics, where the representation of women is traditionally very small. While her role in the development of analytical philosophy and mathematical logic in the USSR is well acknowledged, Yanovskaya has not been honored in Russia as an outstanding figure. The process of rehabilitation of Yanovskaya's scientific authority have began only about 15 years ago with the efforts of her disciples.

In his article "Reception of analytical philosophy in Russia" Dmitry Ivanov names Sofia Yanovskaya as the key figure in the development of analytical philosophy in USSR at a time of a rage of dialectical materialism. Educated as a "Red Professor" of mathematics in 1935 she was trained to criticize bourgeois type of thought, namely, all forms of idealism and to inculcate the

SATURDAY 15 SEPTEMBER, 16.00-18.00

ideology of dialectic of Marxism-Leninism. She began to work with ideologist-mathematician Ernest Kolman, who detonated the political campaign against prominent mathematician Nikolay Luzin and her future seemingly held for the same role. But suddenly Yanovskaya withdrew the mask of adept of dialectical materialism and began to fight for the pure logic and mathematics. In several articles of her late period she discusses theories of Bertrand Russell, Rudolph Carnap, Kurt Gödel and others analytical philosophers. In the conventional style of her time, when she was supposed to criticize bourgeois philosophy from the perspective of dialectical materialism, Yanovskaya speculated about universals, abstract objects and the problem of existence in Quine and pure mathematics. Under her editorship were published the first book on mathematical logic of Hilbert and Ackermann, volume "Can machine think?" with an article of Alain Turing and many others.

Last year Professor Vadim Vasilyev published his philosophical inquiry on the places visited by Wittgenstein during his travel to the USSR in 1935. The author claims that that Wittgenstein certainly visited Sofia Yanovskaya in her home in Moscow. Vasilyev identifies her home as the place where analytic philosophy appeared in the USSR for the first time. However, her importance in both Russian and Anglo-American Analytic philosophy has received little attention. Professor Vasilyev's hypothesis is that the talk with analytical philosopher on pure logical problems overshadowed all her previous works in dialectical materialism and research on Hegel and Marx. Ludwig Wittgenstein has even presented her the two-volumed works of Gottlob Frege, thus indirectly initiating the later research conducted by her students.

Finally, I would like to say that it is very interesting to retrace Sofia Yanovskaya interests year by year. The question of Yanovskaya's own philosophical development is still not well known to analytical philosophers in the present-day Russia. In my impression, in her late works Yanovskaya became very kind to the bourgeois philosophers and even said that idealist philosophers just do not understand well how much they are dialectical materialists. This change of Yanovskaya's philosophical preferences is the one of most interesting topics in the history of philosophy of science in Soviet time.

Surman, Jan (Internationales Forschungszentrum Kulturwissenschaften Vienna)

Volodymyr Yuryneč's Philosophy and Aesthetics

From 1918 onwards, Ukrainian science was in a state of permanent reformulation. After a number of political upheavals following World War I, Soviet Ukraine united scholars from several ideological and paradigmatic currents, permitting in the 1920s substantial topical and theoretical variety in scholarly discussions. Among new elites readily helping to build the Socialist state was the young philosopher Volodymyr Yuryneč (1891-1937), who graduated from Vienna University before the War and then from the Institute of Red Professors in Moscow. From 1924 he was a professor of sociology at the Ukrainian Institute of Marxism-Leninism in Kharkiv. While there, he was involved in manifold discussions in subjects as diverse as literature and the philosophy of physics, until he was condemned as a representative of bourgeois philosophy in 1933 and executed in 1937.

In my talk I concentrate on the seemingly diverse fields of inquiry Yuryneč was involved in, comparing his outlooks on literature and science formulated in the late 1920s. At this point a serious discussion took place both in the literary field, in which Yuryneč challenged Mykola Hvyliovyi, as well as within history and philosophy of science, with different directions in Marxism-Leninism being debated. In my talk I will show how Yuryneč's literary and scientific interests informed each other and how his work should be understood within the philosophical discussions of both the Soviet Union and Soviet Ukraine, which was growingly conscious in the 1920s of its special position within the Soviet nexus.

SATURDAY 15 SEPTEMBER, 16.00-18.00

R60 WHAT IS IT WE ARE TALKING ABOUT WHEN WE TALK ABOUT THE HISTORY OF SCIENCE?

Location: IoE – Room 804

Chair and Commentator: Kline, Ursula

Participants: Boon, Rachel (Science Museum, London)
Chang, Hasok (University of Cambridge)
Esposito, Maurizio (University of Santiago)
Gooday, Graeme (University of Leeds)
Higgitt, Rebekah (University of Kent)

While we all think we know (roughly) what science is, what actually is the history of science the history of? One key issue is what relationship we see between history of science and other knowledge-generating/knowledge-based practices, such as medicine, technology, mathematics, architecture, alchemy, crafts, music, literature, and the humanities. Another is: what kind of methodological perspectives can comprehend the history of such diverse practices – and whether conceived as a unified or disunified discipline? Previous generations had straightforward answers for such questions. When the history of science first became professionalized, many practitioners influenced by positivist philosophy of science focused on the unity and primacy of a monolithic ‘Science’. We seem to have lost such ready answers by rejecting this positivist legacy and embracing instead sociological and anthropological perspectives across world cultures, and by recognizing diverse ways of knowing even within each science. Yet, if our discipline no longer has a unified subject matter, are we instead bound together by alternative values or aspirations? The overall aim of the proposed roundtable session is to encourage an examination into our own practices as historians of science, looking forward to future developments and collaborations while looking back at where we came from in the history of our own discipline(s). We do not expect neat consensual answers, and we instead anticipate a diversity of responses in audience discussions that will illustrate the healthy pluralism among historians of science. After a very brief introduction by the co-organizers of the session, there will be initial statements of 10 minutes each from the panellists. This will be followed by a 15-minute discussion among the panellists, and then 30 minutes of further discussion led by questions from the audience. Hasok Chang will propose that a revitalization of pragmatist philosophy can provide useful conceptual tools for understanding scientific and other epistemic practices. These thoughts will be illustrated through the example of ‘battery science’ in the 19th century, which was an early technoscientific domain incorporating electrochemistry, electromagnetism, electrotechnology, electrophysiology and much else. Graeme Gooday will explore how histories of science are now no longer neatly separable from the history of technology or of history of medicine (or indeed many other kinds of history). Yet can Latour’s all-encompassing notion of ‘technoscience’ or its disaggregated opposite – the techno-sciences – offer us a sufficiently all-encompassing characterization of what we do? Rebekah Higgitt will address the kinds of knowledge and practice being explored in her project on ‘Metropolitan Science: Places, Objects and Cultures of Practice and Knowledge in London, 1600–1800’. One crucial question, especially in dealing with historical time periods before the full professionalization of science, is how we think about artisanal identities and knowledge in relation to what we retrospectively identify as ‘science’.

SATURDAY 15 SEPTEMBER, 16.00-18.00

S38/4 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES: CRITICISMS AND CHALLENGES

Location: IoE – Room 731

Chair: Silva, Matheus Alves Duarte

Organiser(s): Silva, Matheus Alves Duarte (Ecole des Hautes Etudes en Sciences Sociales)

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945

Pinto Barbosa, Thiago (Leibniz-Zentrum Moderner Orient)

Circulating technologies, humans and human remains: grasping the transformation of racialized knowledge across time and space

In this paper, I offer a discussion on a post-colonial material semiotics approach to understand how knowledge about “race” has been scientifically produced and transformed, focusing on certain circulations of knowledge production actants across the 20th century between different localities in German South-West Africa, Germany and India. My case study starts from the analysis of a central node in the intersection of the fields of physical anthropology, genetics, eugenics and racial sciences: the Kaiser Wilhelm Institute for Anthropology, Human Heredity and Eugenics (KWI-A). To assess the transnational circulation of racialized knowledge to and from the Institute, I give special attention to the work of physical anthropologist and geneticist Irawati Karvé between Berlin-Dahlem and in India. Between the 1920s and 1930s, Karvé researched at KWI-A, where she developed a research on “racial difference” and a set of methods based on statistics and anthropometric measurements and researched on 150 human skulls, most of which were obtained in colonial settings. From 1931 to 1970, Karvé played a key role in the adaption of knowledge about “race” and eugenics to different settings in India. Thus, based on historical, multi-archival research, I give special attention to the translocal and

SATURDAY 15 SEPTEMBER, 16.00-18.00

colonial circulations of Karvé's first research objects and technologies, as well as to the political and social entanglements of her work praxis in Berlin.

Heurtebise, Jean-Yves (Fu Jen Catholic University)

From Kant's Anthropology to Liang Qichao's New History: the West-East Circulation of (racial) Prejudices

The influence of Kant on contemporary Chinese philosophers such as Mou Zongsan or Li Zehou is a well-known and documented fact. Kant's influence on Chinese philosophy is strong in both metaphysics and ethics – Kant being the paramount of the “Western” philosopher with its idealist ethicism and rationalist epistemology. However recent scholarship on Kant's anthropology disclosed a darker side of Kant's legacy. Bernasconi, Larrimore and Park have demonstrated the racist basis of Kant's anthropology. Here, following the steps of Dikötter's *The Discourse of Race in Modern China* and Keevak's *Becoming Yellow*, we would like to investigate the racial anthropology of Chinese contemporary thinking – especially in Liang Qichao's writings. We would like to analyse the correlation between modern “German Orientalism” and contemporary “Chinese Occidentalism” to understand the reasons of the circulation of racial prejudices (especially concerning African and Ameridians) from late 18th century Germany to early 20th century China. Thus more than the circulation of “knowledge”, we would like to inquire into the process of circulation of mistakes, prejudices and misinformation in modern times.

Skurnik, Johanna (University of Turku)

Circulation, Transformation, Appropriation? The Formation of British Geographical Knowledge of Australia in the Nineteenth Century

Circulation is currently the buzz word for historians of science. However, it lacks empirical scrutiny and theoretical sophistication. In this paper, I take the case of forming geographical knowledge of colonial Australia as a case in point to argue for and develop further the notions made by, for example, Kapil Raj and Claude Markovits regarding circulation as an analytical tool. To do this I examine the roles of a variety of actors and different types of material in the formation of geographical knowledge of Australia between 1829 and 1863. Particularly I focus on the colonial governors, the civil servants at the Colonial Office, the Royal Geographical Society, and cartographer John Arrowsmith. I trace the marginalia and minutes in the correspondence of civil servants not typically connected to the production of geographical knowledge. By tracing the moments of transformation, I reconstruct a system of knowledge formation that the British established in order to create reliable geographical knowledge of Australia. The case of Australia provides ample ground to argue for the conceptualization of circulation as a tool to capture the transformations in knowledge production. My observations reveal how circulation can be understood as a process that entails appropriation, neglect and forgetting. To understand in practice what the transformations as a result of circulation are, how power relations constitute them and how different types of “spaces of circulation” come to exist, it is vital to engage with a variety of different types of primary material.

Alvarez, Kerby (University of the Philippines Diliman)

The Observatorio Meteorológico de Manila and Hongkong Observatory: Colonial Science and Institutional Meteorology in the Pacific, ca. 19th century

Concurring with the need to sustain and enhance economic activities of different states in the Pacific, meteorological observatories were seen as vital in advancing modern and accurate typhoon warning system for merchant vessels, ships and sea travel in major Asian sea routes and trading coastlines. The pioneers of meteorological institutions were a mix of religious and secular officials. The Jesuits, and European trained scientists were at the forefront of these institutions. These observatories served as Pacific watchdogs, pioneering the advanced studies on typhoons in the regions. Some of these observatories were the Observatorio Meteorológico de Manila (1865) in the Philippines, and Hongkong Observatory (1882) and the Zikawei

SATURDAY 15 SEPTEMBER, 16.00-18.00

Observatory (1872) in the China coast. This paper will analyze the scientific researches, collaboration, and institutional relationships of the Observatorio Meteorológico de Manila and the Hongkong Observatory in the 19th century. The study will present a landscape of modern knowledge, focusing on the role of scientific institutions in supporting colonial and imperial states in the Pacific region, through new studies on weather and natural hazards. The paper will survey the institutional endeavors of the two observatories, and will illustrate a facet of emerging modern societies in the 19th century, by looking at the different levels and stages of shared environmental experiences and knowledge production between the Philippines and Hongkong, and how these institutions pioneered a form of public service through research and public engagement through science.

Haddad, Thomás A. S. (University of São Paulo)

What can circulation tell us about comet sightings in the seventeenth-century Americas? An exploratory analysis of sources and contexts

It is a truism to say that knowledge about comets has always circulated, in one way or another. As one of the most striking kinds of celestial phenomena, comets have raised attention of people across cultures and times. There is a wealth of documented observation reports from all parts of the world, which have been communicated, replicated, interpreted, and re-interpreted all over, for their value as omens, divine signs, or their significance to astronomical systems. Perhaps the most well-known and thoroughly explored case is that of early modern Europe, where some kind of “circulation” of knowledge about comets has long been associated with narratives about the “Scientific Revolution”. In the second half of the seventeenth century comets were also a focus of great interest for actors across the colonial Americas. From Lima to Boston, from Salvador to Mexico, there are some two-dozen printed reports of contemporary sightings, interpretations, and controversies, not to mention passing references in a huge number of sources such as sermons, chronicles, and all sorts of administrative documents. This paper looks at the most conspicuous New World reports on comets in order to probe what an outlook based on the notion of circulation can and cannot tell us. We will inquire what these frequently under-studied sources may bring to bear upon the problematic. Among other questions, can we establish circuits of circulation of knowledge about comets, observation practices, and interpretive frameworks? How are these circuits formed (or hampered), who participates in them, which are their communicative practices?

S43/2 WHEN SCIENCE DIPLOMACY DIVIDES

Location: IoE – Room 739

Chair: Robinson, Sam

Organiser(s): Robinson, Sam, and Adamson, Matthew

The concept of science diplomacy has gained traction in recent years, as the foreign offices of various nations have appreciated and begun reassessing the influence and importance of the soft power of science and technology. Scientists themselves are also recognising the diplomatic roles they have played historically and how they have contributed to global relations. This symposium (divided in five sessions), focusing on the history of science diplomacy, draw together a variety of scholars exploring different aspects of science, technology, and diplomacy at the international and transnational levels. Rather than merely echoing and reifying the scientists' own accounts about the benign effects of science diplomacy, they challenge them with provocative case studies and newly proposed interpretative frameworks.

Diogo, Maria Paula and Simões, Ana (University of Lisbon)

Cultivating scientific and diplomatic networks: The case of the naturalist Abbé Correia da Serra

José Francisco Correia da Serra (1751-1823), known as Abbé Correia da Serra, is a paradigmatic case of a citizen of the world, a Portuguese man of science who saw himself as a member of a borderless community, the Republic of Letters. Correia da Serra was a botanical innovator and a transitional figure at the turn of the 18th to the 19th century. Often persecuted in Portugal due to his links to the freemasons, he travelled in Italy and Spain and lived in Italy, England, and France where he befriended renowned naturalists and engaged with them in lively scientific and philosophical discussions, at the forefront of debates testing the limits of the old Linnaean worldview. He then moved to the USA where he lived for eight years and became involved in the consolidation of local scientific communities. During his wandering life, Correia da Serra played at times diplomatic roles. However, his activities in science and diplomacy have been taken as disjoint, or mildly connected: a scientist working as a diplomat, or a diplomat enrolling in scientific activities unconnected to his diplomatic role. In this talk, we want to explore the connections between science and diplomacy in the life and work of Correia da Serra, and discuss if and how they became entangled at a time in which it does not make sense yet to talk about science diplomacy. We show that when he worked at the Portuguese Legation in England in order to make ends meet, some of his activities bordered scientific and technological espionage; and that when he became the first Portuguese ambassador in the USA, a role which he expected would leave him ample free time to botanize, his diplomatic activities led him to entertain a geopolitical dream in which science played a role. He championed the idea of Portugal moving the court and the capital city to Rio de Janeiro (Brazil), at the time a Portuguese colony, and together with Thomas Jefferson, they dreamed of building two American hemispheres, led by the United States of America and Portugal, politically and scientifically emancipated from old Europe.

Souza da Silva, Luciana Vieira (University of São Paulo)

Diplomatic accords and ruptures: the science in University of São Paulo from the perspective of Gleb Watghin's trajectory in Brazil (1934-1949)

The University of São Paulo was founded in 1934 by members of São Paulo's elite, formed by politicians, journalists, and intellectuals who was part of *Estado de S. Paulo* newspaper. The most important cell of this university was the Faculty of Philosophy, Sciences and Letters, the place where a new intellectual elite had to be shaped, in order to change the national mentality, thanks to the university ideal to produce disinterested culture and science. To achieve their goals, University of São Paulo's founders decided to invite Europeans professors to participate in the organization of the chairs of the Faculty of Philosophy, which were divided by nationality:

SATURDAY 15 SEPTEMBER, 16.00-18.00

French to human sciences, German to natural sciences, and Italian to exact sciences. The Russian physicist Gleb Wataghin was invited to be part of Italian Mission, thanks to his trajectory in Italian universities and his Italian citizenship. The aim of this presentation is to explore the implications of Wataghin's Italian and Russian identities in his trajectory in Brazil, taking into consideration the Brazilian internal and external policies of the period: the diplomatic rupture with Italy in 1942 during the Second World War, the United States approximation, and the beginning of Cold War and its effects in Brazil, inspired by Pierre Bourdieu's perspective to understand a scientific field under construction, and Michel Pinault's idea of intellectual scientist, to explore Wataghin's trajectory. The documentary sources were collected in University of São Paulo Archives and in State of São Paulo Public Archive. In preliminary analyses, we observe that after the diplomatic rupture between Brazil and Italy, Wataghin joined the São Paulo Russian community and helped physicists of Soviet origin from Argentina to exchange to Brazil. Thanks to Wataghin's cultural alliances and the growth of internal anticommunist policies, both Wataghin and the Department of Physics of Faculty of Philosophy were under suspect, even after Wataghin's return to Italy, in 1949. This study was supported by the grant 2015/20490-8, from the São Paulo Research Foundation (FAPESP).

Turchetti, Simone (University of Manchester) and Adamson, Matthew (McDaniel College Budapest)

Friends in fission: The Brazilian atomic energy project and its backers in North America and Europe, 1950-1975

The perception of science diplomacy as a benign force in international relations stems from a selective reading of episodes in the history of 20th century science and technology that tend to focus on successful examples of either bilateral or multi-lateral scientific collaboration. But rarely has science diplomacy come to fruition in this way and certainly not in the controversial area of atomic energy where, especially in the 1950s and 1960s, the diplomats of a number of administrations pursued rival collaborative science schemes in order to dissuade potential partners from joining forces. The recent examination of the papers of Brazilian science diplomat Alberto Alvaro (as well as relevant archival sources in France and the United States) reveals exactly that. As the man at one point in charge of the Brazilian atomic energy programme, Alvaro sought parallel inroads with U.S., French, and German diplomats and scientists. In each case, scientists and government officials offered scientific assistance, in part to dissuade Alvaro to seal a deal with others. And, indeed, rather than unite, diplomacy increased tensions between these Western partners, as Brazil actively sought to exploit these divisions to increase its own nuclear autonomy. Tensions characterized diplomatic exchanges both before and after the U.S. Atoms for Peace initiative. And in the 1970s West Germany struck "the nuclear deal of the century" with Brazil; something which took its allies by surprise. This paper revisits the history of Brazil's nuclear efforts to better understand the impacts of nuclear diplomacy in international relations.

Li, Zhang and Zhu, Yanmei (both University of Chinese Academy of Sciences)

Experiment on Science and Technology Diplomacy: An Investigation of America sending Scientific and technical experts to China in World War II

After the Pacific War broke out at the end of 1941, China's strategic position increased rapidly. As allies, the United States, China and Britain, all began to keep an eye on post-war reconstruction while jointly fighting against fascist aggression. Britain and America, considering their respective post-war interests in China in the long term, secretly game to gain Chinese goodwill. Apart from military and economic aid to China, America put forward a policy of science and technology aid to China for the first time in early 1942, and during the following four years sent a total of thirty scientific and technical experts through the Division of Cultural Relations of the Department of State to facilitate technical assistance to China: help China improve industrial and agricultural construction, thus improve China's anti-Japanese morale. The dispatch of technical experts to China marks the beginning of China-US science and

SATURDAY 15 SEPTEMBER, 16.00-18.00

technology diplomacy. Based on Foreign Relations of The United States (FRUS), the Second Historical Archives of China and Chongqing Archives, this paper combs the reasons and concrete implementation of American science and technology aid to China during the wartime, then analyzes its effect and the influence factors in the result. And then try to explore the US-Sino-British science and technology diplomacy under the wartime allied relations.

Zaidi, Waqa (Lahore University of Management Sciences)

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I134 PHYSICS 1

Location: IoE – Room 709a

Chair: Mitchell, Daniel Jon

Focaccia, Miriam (Museo storico della fisica e Centro di studi e ricerche "Enrico Fermi")

Pietro Blaserna and the Institute of Physics of Rome: a multiform view of science between unity and disunity

Founder and first director of the Institute of Physics in Via Panisperna in Rome, the physicist Pietro Blaserna (1836-1918) here realized his ideal of scientific research center, inspired by the most advanced and modern European Institutes, as the Institute in Vienna, the Manufacture de porcelaine of Sèvres, the Institute of Strasbourg and the Institute of Berlin. Thanks to a unitary vision of Science in general, a vision shared with other illustrious contemporaries Italian scientists, such as Vito Volterra, Blaserna managed to create a true 'home of physics', in which the discipline had the opportunity to evolve in different and multiform aspects: from meteorology to acoustics, from electrical physics to metric, from optical physics to the new physics of the atom. Such a flexible structure could only result in a disunity and multiplicity of lines of investigation according to the will of Blaserna himself, who preferred to leave the freedom of experiments in different directions instead of driving his team toward predetermined thematic areas. The Institute welcomed scholars of different orientations and specializations and it was precisely from the different personalities that crowded its rooms and its laboratories, held together by the far-sighted and liberal leadership of Blaserna itself, that a real 'creative environment' was founded. In more recent years, Enrico Fermi and his group, the so-called 'boys of Via Panisperna', will work here, giving birth to a new and exceptional chapter of Italian Science.

Fraser, James (Max Planck Institute for the History of Science)

The Many Faces of the Renormalization Group

Renormalization group methods play a central role in contemporary high energy and condensed matter physics. The historical development of these techniques is underexplored, however. In this paper I emphasize the fragmentary nature of this story. Rather than a single discovery event, we find a series of approaches being put forward in different areas of physics that were only later brought under the same banner. Early work of Gell-Mann and Low (1954) (among others) introduced some of the key ideas of the modern renormalization group in this context of perturbative quantum field theory (QFT). Independently, Kadanoff (1966) first deployed what is now called the real space renormalization group to the treatment of critical phase transitions in statistical physics. Kenneth Wilson's seminal work on renormalization theory in the 1970s is often understood as synthesizing these two strands, laying the groundwork for the modern conception of the renormalization group. While this characterization is accurate as far as it goes, I suggest that signatures of this piecemeal development remain in the way renormalization techniques are implemented today. I close by touching on some contemporary applications of renormalization group methods and discussing how they draw on different strands of this developmental history. Disunity persists in the formal implementation and interpretation of the renormalization group in different theoretical contexts.

Kragh, Helge (University of Copenhagen)

Transferrmium wars: Unity and disunity in the race toward superheavy elements

The transuranic elements at the end of the periodic table have since the 1960s been known as "superheavy elements." They are all synthetic, produced in the laboratory in tiny amounts and have very short radioactive half-lives. In the 1970s and 1980s the manufacture of so-called transferrmium elements, meaning elements with atomic numbers higher than 100, was restricted to advanced nuclear laboratories in the United States, Soviet Russia and West

SATURDAY 15 SEPTEMBER, 16.00-18.00

Germany. Many of the discovery claims were controversial and coloured by the Cold War atmosphere, adding to the rivalry between American and Russian researchers. Although nuclear scientists in the East and the West were united in their goal of producing still heavier elements, they disagreed about priority questions and criteria of discovery. The naming of elements was a central part of the controversy, which also included disagreements concerning the roles of physical versus chemical methods in element identification. As a result a Transfermium Working Group (TWG) was established in 1985 by the international unions of chemistry and physics (IUPAC, IUPAP). However, the decisions of TWG and IUPAC's proposals for names of the new elements only fuelled the controversy between American and Russian scientists, threatening to split the community of scientists specializing in superheavy elements. According to Paul Karol, an American nuclear chemist, a "transfermium war" was going on. What was this undeclared war about? How did it end? This and other cases are discussed in my recent book *From Transuranic to Superheavy Elements* (Springer, 2018) on which the presentation is based.

Krasnodebski, Marcin (University of Bordeaux)

Buzzword, Technology, or Academic Discipline: An Introduction to the History of Photonics

Photonics is a broad term encompassing various meanings. For some it is a new "science of light" poised to replace optics. Others consider it a technology competing with electronics. Some consider it revolutionary; others think photonics is a redundant term with respect to the fields such as opto-electronics. The place of photonics in the research panorama is ambiguous, even though over the last 40 years it penetrated the universities, the industry and the realm of policymaking. The term has a double genealogy rooted in the 1970s. It stems from the reflection of the French laser physicists as well from the work of the Dutch engineers in high speed photography. Different scientific communities tried to capture the ongoing revolution in light sciences using their own vocabulary. While this double genealogy was largely forgotten, photonics evolved alongside with optics, opto-electronics and electro-optics, and the exact separation between these different fields remains hard to trace down. The understanding of the term "photonics" was linked to the fashions, promises and expectations of the scientific community (and the policymakers) with regard to the power of novel technologies such as lasers, optical fibers or optical computers. Historians and sociologists of science have to carefully navigate while using the name photonics, recognizing the plurality of meanings attributed to it throughout the history in different contexts.

Matarese, Vera (Czech Academy of Sciences)

In the Name of Alessandro Volta. The Unifying Role of Italy in the Development of the Electromagnetic Theory

This paper aims to reconstruct and delineate the international role that the Italian physics community played during the development of the electromagnetic theory. My reconstruction is based on the recent discovery (Cantoni and Morando 2011) of some invitation letters sent by the University of Pavia to renowned electromagnetic physicists, on the occasion of the celebrations of the centenary of Volta's chair in 1878. In a time when the European Physics community working on the electromagnetic theory was divided into two rival views - the German 'action at a distance' view and the British 'action by contact' view - the University of Pavia invited the most renowned leading scholars from both sides (Weber and Helmholtz from one side, and Thomson and Maxwell from the other) and conferred honorary degrees upon them. In this regard, not only did Italy set itself up as an impartial interlocutor in the debate, but it also provided a geographical common platform for the representatives of the two antagonist views to meet and discuss, which was unique and exceptional, given the ideological gulf between England and Germany. It is also particularly outstanding that to the ceremony were invited not only theoretical physicists, but also scholars working in applied physics (Mascart and Joubert) and engineers (Righi and Cantoni), whose inventions were usually not highly esteemed by the elite international community. What comes to light from this reconstruction is

SATURDAY 15 SEPTEMBER, 16.00-18.00

Italy's unifying role in bridging different views and branches of electromagnetism, which should be regarded as Alessandro Volta's legacy.

I122 EARLY MODERN 2

Location: IoE – Room 777

Chair: Roos, Anna Marie

Arsioli Moura, Breno (Federal University of Brazil)

Thomas Melvill and the hanging drop: a study of his short career in optics

In the 1750's, the Scottish natural philosopher Thomas Melvill (1726-1753) presented two studies on optics, published in the *Philosophical Transactions* in 1753 and in the Medical Society of Edinburgh, in 1756, posthumously. These two studies had significant repercussion at that time, although were not completely accepted. For instance, Joseph Priestley (1733-1804) frequently mentioned him in his historiographical account of optics, *The History and Present State of Discoveries Relating to Vision, Light and Colours* (1772). In these two reports, Melvill contested some classic propositions of Newtonian optics, although he was a projectile theorist. In the 1756 paper, Melvill presented a curious discussion about a hanging drop. He believed that it could prove the existence of repulsive powers between bodies. By analyzing the reflection of light in a drop over leaves of coleworth, Melvill assumed that occurred a total internal reflection, because the drops were hanging over the leaves. In this communication, I will present a detailed study of Melvill's two publications, especially the ideas on the hanging drop. My aim is to show that Melvill discussed a different evidence of the repulsive power in nature. Through a detailed analysis of the hanging drop, he believed to have observed a valuable optical indication that repulsion was responsible for other phenomena, besides those of electricity or magnetism.

Regal, Brian (Kean University)

Resurrecting Daniel Leeds: A thwarted and forgotten astrologer's attempt to bring the Scientific Revolution to Colonial America

During the late seventeenth century the English born, self-taught, astrologer Daniel Leeds (1651-1720) attempted to bring the philosophy of the Scientific Revolution to colonial New Jersey. He wanted to integrate the ideas of Francis Bacon, Galileo, Jacob Boehme, William Lilly, and other thinkers into a unified whole which could be utilized by the growing settlements of North America. He did this through a series of books and almanacs he wrote. He argued for education in science and history, and for a community of letters. He tried to convince his neighbors that knowledge of astrology and astronomy were beneficial to life at the edges of civilization. He was the first person south of Boston to argue openly for the acceptance of the Copernican Heliocentric view of the universe. His efforts, however, were met with resistance, ridicule, and censorship by the Quaker community of which he was a part. His printed works were confiscated and destroyed to the point where very few of his original writings survive. So rejected, Leeds turned his intellectual skills to political scandal mongering and bitter pamphlet wars with the Quakers thus leaving the high Enlightenment ideals he so cherished behind. As a result, he is all but forgotten to the annals of science history.

Takuwa, Yoshimi (Tokyo Institute of Technology)

With what prisms can Newton's optical experiments be reproduced?

This study tries to explain why some historical observations of reproductions of Newton's experiment in the 17th and 18th centuries clashed with others. In 1672, Newton introduced the two-prism experiment so-called experimentum crucis in his paper 'A New Theory about Light and Colours'. This experiment demonstrated the "different refrangibility of rays", but in *Lectiones opticae* (c. 1670), Newton admitted that this experiment could not demonstrate that "colors of rays are immutable by refractions" because a separation of rays was inadequate and the second refraction caused new colors in the final image. In fact, in 1676 Anthony Lucas reproduced the two-prism experiment and observed that violet appeared in a red image, and in 1681 Edme Mariotte observed red and yellow in a violet image. However, in the 18th century when Newton's theory was widely accepted, Newtonian writers started to insist that the two-

SATURDAY 15 SEPTEMBER, 16.00-18.00

prism experiment can prove the “immutability of colors”. For example, Newtonians such as William Whiston, J. T. Desaguliers, Willem ‘s Gravesande, Henry Pemberton, Voltaire and Francesco Algarotti wrote that “colors of rays did not change after the second refraction”. Moreover, Voltaire and Algarotti explained that Mariotte failed to reproduce Newton’s experiment because he used “bad prisms”. In addition Algarotti said he failed to reproduce the experiment with Italian prisms but was successful when he used English prisms. To explain these contradicting observations, I will do not only document surveys but also estimations and replications of the experiments and show with what prisms Newton’s experiment could have been done with.

Tonetti, Luca (Sapienza University of Rome)

After and beyond Descartes: The search for a unifying principle of sensory impressions in Italian iatromechanics

Italian Iatromechanics is traditionally believed to be strictly dependent on Descartes' philosophy. However, while supporting a merely mechanistic approach in medicine, it did not passively accept Cartesian "physiology." Brain research in the 1660s, for example, offers us a valuable way to examine the reception of Descartes in Italy. In this paper, in particular, I will analyse the way Malpighi in the second half of the 17th century, and then Baglivi and Lancisi in the early-18th century challenged Cartesian interpretation of pineal gland as the only part of the body on which the soul directly exerts its functions, being considered the necessary place where different sensory impressions from any single object meet in one and are united, before they come to the soul. In *De cerebro, De lingua, De externo tactus organo, De cerebri cortice*, Malpighi abandoned Descartes' theory of vision, by questioning the action of pineal gland: he rather paid attention to the role of "nervous juice" secreted by supposed glands in the cerebral cortex. In *De fibra motrice et morbosa* (1702), Baglivi, whose theory depended on Pacchioni's anatomical dissections, focused on the role of the meninges of the brain: the dura mater is assumed to play a pivotal role in exerting some bodily processes, such as sensation, by granting a regular circulation of nervous fluid throughout the body. Finally, Lancisi, in *De sede cogitantis animae* (1713), claimed that the true seat of the soul is the corpus callosum, while recognizing an accessory role to the pineal gland.

S44/3 SCIENCE IN TRANSLATION: LOOKING AT IT FROM EAST ASIA

Location: IoE – Room 826

Chair: Wu, Huiyi

Organiser(s): Wu, Huiyi, and Brazelton, Mary Augusta

Translation played a crucial role in history of science in East Asia by putting ideas and practices in circulation across linguistic and cultural boundaries, while highlighting the very existence of these boundaries. Throughout the centuries, translation has happened between cultures and languages near and far, within the East Asian sphere (China, Japan, Korea, Vietnam...), between East Asia and its Inner Asian, South Asian and Middle Eastern neighbours (Sanskrit, Persian, Arabic, Tibetan, Tangut, Mongolian, Manchu...), and since the 16th century, increasingly between East Asia, Europe and America. Translation of science has involved a wide array of actors, both men and women, locals and foreigners, from career translators and technical experts to monks and missionaries, not to mention rulers, dignitaries and officials who acted as patrons. These actors promoted translation in accordance with their broader personal, political, cultural and religious agendas which, in return, shaped the ways translations were conducted. In recent years, there has been an ever-increasing interest among historians of East Asian science, technology and medicine in charting this mosaic of peoples and knowledge, revealing numerous hitherto unknown connections. Translation involves both circulation of ideas and shifts of meanings: how historians identify, assess and

SATURDAY 15 SEPTEMBER, 16.00-18.00

interpret these phenomena is often revealing in how they strike a balance between unity and disunity in situations of cross-cultural contacts. In the modern period in particular, questions of scientific translation have been deeply entangled with narratives of modernity and globalization. Perceived failures of translation have long been instrumental in constructing theses of cultural incommensurabilities between scientific traditions in East Asia and in the rest of the world. While these issues continue to be hotly debated, more recently, drawing on insights from broader developments in history of science, historians of East Asia have also become increasingly interested in the material aspects of translation. Attention has been paid to how oral and written practices intermingle in acts of translation, how the interplay between manuscript and printing affects the contents of texts, and how translation has been inextricably linked to other non-verbal means to produce practical knowledge, including diagrams, maps, specimens and instruments. This symposium will seek to bring together not only expertise on different languages, regions, periods and fields of knowledge, but also different historiographical approaches, to enable comparison and cross-fertilization between them. Last but not least, we bear in mind that for today's historians, writing about East Asian history of science is in itself an act of translation, between the classical languages our sources are written in, and the modern (often Western) languages we use to interpret them. We have also witnessed in these years a fruition of initiatives for translating sources of East Asian science into Western languages. We welcome reflections on our own translation practices, in order to lend greater critical nuances to the stories we tell and to continue building bridges with history of science in East Asia with the broader community of scholars.

Kwan, Uganda Sze Pui (Nanyang Technological University)

Translating Zer0 into China: Edward T. R. Moncrieff, Writing, Materialities and Printing mathematics in early 19th century

Early 19th century was an overlooked period in discussing the translation of western science into China. Previous studies focused on the endeavours by the Jesuits missionaries in the Ming Dynasty and the full-fledged transmission of science since the Self-strengthening movement (1861-1895) of China. This paper will center on a translator and a curriculum designer, Reverend Edward T. R. Moncrieff, a Protestant missionary who tutored at Hong Kong St. Paul College in the 1840-50s for the transmission of mathematics into imperial China. Although HK was seen as the hub to exchange East-West knowledge, Moncrieff was frustrated by the teaching conditions where he felt that arithmetic formulas could not be conceived, calculated, or conveyed in Chinese character and writing utilities. This paper will focus on Moncrieff's works at the St Paul's College of Hong Kong, which was a cradle of Chinese modernization at which many advocates of western knowledge, such as John Fryer (translator, educator) and James Summers (later Professor of Chinese at King's College London in the 1850s) were once taught. By a close examination of Moncrieff's papers deposited at the Church Missionary Society in England, we hope to understand how the printing technology helps to overcome the epistemological, mathematical, philosophical conundrum triggered by the problems of translation. We will also try to see how translation gives new impetus to the new lexicon and new technological breakthrough.

Meade, Ruselle (Cardiff University)

A New Language for a New Era: Translation and the creation of a new technical lexicon in 19th-century Japan

When published in 1868, *Jōki kikai sho* ('A Treatise on the Steam Engine') was one of the first comprehensive translations on steam technology in Japanese. As a pioneering work of technical literature, it presented its translators with a challenge: how to describe numerous technical

SATURDAY 15 SEPTEMBER, 16.00-18.00

components and concepts for which no term existed in Japanese. This paper will present the various innovative strategies employed by the work's translators, demonstrating how these contributed to the creation of a modern technical lexicon in Japanese. The paper will then explore the trajectory of these new terms, charting their eventual acceptance within the engineering community or, in some cases, their demise and replacement with other terms. Also explored will be the extent to which various powerbrokers, such as high-profile educators, educational institutions and publishers, influenced the long-term fortunes of these terms. The paper will also describe the 'detective work' required to identify the source of the translation. As is common with nineteenth-century Japanese translations, no source text was identified, and the text itself was extensively reshaped. Identifying the source text provided lessons about conducting histories of technical translation in Japan. Overall, this case study will demonstrate that the creation of a new technical terms in Japanese gave rise to heated debate. These debates broached concerns about the 'correct ways of translating' and the suitability of Japanese as a language of science and technology.

Fang, Yibing (Institute for the History of Natural Sciences, Chinese Academy of Sciences)

Beyond translation: John Bourne's work on steam engines and his connection with the Kiangnan Arsenal

The translations produced under the aegis of the Kiangnan Arsenal (founded in 1865) have been considered as one of the most important steps towards the systematical introduction of Western technical knowledge into China during the Self-Strengthening Movement in the 19th century. These translations have so far been studied exclusively in terms of the textual transfer of knowledge, with the assumption that original authors had no direct contact with the Arsenal. However, this presentation takes the case of John Bourne to suggest that Kiangnan Arsenal translations went along with industrial entrepreneurship. John Bourne was the author of "A Catechism of the Steam Engine", translated into Chinese in 1872 as Qiji biyi (汽机必以). Our research reveals that he ran a shipbuilding and machine manufacturing business in England, and the translation into Chinese of his book sparked his interest in China's industrialization. In 1874, his company produced a planing machine for the Kiangnan Arsenal; two engineers were sent to help the Arsenal design and construct an Armour-clad vessel. Bourne was later appointed the European agent of the Chinese Polytechnic institute and Reading room (格致书院) when its construction in Shanghai was planned, probably because of his longstanding relationship with the Kiangnan Arsenal. We suggest that, beyond the transfer of texts, the translations of the Kiangnan Arsenal could constitute opportunities for entrepreneurs-cum-authors like Bourne to enter the Chinese market and to involve themselves in processes of industrialization in East Asia.

Shen, Yubin (MPI, Berlin)

"Pest" Translated from Japan: Nongxue Bao and the Introduction of Applied Entomology in Modern China, 1897-1906

Founded by the Chinese reformer intellectual Luo Zhenyu in 1897, Nongxue Bao (Agronomy Bulletin) was the first agricultural journal in modern China. By mainly translating Japanese books and journal articles, Nongxue Bao played an important role in spreading entomological knowledge and technology to China. This paper in particular examines how Luo and his Japanese colleague Fujita Toyohachi in this journal translated and represented the "pest" (Jpn., gaichū; Ch., haichong) as a new globally-circulated "social and cultural construct" in East Asia, and biological, cultural and chemical control methods from Japan as "modern and scientific" solutions to insect-induced agricultural crises in China. It argues their efforts were closely related to Chinese scientific nationalism at the turn of the twentieth century, and the introduction of Japanese applied entomology would tremendously change Chinese relations with those "noxious" insects.

SATURDAY 15 SEPTEMBER, 16.00-18.00

Brazelton, Mary Augusta (University of Cambridge)

“Struck by the Needle”: Translating Vaccination in Twentieth-Century China

Immunization against infectious disease was one of the most significant medical technologies and public health interventions to become prevalent in China by the late twentieth century. In this paper, I trace the history of the many terms that described one medical practice, immunization, in China between 1911 and 1958, and evaluate the significance of changes in this terminology to the history of medicine in modern China more broadly. I argue that changing vocabularies of immunization reflected the new roles that this practice took on in public health over the course of the twentieth century. In the 1910s and 1920s, committees of physicians discussed how to translate scientific terms from Western Europe and Japan in dictionaries of bacteriology and immunology. These terms filtered into broader spheres of medicine and public health via medical journals, health magazines, and newspapers. With the specialization of medical and scientific disciplines in the mid-twentieth century, and the development of new vaccines against a variety of diseases, came a more varied vocabulary of vaccination—one that reflected older understandings of disease, as well as novel practices and theories. The standardization of terms for vaccines during the public health campaigns of the early People’s Republic suggested the institutionalization of mass immunization as a key public health practice of the new Chinese state.

I132 MEDICINE 2

Location: IoE – Committee Room 2

Chair: Radick, Greg

Campos, Elisa (Nova Medical School/Universidade Nova de Lisboa)

Emerging studies of lipoproteins in clinical practice (1949-1977)

Lipoproteins developed from the interest they awakened in public health and clinic. Beginning of XX century in the US, statistics indicated an increase of coronary heart disease (CHD), the cause-effect model applied to infectious diseases not being applicable to CHD. While the National Heart Institute (NHI) undertook the Framingham Heart Study (FHS) from 1948 onwards, John Gofman, in Berkeley, elucidated the form of transportation of lipids in circulation; in 1949, he reported that Low Density Lipoproteins are increased in patients who suffered a myocardial infarction. FHS confirmed these lipoproteins as a risk factor for CHD in 1977. Following Gofman's reports, NHI recruited young physicians who established a bridge between research and clinic: Donald Fredrickson stands out by his classification of hyperlipoproteinemias, endorsed by the World Health Organization, in 1970. Electrophoresis on paper popularized phenotyping within the medical community. Petar Alaupovic, arriving to this field in the 1960s, emphasised the protein moiety of lipoproteins, isolating new apolipoproteins, stressing their role in the atherosclerotic process. Some laboratories force a change in the research itinerary, emerging as relevant in the field. Apolipoproteins elucidated the biochemical mechanisms of hypercholesterolemia. Consequently, the NHI was constrained to integrate new apolipoproteins in canonical knowledge, in 1973, as the laboratories involved created a collective consciousness, despite local epistemic cultures, Revelation of epistemic cultures implies ruptures in any uniformities of practice; these ruptures suggest the involvement of multiple frameworks—instrumental, linguistic, theoretical or organizational. However, this contemporary orientation is more visible across diverse sciences than within a science.

McGuire, Coreen (University of Bristol)

Unifying Partial Disability: The Medical Research Council and the Classification of Respiratory Disability in Britain 1936-1945

During the first half of the twentieth century, the mining industry in Britain represented a site of contested medical knowledge, in which the risk to miner's lungs from coal dust was disputed by various governmental, industrial, and medical bodies. Following the legal introduction of 'partial disability' in 1931, attempts to unify these bodies in standard interpretations of respiratory disability were promoted by the Medical Research Council. However, adjudicating disability was complex and involved creating new sets of standardised classifications for what measurable changes constituted disability in relation to respiratory disease. This paper will consider how technology was used by the Medical Research Council in their attempt to create objective measurements of such respiratory disability changes. To combat the difficulty of measuring breathlessness and the impossibility of making direct measurements of lung capacity, the surrogate measurement of vital capacity was made using spirometers. The MRC used this measurement to numerically code breathlessness, which allowed them to scale, standardise, and adjudicate for levels of respiratory disability. Yet such efforts were permeated by tension and disunity between subjective reports of breathlessness and the correspondent objective measurements. I argue that this disunity led to a kind of epistemic injustice facilitated by mechanical objectivity. Analysing the standardisation of respiratory disability through vital capacity measurements reveals how seemingly objective measurement technology has masked elements of the political and social construction of disability.

Sysling, Fenneke (University of Utrecht)

Data rituals. Measuring and recording height and weight in baby books, 1872-1940

This paper examines the notation of height and weight of babies in baby books between 1872

SATURDAY 15 SEPTEMBER, 16.00-18.00

and 1940. Baby books, books in which parents record information about their baby, are still a familiar object in households with babies. In the US, they were first published in the last decades of the nineteenth century and became increasingly popular in the twentieth. Based on a hundred completed baby books from the UCLA Biomedical Library collection, this paper looks in particular to the quantified data in these baby books: records of the weight and growth of the baby. They are a unique source in which we can follow practices of measuring and quantification from the doctor's office and the health departments where standards were produced, into the household where mothers, fathers or others tracked the development of their babies. I argue that professionals and parents 'measured' different things, and that this is therefore a case of disunity. Although the use of weight and height records by parents might appear to exemplify institutional (bio)power manifested through internalized self-monitoring, I argue that keeping a record of baby's growth in a baby book was in fact a ritualized version of measurement. This ritual of measuring and recording focused less on normal growth and disease, but symbolized the transformation of the baby in the first years.

Sierra, Carlos Hugo (University of Basque Country & Open And Distance National University)

Re-Establishing Theoretical Unity on the Pathological Phenomenon. Claude Bernard's Experimental Medicine

The main purpose of this paper is to present and examine the historical impact exerted by the theoretical approaches of the French biologist and physician Claude Bernard, insofar as his experimental work, not only established a new medical rationality and an epistemological rupture with respect to the dominant western anatomy and physiology, but, at the same time, contributed to consolidate the medical practice of the XIX century under the operative bases of experimental medicine. On the one hand, Bernard's experimental medicine constitutes an alternative approach to the attempt to return to the medical Hippocratism which extends during the 18th century (through the works by F. J. V. Broussais or F. Magendie) in order to offer a universal model of explanation about the pathological phenomenon and, in general, about the human body and life itself. On the other hand, Bernard promoted the advent of a physiology as an autonomous medical discipline that could be discharged from the classical subordination of the anatomical-pathological perspective established by X. Bichat or G. B. Morgagni. From this point of view, Claude Bernard represents one of the most outstanding attempts to found an all-encompassing theory about disease and biological phenomenology (through the central concept of "internal environment"), until its definitive interruption with the birth and development of modern bacteriology (through the discoveries of L. Pasteur, R. Koch and others), which also comes to reflect the positivist ideology of nineteenth-century European industrial society.

S46 FROM LOCAL SCIENCE TO PUBLIC HISTORY: PIONEERS, MUSEUMS AND CIRCULATION OF KNOWLEDGE IN PREHISTORICAL STUDIES AT THE EUROPEAN PERIPHERIES (1860-1915)

Location: SciM – Dana Study

Chair: Pizzato, Fedra Alessandra

Organiser(s): Pizzato, Fedra Alessandra

Commentator: Nieto-Galan, Agustí (Universitat Autònoma de Barcelona)

The public use of history and science is not a recent phenomenon. In fact, it is as old as human history itself. From Ramesseum, to the Italian Renaissance, to Nicolas Sarkozy's plan for a French Historical Museum, the past has been used to found and justify present societal structures, political systems, power relations, and cultural identities. However, the discovery of European prehistory and the scientific character of the reconstructions of the origin of the European (and Extra-European) nations carried out by archaeologists and anthropologists in the 19th century represented a crucial fracture. While previous public uses of history had relied on myths, during the 19th century the prehistorical scientists of Central and Northern Europe started to elaborate new narratives on race, people and nations based on scientific objects and practices. These theories spread very rapidly in the European peripheries where they were appropriated differently in different local context. The transnational community of mainly prehistorical archaeologists and anthropologists emerging from this process shared a common set of practices, but differed importantly in the political and social goals, which were strongly related to the different national conjunctures. This dialectical relation of unity and disunity is perhaps best seen in the organization of collections of archaeological objects. For example, while everybody adopted chronological and typological dispositions as scientifically certified, the selection of the object was deeply ideological. Museums become scientific as well as political statements. By their musealization, prehistorical sites and objects were turned from scientific entities into elements of a master narrative for the national public. This session aims at shedding new light on the relation between the circulation of knowledge and at the elaboration of public national histories at the European peripheries. More specifically, we intend 1. to investigate the practices of acquisition and reinterpretation of knowledge by the pioneers of prehistorical research; 2. to elucidate the political (and nationalistic) uses of prehistorical knowledge in the creation and organization of national and local museums; 3. to clarify the diversity and complexity of the public of the prehistorical collections; 4. to show that prehistorical museums at European peripheries were not only cabinets of study, but also players in a new public discourse on history of nations; and 5. to explore the role of science in the development of public histories and narratives at European Peripheries during the Long Nineteenth Century.

Pizzato, Fedra Alessandra (Ca' Foscari University of Venice)

Objects and Theories: Prehistorical Findings and Public Discourses in Liberal Italy (1871-1915)

In the closing decades of the Long Nineteenth century, European paleontologists and anthropologists played an active role as nation builders. In Italy, their contributions covered three main areas. First of all, they elaborated theories on the origin, the settlement, and identity of the Italian nation. Furthermore, they pursued a thorough musealization of prehistoric findings and monumentalization of archeological sites. Lastly, they undertook a zealous activity of popularization carried out according to the typical modalities of positive sciences. The

SATURDAY 15 SEPTEMBER, 16.00-18.00

strategies adopted by prehistoric scientists in constructing the national origin as well as in the formation of network relations hinged on the archeological finding as the central object. Once embedded into a complex object-based epistemology, findings became active elements in the establishment, popularization, and professionalization of pre-Roman studies and the foundations of a novel public history of the nation. In this paper, I aim at deconstructing the role played by archeological findings in supporting national prehistoric narratives and in the complex interplay of power relations, political agendas, and strategies of scientific communications in late nineteenth century Italy.

Coltofean, Laura (Brukenthal National Museum, Sibiu)

Nationalism and Prehistoric Archaeology in Nineteenth-Century Hungary

In 1876, an event of major importance for Hungarian archaeology took place in Budapest: the 8th International Congress of Prehistoric Anthropology and Archaeology (CIAAP). The congress symbolised the international recognition of Hungarian archaeology. In addition to this, it had significant consequences on prehistoric archaeology in Hungary. Soon after the event, prehistoric archaeology matured as a separate discipline and, before the end of the nineteenth century, it was taught in two major universities. After 1876, prehistoric archaeology also became a stronger political instrument, and it was incorporated in the elaboration of a glorious national history. Nationalism had a strong, undeniable influence on this discipline as well. How did this influence manifest itself? This paper aims to explore the connection between nationalism and prehistoric archaeology in Hungary, from the birth of the Austro-Hungarian Empire in 1867 to its collapse at end of the First World War.

Gustavsson, Anna (Gothenburg University)

Artefact Exchange and Knowledge Circulation Between Italy and Scandinavia in the late 19th Century

This paper aims to explore the dynamics and results of scholarly contacts between Italy and Scandinavia, regarding the acquisition of artefacts and the creation of national collections. National agendas together with personal interests had great impact on possible artefact exchange and on the selection of objects. Did the interchange of ideas automatically lead to an exchange of artefacts? How, by whom and why were artefacts transferred between Italy and Scandinavia? These questions will be discussed with the starting point in the Scandinavian collection at the National Prehistoric and Ethnographical museum in Rome (Museo Nazionale Preistorico Etnografico Luigi Pigorini) and the contact between Luigi Pigorini and Scandinavian scholars, among them the Swedish archaeologist Oscar Montelius.

I108 EVALUATING HISTORIC COLLECTIONS

Location: SciM – Dana Studio

Chair: Dean, Katrina

Banaś, Marcin (Jagiellonian University Museum)

Historical scientific instrument - an attempt to unify the museum's evaluation of the subject's value

The evaluation of the museum's value of monuments collected by museums is a task that requires an approach from many sides. For the evaluation of historical scientific instruments, it is necessary to apply different assessment criteria. In addition to the need to evaluate the artistic, technological and behavioral layers of the instrument, it is particularly important to include its impact on the development of science. The above features, analyzed together, will reflect the actual museum value of the object as a monument of science. The speech will present a proposal of a relatively simple method of valuation of historical scientific instruments. The method includes the evaluation of a historical instrument in three categories: historical, scientific and artistic. First attempts to apply it to the analysis of objects from Polish museum's collections will also be discussed. The evaluation method was developed for the purposes of the project "National Inventory of Historical Scientific Instruments", which aims to provide a comprehensive overview of historical scientific instruments in the collections of Polish museums. The method will also be a tool for curators to facilitate the decision to purchase such items for museum collections, to prepare programs for their preservation or to choose the most valuable ones. The project "National Inventory of Historical Scientific Devices" is financed by the National Science Center, Poland.

Bonifácio, Vitor (CIDTFF/University of Aveiro)

Twenty thousand copies per volume – the unusual case of the Bibliotheca do Povo e das Escolas (People and Schools Library)

In 1881, the successful publisher David Corazzi (1845–1896) started a new collection of popular booklets entitled Bibliotheca do Povo e das Escolas (hereinafter BPE, People and Schools Library). Aimed as "Instructional Propaganda for Portuguese and Brazilians" BPE volumes were available in both countries via the company comprehensive distribution network. A BPE title had 64 pages of low-quality paper in a 10.0 cm by 15.5 cm format. Bindings were available for a series of eight volumes. The collection was initially met with both critical and commercial success. Earlier volumes had print runs of 20 000 copies an impressive number by contemporaneous standards. The collection ended in 1913 with a grant total of 237 volumes published during 24 years. In this paper we analyse the BPE publication dynamics, contributors, themes developed and planned while placing it in the context of similar, albeit with considerable lower impact, local efforts and other international 19th century science popularization endeavours. We conclude BPE partly follows partly breaks the mould of comparable collections. From the start Xavier da Cunha (1840-1920), the first and likely only BPE editor, intended to improve upon the foreign models that inspired the collection. His strategic bet on low price, targetted audience, content quality, science topics and a reduced number of authors paid off. While the Portuguese government adoption of several volumes as textbooks likely assisting BPE initial commercial success.

Takigawa, Yuko (Kagawa University)

Significance of the Vega collection from Japan

The Swedish Vega expedition (1878-1880), led by Adolf Erik Nordenskiöld, was a monumental exploration, which achieved the first successful navigation of the Northeast Passage. After passing through the Northeast Passage, the Vega visited Japan in 1879 for about two month in total, partly for docking, and partly for scientific research. During her stay in three ports, namely, Yokohama, Kobe and Nagasaki, scientists in Vega conducted excursions in Japan and collected specimens. The Vega collection has been classified and stored in the Swedish Museum

SATURDAY 15 SEPTEMBER, 16.00-18.00

of Natural History, Stockholm, according to the taxonomic classifications. From 2015 to 2017, our research project was conducted to investigate the Vega collection from Japan collaborating with different specialists in zoology. There are three purposes for this paper: one is to present the overview of the collection, based on the identification of each specialist; second is to reconstruct the past environment of the collected areas. Lake Biwa, the largest lake in Japan can be good example which has been damaged by various anthropogenic influences, especially during the late 20th century during the rapid economic growth; and finally, to evaluate the collection as the united entity for considering the meaning of the Vega collection of 140 years ago, from perspectives today.

Wyka, Ewa (Institute for the History of Science Polish Academy of Science, Warsaw; Jagiellonian University Museum, Cracow)

Historic Scientific Instruments - The Union Of Science, Technology, Art and Craft

This paper aims to show how scientific instruments, across many eras of history, reflect the period of their creation - in the level of scientific knowledge, the maker's skill and the style of the particular time. Historical scientific instruments display a unity in these facets. Makers created early scientific instruments as individual objects, usually commissioned by scholars, in the same way as orders for works of art, furniture and other objects for decorating aristocratic interiors were. Sometimes, beautifully decorated scientific instruments adorned those same interiors. In the 18th century, in response to the development of modern science, including experimental physics, there was an increase in the manufacture of scientific instruments. Instrument fabrication began to be carried out on a larger scale, not only to satisfy the needs of scholars but also for schools and private enthusiasts of modern science. Still, many of these instruments, in their materials and style, reflected the contemporary trends of art and standard methods of craftsmanship. Comparing old works of art and craft with scientific instruments, one can perceive some common factors in their manufacture and ornamentation, resulting in a kind of aesthetic unity. Modern scientific apparatus - apparatus of the twentieth and twenty-first century - belong amongst the highest-class of technological works, in which all artistic dimensions are limited to the minimum. Do these works reflect current trends of design? Do they still follow fashion?

SATURDAY 15 SEPTEMBER, 18.00-22.00

18.00-18.45	TRAVEL TO ROYAL INSTITUTION	
18.45-19.30	YOUNG SCHOLAR LECTURE 3	
	Royal Institution	Chair: Professor Frank A. J. L. James
	Professor Jennifer M. Rampling (Princeton University)	
	<i>Picturing Experiment: Reconstructing Alchemy in Image and Practice</i>	
19.30-20.30	PLENARY LECTURE	
	Royal Institution	Chair: Dr Antoni Malet
	ESHS President-Elect Professor Ana Simões (University of Lisbon)	
	<i>Looking back, stepping forward: reflections on sciences in Europe</i>	
20.30-22.00	CONFERENCE DINNER (ticketed)	
	Royal Institution	

SUNDAY 16 SEPTEMBER, 09.00-10.30

S14/1 THE EMERGENCE OF COMPUTATIONAL SCIENCES

Location: IoE – Room 804

Chair and Commentator: Agar, Jon (UCL)

Organiser(s): Hashagen, Ulf

The digitization of the scientific world began after World War II when scientists started using the recently invented electronic digital computers to manage complex calculations and computation problems in science and engineering. While on the one hand computer science was established as a new scientific discipline in the following decades, on the other it became almost natural for scientists to use computers as a scientific instrument or research technology in the last third of the 20th century. As a consequence in some scientific disciplines novel computational methods were widely used. In mathematics numerical analysis was transformed by the computer from a former marginal sub-discipline into an important research field. Hereby only the computer as an enormously fast and programmable machine made it possible to process the many newly invented numerical methods for the solution of algebraic and differential equations and other mathematical problems. Furthermore a bunch of computer-based techniques arose in the following decades in various disciplines and transformed the researchers' work in fundamental ways. For example the well-known Monte Carlo Method was created in the context of war research in atomic physics, algorithmic approaches and scientific visualization in application fields. Among these new research technologies computer simulation became the probably most important tool, and in scientific communities the question appeared whether simulation is a third scientific method beyond experiment and theory. Moreover the scientists' eagerness for high performance computing devices had also a strong impact on the hardware development (supercomputers or parallel processing) and resulted in the setting of computer centers as service providers for scientific research in academic institutions all over the world. Moreover, in various disciplines forms of computational sciences emerged, such as computational astronomy, computational fluid dynamics and computational chemistry. While only few aspects of this eminent historical development have been explored so far—such as supercomputing at the large national research laboratories, the use of the computer in high-energy physics and in X-ray crystallography and the efforts to computerize bio-medical research—the field has been dominated by studies on computer simulation, mostly with a strong philosophical orientation. In general the emergence of computational sciences and the use of developments have not become a central topic for historians of science and technology so far and there are still large gaps in the knowledge on the history of computational sciences. This symposium aims at considering different developments of computerization and computer-assisted methods in various periods, nations, societies and cultures. These views support the interpretation of disunited paths of scientific disciplines to their computational continuations. The studies in this symposium will highlight relations between these scientific disciplines and aspects of politics, technology, and economics, which are part of the process that terminates in the computational turn. Finally, the symposium refers to the question whether the particular developments of disciplines are just parts of one unique process of “computationalisation”. Is the second half of the 20th century the beginning of an era of computational sciences or rather of a unified computational science?

Hashagen, Ulf (Deutsches Museum, Munich)

A Failed Attempt to Make Computational Science a Scientific “Cross-Discipline” in the

SUNDAY 16 SEPTEMBER, 09.00-10.30

Kaiserreich in Germany

The invention of the computer has had a significant influence on the disciplinary development of the sciences in the 20th century. Take the cases of the computational sciences (e.g. computational physics) which emerged as subdisciplines in many natural sciences in the 1960s. Whereas historians of science would surely agree that numerical methods were widely used long before the computer was invented, the question, if computational sciences have existed as disciplines prior to that time, seems to be hypothetical. This talk will present a counter-example to this assumption by analyzing the failed attempt of establishing scientific computing as a discipline in the Kaiserreich. In the 1870s the director of the Berlin observatory Wilhelm Foerster founded an Astronomisches Recheninstitut as well as a Seminar für wissenschaftliches Rechnen at the University of Berlin. In his view the methods scientific computing and the evaluation of measurement results should be taught to all students of the exact sciences and his newly founded seminar aimed at introducing students to the theory and practice of scientific computation in a systematic manner. Foerster's attempt failed in the long run since the disciplinary influence of his Seminar for Scientific Computing remained limited to astronomy and found only few emulators at other German universities. It proved impossible to institutionalize scientific computing as a new scientific "cross-discipline" and to get over the boundaries between the scientific disciplines set up in the 19th century.

Durnová, Helena (Masaryk University, Brno)

Emergence of prescribing the computational procedure description

How do we quickly compare the efficiency of two computational procedures? Such a comparison can be enabled, or hindered, by the language used. When a computational procedure is described in plain language, ambiguities arise, making comparison difficult. Thus the call for finding a uniform way to describe them may be interpreted as a natural consequence of these difficulties. I take the example of the minimum spanning tree (shortest spanning subtree), problem in discrete mathematics. The principal task lies in connecting points through lines of non-negative lengths in such a way that the total length of those lines is minimal. Diverse plain-language formulations of the problem appeared before WWII, and the mathematicians asking to deal with the problem also provided several plain-language and intuitively clear solutions to the problem. However, it was not until April 1972 that a minimum spanning tree algorithm appeared in the Algorithms section of the Communications of the ACM, a decade after the section was established. From the point of view of mathematicians, there are two, maybe three, significantly distinct ways to find the correct solution, whose use can be a matter of taste. Taste, however, was not a good enough measure for programmers. Their attempts to measure the taste resulted in a more engaged discussion than the intuitive solution of the rather banal problem, from which mathematicians run away after having solved it, leading to re-assessment and re-formulations of the old solutions, as will be shown in the talk.

Eckert, Michael (Deutsches Museum)

The Rise of Computational Fluid Dynamics

Computational Fluid Dynamics (CFD) applies to the flow of liquids in natural environments and hydraulic machinery, the air flow in aeronautics and ballistics as well as flows on geophysical and even astrophysical scales. The application of numerical methods for flow problems was analyzed from a theoretical vantage point as early as in the 1920s, but the potential of these methods became exposed only with the use of fast computational machinery in World War II and the subsequent development of electronic computers. Among the first applications were computations of shock waves spreading from a pointlike detonation and numerical weather prediction. The Cold War fueled the development of powerful computers which in turn extended the applicability of CFD. By the late 1960s CFD could be discerned as a rising specialty. With its wide range of applications CFD became the vanguard of computational sciences at large. Beyond its uses in applied areas, CFD also played a role for fundamental research fields such as the turbulence problem. Due to the limitations of the computational mesh direct

SUNDAY 16 SEPTEMBER, 09.00-10.30

numerical simulation of turbulent flows was in most cases prohibitive. This gave rise to the development of turbulence models and other efforts by which the motion down to the smallest scales could be taken into account – and thus resulted in a renaissance of basic research on turbulence. The paper is focused on the nascent CFD and the transformation exerted by its use in basic and applied fluid mechanics.

van Helvoort, Ton (Acta Biomedica)

A 'Silent' Revolution at the University

Half a century of computers driving centralisation and decentralisation This paper concerns the digitisation or computerisation of the University of Groningen during the second half of the 20th century, while also discussing computer policies at all Dutch universities. My analysis is a story of the particular and the general at the same time. Groningen university was, on the one hand, an archipelago of institutes, laboratories, disciplines and bureaucratic organisations, seemingly governed at first by the Curators and later by the 'Board of Governors'. On the other hand, the university was largely centrally funded by Dutch Government. When the first digital computing machines were introduced in Groningen for a select number of scientific fields — such as astronomy and X-ray diffraction — the national government soon realised that coordination of such heavy investments was necessary. More and newer computers were acquired and were housed in a central building — the Computing Centre — where scientists and students were taught how to program software and executing the computer programs. The introduction of these costly machines was an outspoken computer revolution. The pendulum of centralisation towards decentralisation and back again, becomes visible only when computer history is analysed at the level of the actual disciplinary use of computers in past and present. These tendencies structured the workings of university laboratories, departments and offices. It is this dynamics that forms the silent or hidden aspect of the computer revolution but is formative to the emergence of computational sciences.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S10/1 THE BUREAU DES LONGITUDES (1795-1932): COOPERATION AND COMPETITION NETWORKS

Location: IoE – Room 822

Chairs: Schiavon, Martina, and Rollet, Laurent

Organiser(s): Schiavon, Martina, and Rollet, Laurent

Created in 1795, the Bureau des longitudes was an international academy devoted to science and technology: a place for collective expertise and an advisory committee for the French government. It played a primary role in the organization and development of astronomy and celestial mechanics, the adoption of the decimal metric system, the definition and implementation of time standards, the production and transmission of time signals, the development of earth physics and geodesy and the organization of major scientific expeditions. In the 19th and 20th centuries, its prestigious members – scientists, military and naval officers, and precision instrument makers – organized and participated in various national and international projects: the international geodetic association, the spread of standardization and the study of units of measurement, the dissemination of time signals, the adoption of the Greenwich meridian, among others. The Bureau des longitudes is thus a crucial place to study various cooperation and competition processes: from science to technology via the military, from scientific diplomacy to politics through economy, and vice versa. This symposium will be devoted to the analysis of such questions, in particular: § Circulation and priority conflicts concerning instruments and scientific discoveries § The influence of war on scientific organizations § Cooperation, rivalry and priority disputes § Conflict and collaboration between amateur and expert § Editorial rivalries (for instance between *La connaissance des temps* and other ephemerides) § Metrology, the metric system, almanacs and annuaires § Professional and institutional rivalries (scientists, military men, precision instrument makers, etc.) § Unity and discord between centre(s) and periphery(ies) The weekly minutes of the Bureau des longitudes from 1795 to 1932 are available online at <http://bdl.ahp-numerique.fr>.

Fox, Robert

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Dunn, Richard (National Maritime Museum)

After 1815: British science through a French prism

The archives of the Bureau des longitudes provide a rich resource revealing not only the inner workings of that institution but also how the work of scientific institutions and practitioners from other countries was being discussed in France. This paper will look at what discussions at the Bureau des longitudes might tell us about British institutions and practitioners in the post-war decades after 1815, a period that saw significant changes in the way scientific work was organised in both countries. By highlighting individual case studies around the practical application of astronomy and related research areas, it will look at issues of collaboration, rivalry and accommodation.

Belteki, Daniel (University of Kent)

A Model Instrument - Exhibiting the Airy Transit Circle at the Exposition Universelle 1855

George Airy (director of the Royal Observatory, Greenwich) exhibited at the Exposition Universelle 1855 in Paris, a set of models showing features of his newly designed Transit Circle. Using Airy's personal correspondence with the makers and the supervisors of the models, the paper investigates how individuals interpreted the models, and why attempts failed to gift them

SUNDAY 16 SEPTEMBER, 09.00-10.30

to French scientific institutions and to the Paris Observatory.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S01/3 UNITY AND DISUNITY OF THEORY AND PRACTICE IN RESEARCH ON ECONOMICALLY SIGNIFICANT SPECIES

Location: IoE – Committee Room 2 **Chair:** Mueller-Wille, Staffan

Organiser(s): Fedotova, Anastasia, and Mueller-Wille, Staffan

This symposium will be devoted to economically significant species as research objects and their impact on research agendas, methods, strategies, and institutional frameworks in natural history and biology. The topic is deliberately conceived as a very broad one that could potentially encompass a vast array of disciplinary fields within the life sciences. The panellists will consider research on such objects as crops, officinal plants, domesticated animals, fish and wildlife game species, insect pests, and species transmitting contagious diseases. It makes sense that economically significant species have always enjoyed better chances to become privileged research objects; however, there are numerous examples also when some of these species remained under-researched for a long time. The economic, ecological or medical significance of a given species may considerably vary from one national or regional context to another and from one point of time to a different century or decade. Technological changes, in particular, would inevitably lead to enhancing the importance of some species that previously never attracted focussed attention, while other species would cease to be treated as a valuable resource or commodity deserving such attention. Geographic location and economic conditions exercise a powerful influence upon what counts as a biological resource, and thus might affect the making of specific institutional, regional or national traditions and ‘schools’ within specific fields of study. The focus on economically significant species may have provided a convenient strategy to legitimise and enhance the credibility of a particular research agenda in the eyes of academic administrations and private and public sponsors. But even if the choice of some of these species as principal research objects was thus often pragmatically motivated, it could still lead to substantial changes in the institutional and methodological landscapes of science. In earlier periods in the history of life sciences, for example, local agents – farmers, craftsmen and entrepreneurs, hunters and healers, etc. – would usually have had vastly more substantial experience in dealing and working with a specific species than travelling naturalists who produced first scientific accounts of these species. Growing awareness of the economic importance of such species by the state would thus have pressured metropolitan scholars into changing social and institutional arrangements to tap into these knowledge sources at the periphery, forcing them to leave their familiar environment and relocate to new, often challenging and potentially dangerous milieus. At the same time, knowledge gathered in this way needed to be reported back and systematized, often causing major changes in the material culture and publication regimes of science. By looking at the history of research on economically significant species, we hope to arrive at a better understanding of the entangled histories of supposedly ‘pure’ and ‘applied’ research in different regions of the globe and what unites and separates different national and regional traditions in the history of the life sciences from the early modern period to the present.

Pannhorst, Kerstin (MPI, Berlin)

Unity and Disunity between Taxonomy and the Decorative Arts Trading Insects in early 20th Century Taiwan

This paper focuses on practices of collecting, processing and trading insects in early 20th century Taiwan and explores the entanglement of a mass-fabrication of research specimens,

SUNDAY 16 SEPTEMBER, 09.00-10.30

insect decorative art and knowledge. In the early Japanese colonial period, the small town of Puli in Taiwan's central mountain range became a hub of commercial insect trade which decades later would become the center of an industry that turned the island into the world's largest exporter of butterflies. Taiwan's insects gained this economical significance as a resource for the production of decorative art. Preserved specimens, mainly butterflies, were sent to entomologist Yasuhsi Nawa in Gifu in central Japan and turned into commodities such as paper fans, hair pins or postcards at the Nawa Entomological Institute. Simultaneously, the only recently accessible island Taiwan attracted entomologists looking to find insect species not yet scientifically named. One of the most prolific collectors was Hans Sauter, a German entomologist turned collecting entrepreneur permanently based in Taiwan who made Puli one of his main field sites, employing some of the same insect collectors as Nawa. Together with the German Entomological Museum in Dahlem, today a part of Berlin, Sauter aimed towards a „mass-fabrication of knowledge“: Tens of thousands of carefully packaged specimens were sent to European museums along global trading routes with the goal of a successive publication of the „complete fauna of Formosa“ by taxonomists all over Europe. Before the First World War, the Dahlem museum moved its focus to insects from Taiwan, even founding a new annual journal that in its first five years exclusively published papers about insects sent by Sauter. Fueled by the demand for Japanese decorative arts, collecting insects became a lucrative skill for the rural population in early 20th century Puli, enabling the mass production of research specimens and leading to changing entomological research and publication regimes.

Kelly, Ann (KCL)

Detinova on Safari: Cold War Entomologies and the Labours of Eradication

This paper focuses on techniques of mosquito dissection, a crucial element in the understanding of the dynamics of disease transmission. Specifically, I explore the history of a method pioneered in the 1940s by Soviet entomologists. The Detinova Technique, as it would become known in the West, offered a highly precise way of determining the exact physiological age of the female *Anopheles* mosquito by counting the dilations in the ovariole stalk left by each egg. This information was crucial for the estimations of the vectorial capacity of mosquitoes in any given region of concern, and was heralded as a game-changer for global malaria eradication. Yet the degree of manual dexterity implied by the technique limited its diffusion and led eventually to its demise. The article explores the dynamic tension between technical precision and pragmatic doability, and the delicate fate of interventions that rest on forms of highly skilled practice. The history of the Detinova Technique also allows us to trace connections between Soviet researchers and malaria control in sub-Saharan Africa, and thus expands the geographical and political horizons of global health beyond the traditional focus on Western science.

Fedotova, Anastasia (Russian Academy of Sciences, St Petersburg) and Kouprianov, Alexei

Dissolving interdisciplinary and interspecific borders: Boris Uvarov and the hybrid origins of locust phase theory (1911–1921)

Despite their proverbial pest status, locusts were rather poorly studied until the 20th century. An important breakthrough in locust control became possible due to Boris Uvarov's (1886–1970) phase theory (1921). His study of migratory locust, in which Uvarov transgressed the pure / applied entomology divide characteristic of his elder colleagues, was a paradigmatic example of a fruitful hybridisation of taxonomy, biogeography, and locust control practice. Nicolai Adelung (1857–1917), a curator at Zoological Museum in St. Petersburg, worked on the problem of migratory locust species identification using genitalia structure but retreated facing the lack of comparative material. Fyodor Lebedev (1858–1927), an officer at the Department of Agriculture, was a keen observer and practical expert but lacked interest in taxonomic subtleties. During his first anti-locust campaign (Stavropol, 1911–1913), Uvarov, trained as a taxonomist and biogeographer, tried to solve the problem of identification of two migratory locust species (*Pachytylus migratorius* and *P. danicus*). A combination of museum zoology

SUNDAY 16 SEPTEMBER, 09.00-10.30

practices, routine exposure to thousands of specimens in the field, observation and mapping of locust swarms led Uvarov to the rejection of his original ideas and acceptance of conspecific nature of the two forms. The 1913–1915 experiments by Uvarov's correspondent Vasilii Plotnikov (1877–1954) confirmed the possibility to breed *P.danica* from *P.migratoria*. WWI and Revolution distracted Uvarov from his work but right after settling in London (1920) he embarked on the taxonomic revision of migratory locust. Further analysis allowed Uvarov to reduce all forms of migratory locust to the single species *Locusta migratoria* (with gregarious and solitary “phases”) and extend his phase theory to other locust species.

Martinez, Alejandro (Universidad Nacional de La Plata)

Unity and disunity in pest control research during the 1910s

It is well known and demonstrated that locust outbreaks have no respect for political boundaries and have affected crops in almost all continents. Although not equally harmful in all regions, nations and colonial territories, they represent a global economical and environmental risk. At the turn of nineteenth and twentieth century the concern for its control was beginning to scalate from the local level to a certain international cooperation. In this scenario the circulation at a world scale of information, knowledge, people, technologies, and instruments related to locust control was a key. Here I will focus on the work of French-Canadian bacteriologist Felix D'Herelle in the “fight against locusts” in Mexico, Argentina and Tunisia during the second decade of the twentieth century. My aim is to underline and analyze the character of research on an economically and ecologically significant insect pest spread among different political and cultural contexts. D'Herelle's story is an interesting case in the history of pests' biological control and would contribute to highlight what unites and separates fundamental from applied research, theory from practice, labwork from fieldwork, different local research experiences with locust outbreaks and also what makes scientific and political interests either to converge or diverge.

S58 UNITY AND DISUNITY IN MATHEMATICAL MAGIC SQUARES ACROSS CULTURES AND LANGUAGES

Location: IoE – Room 731

Chair: Burnett, Charles

Organiser(s): Comes, Rosa

Commentator: Calvo, Emilia (University of Barcelona)

Magic squares are potent symbols of unity. Composed of cells in an equal number of rows and columns containing a string of consecutive natural numbers arranged such that the sum of each row, column and main diagonals is the same, the numerical relationships within a magic square remain the same however it is rotated or presented as a mirror image. Magic squares also symbolise disunity, since as the number of cells in a square is increased there is a corresponding, almost exponential, increase in the number of its possible magical arrangements. Historical and modern discourse on magic squares also reveals elements of unity and disunity as magic squares appear in a variety of literary and artistic settings across a huge chronological and geographic range. In Islamic literature, magic squares first appear in 9th- and 10th-century medical contexts, where their healing power was imagined to have a natural cause. The earliest Arabic treatises devoted to magic squares, however, were written by well-known mathematicians such as al-Būzjānī (10th c.) and Ibn al-Haytham (10th-11th c.) and were purely mathematical in scope. The Islamicate tradition of mathematical interest in magic squares inspired the Byzantine grammarian Moschopoulos to write the first European mathematical treatise on magic squares in the 14th century. In the 10th-century *Epistles of the Brethren of Purity*, we find the first discussion of the magic squares in an environment that is both mathematical and arguably magical. The Andalusian astronomer al-Zarqālī (11th c.) was perhaps the first to propose the astrological-talismanic use of the first 7 magic squares associated with the 7 planets. The first dateable reference to a magic square in Latin Europe derives directly from the work of al-Zarqālī and is found in the *Alfonsine Astromagia* (13th c.). In fact, the standard European term “magic square” arose because only Arabic magical and not mathematical treatments of the squares were known. Later Islamicate treatises, such as those attributed to al-Būnī (12th -13th c.), combine discussions of the magical uses of the squares with mathematical descriptions of their construction, and the earlier astrological and natural philosophical explanations of their talismanic powers give way to explanations rooted in letterist and Sufi traditions. In Europe, Athanasius Kircher (17th c.) wrote the first known European mathematical description of magic squares since Moschopoulos, and employed his insights in this area to his attempts to decipher the hieroglyphs of the ancient Egyptians. Many Arabic and Persian treatises dealing with purely mathematical squares have been surveyed in recent decades, but most of the Arabic and Latin works dealing with their magical and astrological aspects are neglected. More generally, modern scholarly research into the history of magic squares has been hindered by a tendency to impose artificial unity on the historical source material while assuming disunity between, for example, authors dealing with mathematical aspects of the squares and their magical applications. This symposium seeks to reassess the history of magic squares, focussing on instances of unity and disunity, while accepting both their mathematical and their magical and astrological aspects.

Comes, Rosa (University of Barcelona)

Some Remarks on Unity and Disunity Regarding Magical Square Construction Systems as

SUNDAY 16 SEPTEMBER, 09.00-10.30

Shown in Latin Manuscripts

The earliest Arabic treatises on mathematical squares, as indicates the title Harmonic Disposition of the Numbers, deal with their construction system. In some Arabic treatises written in al-Andalus, as Azarquiel's *Kitāb tadbīrāt al-kawākib* (11th c.) we find, for the first time, the first seven squares related to the virtues of the seven planets, as used in talismans. This tradition has its roots in the *Rasā'il* of the Ikhwān al-Ṣafā' (10th c.), heirs of the Hermeticism and the so called "Neo-Pythagoreanism", received through the Sabians, where we find the first seven squares in a magical environment, although not related to the planets. Regarding Latin texts on magic squares, we observe that the squares shown in them are constructed following different construction systems. The paper intends to establish the links among the surviving traditions by comparing the methods of construction of the squares and the texts; rituals; elements of the animal, vegetable and mineral world and planetary data, among them and with the Picatrix III, *De attractione virtutis planetarum ... per planetas, figuras ...*, *sufumigaciones, ... et status celi necessarii cuilibet planetarum*, while in IV, magical squares are related to the planets, although without the *figurae*. Also, the paper will focus on the traces of a possible Arabic original, like the expression "scias quod", the Arabic *أنه اعلم*, or the frequent misunderstanding of numbers 3 and 8 that betray an Arabic original in abjad alphanumerical notation.

Hallum, Bink (British Library)

Unity and Disunity in the Tradition of the Seven Planetary Magic Squares

Modern students of the history of magic squares have imposed unity and continuity across huge chronological, geographical and ethnolinguistic expanses. Scholars have focused on questions of historical precedent for the methods of construction for squares of various orders, and adequate importance has rarely been attached to the wider cultural significance of the squares. The magical and talismanic use of the squares is a case in point. The story of the magic-square talismans has not been taken seriously in relation to the history of the sciences. This paper takes a nuanced look at the tradition of the planetary magic squares while problematising this tradition, highlighting its many points of unity and disunity. Following the discussion of the planetary squares in Agrippa's *De occulta philosophia* (1533), their popularity boomed across Europe. Agrippa presented the planetary squares in the context of Neoplatonic philosophy and Jewish cabala. In the Islamic world their talismanic use can be traced back to al-Zarqālī's (d. 1100) *Treatise on the Movements of the Planets*. Agrippa's immediate source was a Latin translation of extracts from al-Zarqālī's treatise. Cardano reversed the system of correspondences between the squares and the planets used by Agrippa. Some modern scholars have claimed that Cardano's system of correspondences is derived from an old Ḥarrānian astrolatric tradition passed down via Thābit b. Qurra, but this is baseless speculation. A further point of disunity between the European and Islamic traditions of the planetary squares is in their theoretical underpinnings.

Chahanovich, W. Sasson (Harvard University)

Magic Squares in Pseudo-Ibn al-'Arabī's The Tree of Nu'mān: A Case Study in Ottoman Apocalypticism and Occult Prophecy

The Ottoman period constitutes a renaissance in the history of magic squares. Subsequent to the conquest of Constantinople, the Sultan-Caliph cultivated an imperial ideology of eschatological apocalypticism. They imbued their authority through an alchemical amalgam of astronomy, lettrist prophecy, and the occult authority of magic squares. One of the most important, yet unstudied, texts that demonstrates this fact is *The Tree of Nu'mān*. Herein one encounters the language, style, and method of Ottoman apocalyptic ideology, and its unique reliance on magic squares, diagrams, and astrological charts. This text is apocryphally attributed to Ibn al-'Arabī (d. 638 AH/1240 CE). In my paper, I propose a case study of *The Tree of Nu'mān* and interwoven importance of magic squares, astronomical charts, and lettrism. I tentatively argue that this tricephalic methodology was employed primarily to imbue the

SUNDAY 16 SEPTEMBER, 09.00-10.30

nascent Ottoman Sultans' apocalyptic-imperial ideology with legitimacy. Magic squares, astrology, and gematria possessed a matrix of 'street cred' among the educated elite. I prove this by tracing the history of this practice to their Timurid predecessors who pioneered the genre. I present the issue of apocryphal attribution to Ibn al-'Arabī as a crucial piece of evidence that points to a 'darker' side of mystical musings. The author(s) were well-acquainted with the works of Ibn al-'Arabī. Magic squares there afford us a new lens through which to understand the post-classical development of Islamic apocalypticism and mystical thought in the Ottoman period.

Tolsa, Cristian (Independent Scholar)

Multiple-association systems in the medieval magic squares and the Hellenistic astrological tradition

Maybe the most basic feature of medieval treatises on magic squares derived from the Arabic tradition (including Old Castilian, Latin and Greek Byzantine texts) is that such squares are associated in the texts through one-to-one correspondences with metals, plants, stones, and most importantly with planets. In this paper I will trace back this kind of grid-like structure to specific Hellenistic and ancient Greek cultural practices, especially within the Hellenistic astrological and Pythagorean traditions. It is thus no surprise that the earliest Arabic texts propounding a correspondence between magic squares and the planets bear a close relation with this kind of Greek sources (Brethren of Purity) or are deeply familiar with astrology (Al-Zarqali). What is more, the magic square texts normally include astrological lore such as the effects of the planets, the phases of the moon, retrogradations, and exaltations. In this respect, it will be illustrative to compare the medieval magic square treatises with Greek astrological and Pythagorean texts, and with magical texts of the Greek tradition, such as the Hermetic treatise on the decans, featuring a similar series of instructions for the construction and use of engraved talismans associated with astrological entities.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S34/2 HISTORY BEHIND STATISTICS: UNITY AND DISUNITY BETWEEN SCIENTIFIC COMMUNITIES AND BUREAUCRACY

Location: IoE – Room 736

Chair: Daniel, Claudia

Organiser(s): Lanata Briones, Cecilia T., and Daniel, Claudia

Statistics can be perceived as facts detached from producers and users that are unproblematic and certain, as ready-made science (Latour 1987). Since the nineteenth century, nation-states have produced and relied heavily on statistics, to the extent that governments' performance began to be evaluated by what numbers (do not) show. Economic and social statistics became the foundational backbone of modern government. The incorporation of numbers into public life aimed to depoliticise functions of public and private administration through rationalisation (Stapleford 2009). How were quantification tools constructed? Who developed them? How were public statistics and measurement tools used in different fields (science, politics, firms, etc.)? How have these instruments changed through time? This symposium examines the ways to produce statistical knowledge and the role played by statistical quantification tools throughout history. The panels bring together socio-historical approaches that enhance the social and political foundations that explain the transformations of quantification techniques, practices and languages. The unfolding of the history of statistics merged research categories that were born separately: one referring to the history of institutions and statistical systems and the other to mathematical statistics and probabilities. This convergence added complexity to the way we understand what statistics do and what we do with them. The encounter is linked to the fact that probabilities and macro-social descriptions of public statistics have been continuously intertwined, meeting and separating (Desrosières 2004). Therefore, the studies of its historical evolution should address both the academic and administrative dimensions of statistics, as they reciprocally shape each other (Porter 2000). Statistics is simultaneously a tool of constructing and proving scientific facts and a technical language used in the social debate with great capacity for persuasion (Desrosières 2008). This power lies on its double source of authority, of science and the state. The study of statistics has developed across a variety of fields, settings and actors, joining several histories. The history of economic facts and the trajectory of schools of thought were intertwined with the evolution of technical tools and statistical models used by economists. The production of sanitary statistics was connected with the social history of health and disease, the development of the medical profession, the public health movement, and of life insurance. Both the historic population moves and the development of demography were involved with the historical and political nature of censuses and the generation of vital statistics and statistical nomenclatures. Linking elements only distant in appearance, the history of statistics shows that the institutionalisation of concepts, practices and statistical tools does not follow linear trajectories. Quite the contrary, they are basting formulations made in national statistical agencies or academic spheres, discussions in statistical communities, applications in the practical world, and mobilisations of private interests or state support. These entangled histories sometimes portray tensions and controversies within scientific communities or between scientific societies and state bureaucrats. The inclination of statistical language towards universality intersects with specificities marked by national traditions. Lastly, private and public uses of statistical tools could also be seen as factors of union and disunion.

Aragão, Roberto (University of Amsterdam)

Macroeconomic Indicators in Brazil: Lessons from a historical analysis

Macroeconomic indicators are a part of society's decision processes. GDP, inflation and public debt help assessing economy conditions and governmental capacity. Despite of their apparent simplicity and objectivity, synthetizing concepts into a single number is a difficult task, subject to methodological shortcomings and influence from powerful actors. Methodological changes in statistics, determined behind the scenes by statistical experts, are constantly overlooked. This paper contributes towards filling this gap by analyzing the methodological evolution of Brazilian GDP, Inflation, Public Debt, and Public Deficit. Brazil is a middle-income country with a satisfactory level of governance and democracy standards. Brazil is unique because the country has some statistical data provided simultaneously by several different institutions including the National Statistical Office. This situation creates conflicts when the indicators show different tendencies. When these indicators coincide, they serve to validate each other and reinforce the measurement. Using a process tracing approach, I show that Brazilian indicators were not created in a linear way, but instead are products of conflicts between internal actors as well as the influence of international organizations encouraging the adoption of international standards. Moreover, this paper sheds light on the roles of different actors in pushing methodological changes, filling an existing gap of knowledge about the construction of macroeconomic indicators outside the North Atlantic region. I identify which actors were most relevant in the definition of the Brazilian macroeconomic indicators' methodology and to what extent Brazilian macroeconomic indicators comply with international standards.

Touchelay, Béatrice (Université de Lille)

To what extent the French Colonial Statistics is a tool to manage the Empire (19-half 20th C.)?

The aim of this communication is double. It consists at first in presenting the making of some demographic and economic colonial statistics in various configurations of French Colonial Empire (Old Colonies of the Antilles, French dependences in Africa and in Indo-Chinese Peninsula) at different periods (the conquest, the end of slavery, the beginning of the 20th Century when the Colonial Empire was forced to acquire the budgetary autonomy and 1930s when the Metropolis realizes the economic importance of its Empire). Secondly, this communication aims to wondering about the purposes of those colonial statistics: to what extent the colonial statistics is considered, in Colonies and in Metropolis, as one efficient management tool of the Empire? Who are his followers, his users and his producers. The hypothesis of departure is the insufficiency of the credit attributed to the French imperial statistics and the weakness of its results. The aim of this communication is to discuss that hypothesis and to find the way to analyze the French colonial statistics independently of the "British model".

Prévost, Jean-Guy (Université du Québec)

Genesis and migration of a concept: quality in statistics (and elsewhere)

"Quality" is the 21st century a motto of official statistics. Its definition varies including relevance, accuracy, timeliness, coherence and comparability, interpretability and accessibility. Entanglement between statistics and quality is older and deeper. This paper traces quality's genesis and migration across several fields, settings and agents since the 1920s. Five stages/settings exist: (1) Industry, where statistical control of quality was first introduced at the Hawthorne General Electric plant and from there transferred to other domains of production; (2) The 1940 United States census, when sampling methods were introduced defining quality as error reduction; (3) The postwar reconstruction of Japanese economy which saw the implementation of the idea that quality control should move from the end product back to all of a firm's operation, integrating suppliers, producers and consumers; (4) The dissemination of these ideas in American and Western management theory throughout the 1980s and 1990s; (5) The adoption of quality, quality frameworks and codes of

SUNDAY 16 SEPTEMBER, 09.00-10.30

practice by all national statistical agencies from the early 1990s on. Ontologically quality posits variation as a dimension of reality. Epistemologically it envisions phenomena through probability. Ethically and normatively its action models predict and control. Quality is a nomadic practical concept rooted in statistics. As it questions the distinction between quality and quantity – quality can be “quantified” as well as the quality of quantities can be estimated –, it offers an example of unity/disunity in science, and of unity/disunity between science and the practical world.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S39/2 CULTURES, STARS AND NUMBERS: INTERCULTURAL EXCHANGES IN EAST ASIAN MATHEMATICS AND ASTRONOMY

Location: IoE – Room 790

Chair: Cullen, Christopher

Organiser(s): Cullen, Christopher

Pre-modern East Asia was the home of distinctive traditions in both mathematics and astronomy. During the first millennium CE these traditions, first developed in China, became common to the whole region, including Korea and Japan. Within the broad theme of the conference, 'Unity and Disunity', the aim of this panel is to encourage discussion of relevant issues in a regional and global historical and cultural context. Despite their common roots, the theory and practice of mathematics and astronomy was by no means uniform across the whole East Asian land-mass. It is thus illuminating to trace the way that elements of these disciplines were appropriated, adapted and developed as they moved across regional and cultural boundaries. Moreover, pre-modern East Asia was highly permeable to the flow of ideas from the rest of the Eurasian continent - first from South Asia in the context of the coming of Buddhism in the first millennium CE, then from the Islamic world from the Yuan dynasty (1271-1368) onwards, and finally from early modern Europe with the arrival of Jesuit Christian missionaries in the later part of the 16th century. The complex interactions that followed from these contacts are revealing not only of the nature of the East Asian traditions in astronomy and mathematics, but also of the traditions that scholars in East Asia encountered afresh.

Qu, Anjing and Yuan, Min (Northwest University, Xian)

How did astronomer survey the distance between Beijing and Samarqand in 1220 AD?

In his Gengwu epoch calendar (1220), Yelv Chucai (1190-1244) invented the *Licha* method which was used to calculate the difference of longitude from Yuan Dadu (Imperial Observatory of Yuan). According to the result and its application of geodesic survey led by Yixing (724AD), we find an interesting link between Yixing's survey and the *Licha* method. From this, we may reason what the picture of the shape of earth in the mind of Yelv Chucai could be.

Sôma, Mitsuru (National Astronomical Observatory of Japan)

Time System in the Heian Period in Japan Inferred from Midô-Kanpaku-Ki

Mido-Kanpaku-Ki is a diary during the years from AD 998 to 1020 written by Fujiwara-no-Michinaga, who was a court noble in the Heian Period in Japan. The diary was written in blank spaces of the calendar called Guchû-reki, and in the Guchû-reki the times of sunrise and sunset were written in the time system used in the calendars at that time. From them we have found that in that time system 1 day consists of 12 double-hours, and each double-hour consists of 4 koku 1 fun, where 1 koku equals 6 fun. From analyses of the times of sunrise and sunset we have also found that the latitude of the observation place of the sunrise and sunset was about 35.5 degrees and the standard deviation of the errors in the times of sunrise and sunset is 2.4 minutes as measured in the current time units. The errors are especially small for the latter half of the year, and the standard deviation becomes 1.4 minutes for this period. Calendars and miscellaneous data at that time were brought to Japan from China but the data for the times of sunrise and sunset shown above cannot be found in China. Therefore it is a mystery how they obtained such precise times of sunrise and sunset at that time in Japan.

Tang, Quan (Xianyang Normal University)

Chinese Solar Theory in the Sui and Tang dynasties: was it influenced by the other civilizations?

SUNDAY 16 SEPTEMBER, 09.00-10.30

Chinese astronomers calculated the position of the sun according to the mean sun before the middle of sixth century. After Zhang Zixin declared his discovery on the non-uniform motion of the sun, his successors began to design the solar equation table to calculate the true motion of the sun. Considering the fact that Indian astronomy knowledge were always introduced into China from the Southern and Northern period to the Tang dynasty, it is still necessary, interesting and challenging to investigate the question that if Chinese solar theory in the Sui and Tang dynasties was influenced by Indian astronomy. In this paper, we compare the solar theory in the Sovereign Pole System, the Great Patrimony System and the Great Expansion System with the solar theory in Indian astronomy work Pañcasiddhāntikā, which was completed in the sixth century. After comparing the similarities and differences between Indian and Chinese solar theory in the Sui and Tang dynasties, we do not rule out the possibility that Zhang Zixin's significant astronomical discoveries and solar theory in the Sui and Tang dynasties were influenced by Indian astronomy. But we want to say the influence of Indian solar theory to Chinese solar theory is very limited because Chinese astronomy tradition is very strong.

Tanikawa, Kiyotaka (National Astronomical Observatory of Japan)

Japanese Astronomy in the seventh and eighth centuries

The initial Astronomy in Japan did not develop monotonically. I will talk about the reason of non-monotonicity together with the contents of the astronomy itself. Japanese observational astronomy started in the seventh century AD. Astronomical records are contained in the first Japanese official history book 'Nihongi' edited in AD 720. The number of records is 31. The number of Emperors is eight, and correspondingly, the number of volumes of the Nihongi in the seventh century is 9. The serial number of the volumes runs from 22 to 30. The astronomical records are dispersed in these volumes. We found that records in volumes 22, 23, 28, and 29 are observed ones. There are only three records in volumes 24, 25, 26, and 27, and these are considered to be not observed. six records of solar eclipses in the volume 30 are predicted. We identified three groups of the volumes of the Nihongi with different characters of astronomical records. The astronomical records of the eighth century AD is contained in the second official history book 'Shoku-Nihongi' meaning the continuation of the Nihongi. In this book, all records of solar eclipses are predicted ones.

SUNDAY 16 SEPTEMBER, 09.00-10.30

SUNDAY 16 SEPTEMBER, 09.00-10.30

S20/1 SCIENCE AND SPIRITUALISM IN THE MODERN AGE

Location: IoE – Room 780

Chair: Rocha, Gustavo Rodrigues

Organiser(s): Sera-Shriar, Efram

Traditionally, scholars and an interested public have attributed the rise and growth of spiritualism over the past two centuries to the so-called nineteenth-century crisis of faith. However, when conflicts did occur within discussions regarding ghosts, spectres or psychical forces, the cruxes of the arguments often revolved around issues of evidence (or lack of it), rather than around beliefs or disbeliefs per se. The central question to emerge was: who had the burden of proof, believers or sceptics? Therefore, this panel will suggest that when studying the phenomena of spectres, spirits and psychical forces the emphasis should not be on their relation to a crisis of faith, but instead to a crisis of evidence. By asking more insistently what the methods and ideas of spirit investigators and psychical researchers were, this panel aims to develop a more rigorous understanding of how our modern conceptions of ghosts, spectres and psychical phenomena have been formed over the past two centuries. Such an approach will help to better contextualise the relationship between spirit studies, psychical research and other sciences, showing how scientific fields such as physics, psychology, anthropology and physiology have influenced spirit studies and psychical research, and how spirit studies and psychical research have influenced them.

McCorristine, Shane (University of Newcastle)

What is the matter with ghosts? Or, why aren't they naked?

"What is the *matter* with ghosts?": this was a key philosophical question for people interested in spiritualism and psychical research in Victorian Britain. Sceptics and ghost-seers alike delighted in thinking about how exactly ghosts or spirits could have form and force in the material world. How did ghosts affect perception, move objects, and touch living bodies? Just what kind of *stuff* were they made of that allowed them to share our plane of existence, in all its mundanity?

These debates - sometimes profoundly metaphysical, sometimes absurd - are worth examining because they were influential in forming popular and scientific opinion on the validity of ghost belief. This paper starts to sketch out the parameters of these debates by focusing on the knotty issue of the clothes of ghosts.

The director of the recent film *A Ghost Story* (2017) described the white sheet that the lead actor wears as "the biggest challenge of the entire movie" because "if the sheet billowed in the wrong way, it ruined the illusion"; "it's an inherently goofy image", he said. This image of the ghost as a figure in a white winding sheet or death shroud has retained its iconic status because it suggests continuity between corpse and spirit. Yet from the early modern period, most reported ghosts appear in everyday and contemporaneous (or near contemporaneous) clothing. This raised two problems that can help elucidate themes in the *Science of Ghosts* project.

Firstly, if the ghost was an objective reality, why should it be wearing clothes? If the tenets of spiritualism were true, should the soul which has returned to visit the earth be formed of light or some other form of ethereal property? How can spirits wear everyday clothes? Were the clothes also spiritual, and if so, did they share in the essence of the spirit or were they the ghosts of clothes in their own right? As F.W.H. Myers pointedly asked, "how has the meta-organism accreted to itself a meta-coat and meta-trousers?" The contention that "ghosts are never without drapery" fed into the position advocated by some psychical researchers that ghosts were the projections of the mind. From such small and knotty minutiae theories were formed and positions staked.

Secondly, apart from a handful of examples, there are very few naked ghosts recorded. Why aren't more spirits naked? Is this because they were *essentially* dressed or because the ghost-

SUNDAY 16 SEPTEMBER, 09.00-10.30

seer mentally dressed them? If they were mentally dressed was this because of morality, fashion, or an instantaneous remembering of how the deceased was last seen? In other words, were ghosts mundane features of Victorian supernatural experience [Latin: *mundanus*: “belonging to the world”] or did they stand out as supra-mundane beings clothed in ideal robes that were disconnected from material reality?

This paper will pose these questions, sketch out some of the contemporary positions, and attempt to catalogue some of the ghostly fashions of the nineteenth century.

Richardson, Elsa (University of Strathclyde)

Ghost Hunting in the Highlands: Ada Goodrich-Freer and Scottish Second Sight

In 1893 the Society for Psychical Research (SPR) launched an Enquiry into Second Sight in the Highlands that saw members of the organisation turn their attention to a form of prophetic vision long associated with Gaelic folklore. Headed by Frederic W.H. Myers and financed by the influential Scottish nationalist Lord Bute, the investigation aimed to delineate the characteristics of the second-sighted vision, establish its incidence, and determine its supernormal qualities. Intended to contribute to the ongoing Census of Hallucinations, the Enquiry started as a schedule of questions dispatched to sympathetic parties in request of information regarding instances of prophetic sight in their local community. When this survey failed to produce any serviceable data, of nearly 2000 questionnaires sent out only sixty-four were returned with useable information, a decision was made to send a researcher north to conduct interviews and collect evidence in the field. The decision to dispatch an emissary to the Highlands was an unusual one for the organisation, but if the structure of the investigation was somewhat anomalous, then the figure chosen to lead it was even more so. Focusing on its chief researcher, Ada Goodrich-Freer, a self-identified clairvoyant, expert in crystal vision and sometimes spiritualist medium, this paper tells the story of this unusual investigation and considers what it might reveal of the complex relations between the folkloric and the psychical in this period.

Lamont, Peter (University of Edinburgh)

The Psychology of Error: A Debunking Strategy of Endless Use

The reported facts of Victorian Spiritualism provoked a ‘crisis of evidence’, because some of the facts were hard to explain. One response to the ‘crisis’ was the emergence of a psychology of error. This was part of a broader psychology of belief that sought to provide natural explanations for ‘supernatural’ phenomena, including references to pathological conditions and the deceptive strategies of conjurors. The psychology of error was more specific: it emphasised the errors and biases to which the normal mind is prone (modes of self-deception), and claimed that they could be avoided by using proper scientific methods. For example, W. B. Carpenter, stressed how ‘prepossessions’ lead us to misinterpret what we see in line with our beliefs and expectations, and that expert knowledge of such fallacies was needed in the investigation of ‘supernatural’ phenomena. The basic argument was hardly new, but it became a popular debunking strategy, and was deployed by many sceptical psychological scientists in Britain, Europe and America. The psychology of error had wider relevance beyond the debunking of psychic phenomena. It reflected two of the most important problems for early scientific psychologists: the claim to objectivity, and the applicability of psychological knowledge to society. When used to debunk psychic phenomena, however, it amounted to little more than a circular argument that certain beliefs were erroneous, and so were the result of error. Despite this, it continued to be used, and continues to be used, in this way.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S50 UNIFYING LIFE FROM THE SCIENTIFIC REVOLUTION

Location: IoE – Committee Room 1

Chair and Commentator: Stein, Claudia
(University of Warwick)

Organiser(s): Dyde, Sean

One assumption is that the Scientific Revolution primarily affected the physical sciences. This panel argues that its most profound effects occurred in the life sciences – not least what it meant to have a ‘life’ to be scientific about. Though competing natural philosophies, through much soul-searching in the aftermath of war and new experimental practices, from the early modern period emerged new ways of ordering the cosmos which privileged some aspects – the living – above others, which have since become an important framework for humanity to understand itself.

Garau, Rodolfo (Ca' Foscari University of Venice)

Naturalizing the Human Body in the Early Modern Period

The theme of life during the once-called “Scientific Revolution” has sometimes been described by scholar as “uncontroversial.” According to this view, early modern inquirers were generally uninterested in defining what makes life phenomena unique, by contrast assimilating them to physical ones. While this view – carrying a general rebuttal of teleology, and in turn of underplaying the idea of organic unity – misrepresented some essential features of biological entities, it also contributed to the rise of modern biology with the “disenchantment” of living matter from the hylomorphic heuristic of scholastic Aristotelianism. When applied to the human body, such a materialistic turn transformed the combined operations of the three Aristotelian souls in a series of mechanical, iatrochemical, or hydraulic ones, often implying a re-discussion of the nature and function of the immortal soul. While the most renowned solution to such problems was represented by Descartes’ substance dualism, the revival of Epicurean philosophy, underpinned by a materialistic understanding of the human soul and of its operations, paved the way to an alternative vision of the human soul, and therefore, of the human body. Focusing on the works of Pierre Gassendi (1592 – 1655), Thomas Hobbes (1588 – 1679), and Thomas Willis (1621 – 1675), in this presentation I show how the revival of the Epicurean idea of “corporeal soul” allowed to emancipate the study of organic functions from immaterial principles, therefore contributing significantly to the “disenchantment” of the realm of life.

Dyde, Sean (University of Leeds)

The Blood of the Lamb

In 1667, one of the first animal-to-human transfusions took place in London. It worked, though precisely what worked and how depended upon who you asked. This talk investigates how various groups and actors responded to such experiments, from the Royal Society physicians who conducted the experiment, to the periodical press who mocked the pretensions of the new ‘men of science,’ as well as the patient himself, whose madness was allegedly eased because of the new blood. More significant, however, were discussions that arose that tried to take account of the disgust which people towards such experiments: not a fully-fledged concept, but a feeling, an ethical charge. What arose, this talk details, became an idea central to how we see ourselves and the world: the sanctity of ‘life.’

Wolfe, Charles (University of Ghent)

From the early modern ontology of Life to Enlightenment proto-biology

Well prior to the invention of the term ‘biology’ in the early 1800s by Lamarck and Treviranus (and lesser-known figures in the immediately prior decades), and also prior to the appearance of terms such as ‘organism’ under the pen of Leibniz in the early 1700s, the question of ‘Life’, i.e., the status of living organisms within the broader physico-mechanical universe, agitated

SUNDAY 16 SEPTEMBER, 09.00-10.30

different corners of the European intellectual scene. From modern Epicureanism to medical Newtonianism, from Stahlian animism to the 'animal economy' idea in vitalist medicine, models of living being were constructed in opposition to 'merely anatomical', structural, mechanical models. It is therefore curious to turn to the classic narratives of the Scientific Revolution and find there a conspicuous absence of worry over what status to grant living beings in a newly physicalized universe. Neither Harvey, nor Boyle, nor Locke (to name some likely candidates, the latter having studied with Willis and collaborated with Sydenham) ever ask what makes organisms unique, or conversely, what does not. Here, I examine how something we might call 'the knowledge of Life' (using an expression of Canguilhem's) emerged in the early modern era without being part of the mainstream history of life science, leading to the question: can one correlate early modern "knowledge of life" with the emergence of a science called 'biology'? How do we account for the increasing fascination with the ontology of Life during the decades prior to the 'naming of biology' (McLaughlin), at the end of the eighteenth century?

SUNDAY 16 SEPTEMBER, 09.00-10.30

S43/3 WHEN SCIENCE DIPLOMACY DIVIDES

Location: IoE – Room 828

Chair: Adamson, Matthew

Organiser(s): Robinson, Sam, and Adamson, Matthew

The concept of science diplomacy has gained traction in recent years, as the foreign offices of various nations have appreciated and begun reassessing the influence and importance of the soft power of science and technology. Scientists themselves are also recognising the diplomatic roles they have played historically and how they have contributed to global relations. This symposium (divided in five sessions), focusing on the history of science diplomacy, draw together a variety of scholars exploring different aspects of science, technology, and diplomacy at the international and transnational levels. Rather than merely echoing and reifying the scientists' own accounts about the benign effects of science diplomacy, they challenge them with provocative case studies and newly proposed interpretative frameworks.

Meredith, Margaret O. (Vrije Universiteit, Amsterdam)

Thomas Jefferson as Philosopher and Statesman: Diplomacy and Science in the Enlightenment

There is a long history in late-modern statecraft of deploying scientists in diplomatic functions at the behest of the state. Their utility in this overtly political function is predicated on their special apolitical status as disinterested, neutral actors. Before the mid-nineteenth century, however, such a clear professional divide between the statesman and the scientist did not yet exist. Instead, most men elected or appointed to political offices, including diplomatic posts, were men of learning. The reason for this is that both were the products of a university education in one of the three professions, medicine, theology, and law. The amalgam of the two within the learned world is highly suggestive because it implies that diplomacy and science were far more intertwined in this period than has been understood. And it raises the question of whether the social attributes associated with learning, such as disinterestedness and judgment, also had value in diplomatic functions. The coupling of learning and diplomacy in the late eighteenth and early nineteenth centuries is nowhere more perfectly embodied than in the American statesman Thomas Jefferson. Although Jefferson's wide-ranging philosophical interests, which spanned the moral and the natural sciences, are well known, historians have never viewed them as being intertwined with his long and impressive political career. In fact, he was one of many men of learning in the eighteenth century for whom diplomacy and other political posts served as a platform for philosophical inquiry. Moreover, he undertook most of his scientific endeavors while in serving one of the many political offices he held, for instance while governor of Virginia (1778-1780), Minister Plenipotentiary to France (1784-1789), and president of the United States (1801-1809). Jefferson's election in 1801 to the prestigious Institut National des Sciences et des Arts beautifully captures both the conventionality of and the high value accorded to the coupling of statecraft and the natural sciences, for he was awarded it on the basis of his distinguished work as both a philosopher and a statesman. This paper draws on several moments in Jefferson's political career to illustrate the entanglements between science and diplomacy during this period. These relationships were not straightforward. Just as with the late-modern period, what was understood to be necessary for philosophical inquiries--disinterestedness--was impossible to maintain in a diplomatic function where one acted in the interest of one's government. Jefferson's engagement in philosophical inquiry and diplomacy played out precisely along this divide, resulting in two distinct modes of coupling the two. I illustrate the first of these through Jefferson's use of his diplomatic post as Minister to France as a platform for furthering his philosophical endeavors. Here his diplomatic function augmented his philosophical achievements by virtue of his location within a large community of well-connected men of learning. The second mode, which I take up in the last half of the paper, plays out in Jefferson's use of philosophers, precisely because of their intellectual

SUNDAY 16 SEPTEMBER, 09.00-10.30

prowess and authority, in negotiations with France over the Louisiana Territory during his first term as president of the United States. Here we see the merging of philosophy and diplomacy for political ends.

Somsen, Geert (University of Maastricht)

The Philosopher and the President: Henry Bergson's International Relations Missions between 1914 and 1925

Henri Bergson, the famous French philosopher of "élan vital", served to represent science as well as the French Republic on several international relations missions between 1914 and 1925. When the First World War broke out, Bergson was the president of the *Académie des Sciences Morales et Politiques*, in which capacity he fiercely defended his country's war cause and developed philosophical justifications for fighting Germany. In the beginning of 1917, he was sent to the United States with the aim of convincing the American government and public to join the war on the French side – successfully, as it turned out. After the war Bergson was chosen to preside over the International Committee on Intellectual Cooperation (ICIC), the League of Nations' own showcase Republic of Letters.

In all of these efforts, Bergson drew on his own philosophical work in order to construe an image of civilization that was at the same time universal, anti-German, and pro-French. In my contribution, I will analyze this paradox and raise the question why it was that scientists and intellectuals like Bergson were to play such major roles in inter-state diplomacy during and after The First World War.

Sinelnikova, Elena (St.Petersburg Branch of Institute for the History of Science and Technology)

Scientific societies as diplomatic instruments for the international policy of Soviet Russia in the 1920s

After the October Revolution most states did not give Soviet Russia diplomatic recognition. The main goal of the new government was to overcome diplomatic isolation, the great importance was given to scientific diplomacy, and scientific societies played not the least role in it. The system of scientific societies in Russian Empire grew at a significant pace, and they had a great influence in the international scientific community and extensive international scientific links. Therefore soviet authorities encouraged restoration and development of broad pre-revolutionary international links of scientific societies, as well as creation new ones. Indeed, sometimes international contacts of scientific societies were built and developed even before the official state contacts. For example, the Russian Entomological Society exchanged books with scientific institutions of Argentina, with which official diplomatic relations were established only in 1946. The international communication developed actively in different forms, especially as a publish exchange. The Russian Mineralogical Society, for example, exchanged with 200 foreign research organizations and higher education institutions in 1923. At the same time the Society of Ancient Literature and Art sent its publications to the New York Public Library and the Institute of Slavic Studies in Paris. The Russian Entomological Society sent its publication to Romania, Bulgaria, Austria, Czechoslovakia, Yugoslavia, Spain, Japan, and others. The Russian Physicochemical Society sent its journal to the UK, France, the USA, and Italy. Scientific societies used a membership of foreign scientists for developing the international scientific relations as well. For example, in the Russian Mineralogical Society there were 124 (44 honorary and 80 active foreign members), and in the Russian Botanical Society 51 (2 honorary and 49 active foreign members). This also contributed to the strengthening of international scientific contacts. Another form of international collaboration was the participation of scientific societies' members in conferences, congresses, and jubilee celebrations abroad, as well as missions to foreign museums, archives and libraries. So, they managed to visit Spain, Egypt, France, Norway, Germany, Poland, Italy, and England. The authorities understood the importance of such trips as elements of diplomatic activity to strengthen the prestige of the new government in the international arena. Scientific societies

SUNDAY 16 SEPTEMBER, 09.00-10.30

also protected national interests at the international level. Thus, in 1922, the Russian Geographical Society (RGO) protested against the proposal of the London Geographical Society to remove the names in Tibet associated with the names of Russian travelers. This protest, supported by the NKVD, was sent to the London and some other foreign geographic societies. In 1923, RGO protested against the Norwegian renaming on Novaya Zemlya. Thus, soviet government in the 1920s, quite successfully used scientific societies and their international contacts as diplomatic instruments for to achieve geopolitical goals.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S42/1 THE GREEN AND DARK SIDE OF ENVIRONMENTAL ISSUES IN CITIES (1850-1950)

Location: IoE – Room 709a

Chair: Hochadel, Oliver

Organiser(s): Gomes, Inês; Miralles Buil, Celia; and Duarte Rodrigues, Ana

In 1984, the expert on French urban history, Bernard Le Petit, stated that “the city is neither a context nor an environment, but the expression of practices and social relations”. This symposium's ambition is to bring back “la part du milieu” (Braudel, 1949; Massard-Guilbault, 2002) into the cities, focusing on the question of hygiene. Hygienic issues in cities have been studied by different scholars, through different lenses. We argue for a change of perspective, connecting urban history of sciences and technology, garden history and urban environmental history. In particular, this symposium focuses on the role played by nature and/or environment (concepts that we want to clarify during discussion) in the healthy/unhealthy city. On the one hand, bringing “nature” (e.g. trees, plants or animals) and its natural elements (e.g. sun or air) into the city was considered a solution to solve some of its hygienic problems. On the other hand, the “nature” in the city was, periodically, considered as a source of danger for dwellers’ health. What kind of “nature” inhabitants, municipal authorities, doctors or other actors which addressed urban problems wanted in the city? Who were, in fact, the leading actors claiming for healthier cities - doctors, gardeners, engineers, or others? Did they agreed or disagreed about the necessity and effectiveness of the proposed measures? What policies were required to transform the city from dark to green? Are there similarities among those policies in different cities dispersed worldwide? How did, different actors, in their discourses and practices, try to unify or des-unify nature and city? These are the main questions addressed in this symposium. The diversity of case studies covered seeks a comparative analysis between cities – with different size, political importance or economic affluence - in Europe, America, Russia or India, highlighting the importance of experts’, ideas and models circulation, at a global scale. Furthermore, it also emphasizes the importance of local exchanges between different social groups in the construction of healthier cities, challenging the traditional center-periphery model. The variety presented in this symposium offers an overview of the significance of environmental urban history to our understanding of the history of science and technology in the city. This symposium is divided into three sessions, focused on animals and pathogenic organisms; cities and infrastructure; and gardens and green grounds arrangements. This symposium is divided into three sessions, focused on animals and pathogenic organisms; cities and infrastructure; and gardens and green grounds arrangements. Focusing on gardens and landscape through the lenses of the urban history of science and technology, the third part of this session shows how different contexts lie behind similar solutions in European cities. The disunity of causes between London and Holland or between Paris and Lisbon are opposite to a certain unity recognized in the renewal of urban green grounds.

Miralles Buil, Celia (Universidade de Lisboa)

Building a green city to fight against tuberculosis? Barcelona 1929-1936

This communication analyses how the fight against tuberculosis in the discourses and practices of the actors which addressed health issues was articulated with the discourses of improvement of the urban environment in the case of the city of Barcelona during the Second Republic (1929-1936, before the Civil war). First, I will address how the regulation of unhealthy environments was put in place and how it was articulated with the bacteriological theory. I argue that after

SUNDAY 16 SEPTEMBER, 09.00-10.30

Koch's discovery, in 1882, the fight against tuberculosis in Europe focused on killing the germ.; in that perspective, the city was the main receptacle for the germ. To eradicate the disease, it was mandatory to control the urban environment in which it was located. Secondly, the communication focuses on the establishment of specific infrastructures to improve health in Barcelona during the Second Republic. By remarking how doctors and architects came together to improve health and the urban environment, I argue that their main issue was to bring the sun and the greenery into the city. Finally, I will discuss the utopian vision of the healthy city. Using the physicians' discourse, I will illustrate how their visions of a healthy city changed, from the model of the garden city to the acceptance of a new model proposed by modern architecture. The vision of "nature" in the city, and its status as a health guarantor, in this new model were articulated differently.

Robichaud, Andrew (Boston University)

Livestock and Slaughterhouse Regulation in 19th Century Boston

This paper explores livestock regulation in Boston in the nineteenth century. In the wake of the American Civil War, American cities undertook major projects of relocating livestock and slaughterhouses in new ways, leading to the exclusion of livestock from downtown cities and the creation of legally-sanctioned slaughterhouse and nuisance districts on the outskirts of cities. Amid urbanization, Boston's slaughterhouse district in Brighton saw increased environmental and sanitary pressures in the 1860s. A growing public health movement—and new agencies of the state to implement health policy—created a new regulatory capacity to remove animals from American cities, and to establish new physical and legal spaces for slaughtering and processing animals in the 1860s and 1870s. This paper explores this particular urban transformation—happening in many cities in the United States and worldwide—and the social, legal, technological, economic, and scientific developments that enabled and shaped these changes. With an eye toward comparisons to other American cities—along with cities worldwide—this paper considers the story of Boston's slaughterhouse district alongside others. Where do we see overlap and commonality, and where are there distinctions? In particular, how did developments in scientific knowledge and sanitation create a new urgency in regulating animals and slaughterhouses in 1860s Boston?

Gomes, Inês (Universidade de Lisboa)

Allies or enemies? Dogs and the prevention of rabies in the second half of 19th century Lisbon

The study of urban environment is usually pursued in the realm of urban history, history of science and technology and urban hygiene. Urban areas impose themselves on natural areas, being usually seen as antagonists. The second half of the nineteenth century saw, however, a 'reconciliation' of nature and cities, with an increased interest on the creation of public gardens worldwide, as a way to bring the 'countryside' fresh air and healthier conditions to the city space. Notwithstanding, the development of the modern city led to the need of dealing with animals' co-habitation with humans. The 'naturalness' of animals in urban areas faded, leading them to a status of urban pest. This talk seeks to identify and describe the actions of some of the actors which addressed urban problems associated with the interactions between dogs and urban society taking place in the growing city of Lisbon (Portugal) in the second half of the nineteenth century, when the friendly and useful dog became a true enemy for human health. Different visions collided regarding the measures to be taken to control stray dogs which were potentially rabies-prone, and no consensus emerged. Tensions among various agendas helped to outline approaches to public health. How have dogs shaped the city space and the practices of city inhabitants over time in the context of the political efforts taken to control and exclude them? How can urban pests contribute to our understanding of the history of the city? These are some of the questions this talk addresses.

SUNDAY 16 SEPTEMBER, 09.00-10.30

S33/3 STABILITIES AND INNOVATIONS IN THE ASTRAL SCIENCES: PERSPECTIVES FROM CHINESE, SANSKRIT, ARABIC, AND LATIN SOURCES

Location: IoE – Room 777

Chair: Husson, Matthieu

Organiser(s): Husson, Matthieu

Commentator: Kremer, Richard (Dartmouth College)

It is often a tacit belief in the study of history of science that habitual and customary practices are of lesser interest than innovations and novelties. The agency and creativity of historical actors are supposed to chiefly required for innovations, whereas the stability of their practice implied some sort of passivity. This view also usually implies that innovation need to appear against or in spite of conservative forces. In contrast, we want to explore a more dialectic interpretation of stabilities and their relations to innovations, by investigating questions such as: • What are the particular knowledge elements that remained stable in given context of scientific practices? • What kind of active choices and concrete actions endorsed by historical actors allow those knowledge elements to remain stable in a given context of practices? • How do these efforts to maintain stability of specific knowledge elements allow historical actors to investigate reconfigurations of other aspects of their scientific practices? We hope to substantiate the view that there is a plurality in the ways of a scientific practice to select and retain a specific set of knowledge elements as stable within a given context; and to use them to explore other possibilities of reconfigurations and innovations. For instance in Alfonsine astronomy, during the late medieval period in Europe, astronomical parameters remained stable for almost two centuries while the layout and organisation of tables varied a lot. We expect to address these general methodological issues in the history of science from case studies in the development of the astral sciences in Arabic, Sanskrit, Chinese and Latin sources. While astral sciences is not the only field of exploration for these questions, it certainly offer a promising start to this endeavour. For instance Astronomical practices involve a range of knowledge elements from fundamental mathematical ones like numbers or geometrical objects to more global ones like epistemological values expressed, for instance, in cosmological theories, observations, or reasoning practices. The material cultures of astronomical practices are also quite diversified. Multiple different kinds of instruments are known to be used and various different form of texts are available to us, for example: oral texts (prose or verse), numerical tables, technical diagrams, iconography, etc. Moreover, the practices of astral sciences were often socially distributed across various milieus. These ranged from highly specialized individuals working in intellectual, political or religious institutions to more modest practitioners engaged with astronomy in some specific and limited way. In this way, the field of astral sciences offers a choice of relatively well-connected historical contexts necessary to explore these issues, while at the same time, it provides a topical focus to compare various case studies in a meaningful and effective manner.

Minkowsky, Christopher (University of Oxford)

The Philosophy of Foundations and the Exact Sciences in Sanskrit

David Pingree once remarked that the exact sciences in Sanskrit – astronomy, astrology, and mathematics – were advanced by a conspicuously small number of original thinkers, who operated in an intellectual setting that was not tightly connected with other, more prestigious systems of knowledge in Sanskrit. Indeed, while Indian authors in logic and exegetical theory (Nyāya and Mīmāṃsā) the philosophical systems most concerned with what constitutes good

SUNDAY 16 SEPTEMBER, 09.00-10.30

reasons, began their texts with consideration of its foundations and with extended rationales for the practice of their discipline, it appears that the astronomers did not feel it necessary to include a discussion of their science's philosophical basis. The methodological passages of the most intellectual astronomical texts, the *siddhāntas*, may identify the questions to be answered - relative positions, conjunctions, eclipses and so on. They may cover spherics and some principles of the motions of the luminaries in circles and epicycles, but they offer no justification for the science beyond making claims about utility and accuracy. The same situation obtains in the astrological compendia (*saṃhitās*). In the early modern period this changed. Astronomers and astrologers alike began to include just such discussions in their works. In this talk I will consider some passages in *Mīmāṃsā* texts. I will discuss what these passages meant for the intellectual history of the exact sciences, and the reasons for *jyotiṣas'* evident confidence in the legitimacy of their discipline.

Feke, Jacqueline (Université de Waterloo)

The Physics of Ptolemy's Astrology

In his astrological text, the *Tetrabiblos*, Ptolemy describes celestial bodies as transmitting their powers through the heavens and into the sublunary realm. The way they do this is by means of rays. Ptolemy nowhere states what these rays consist of, if anything, or how the stars transmit them, and yet they bring the powers of the stars into contact with one another as well as with sublunary bodies and souls. It is because the stars' rays come into contact with the elements comprising the sublunary region that the stars and their movements effect changes there, including meteorological phenomena and even the characteristics of human souls. In this paper, I will explore the nature and movements of these celestial rays by drawing on Ptolemy's physical theory as portrayed in the *Tetrabiblos* as well as his *On the Kritêrion and Hêgemonikon*, *Planetary Hypotheses*, *Optics*, and fragments from his lost *On the Elements*. I will argue that Ptolemy may have adjusted his element theory in order to maintain the consistency of the astrological theory of rays with his physics.

Husson, Matthieu (Paris Observatory)

On John of Saxony comments's to John of Lignères *Cujuslibet arcus...: Stabilities and innovations in a (pedagogical) commentary practice*

John of Lignières and John of Saxony were two important Parisian astronomers in the first half of the 14th c. The first wrote an encyclopaedic set of Canons and tables in the early 1320 (canons dated 1322, epoch dates of tables 1321) inspired from Albattani but also introducing then relatively new Alfonsine ideas in Latin. These alfonsine ideas had then a great success and progressively became dominant in Europe up until the 16th c. This success is attested also by the numerous manuscripts copies of another set of Canons to the Alfonsine tables wrote in 1327 by John of Saxony who was trained to mathematical astronomy by John of Lignères. Several manuscripts sources provide evidence of this pedagogical relationship between the two astronomers. More precisely we are going to look at the chapter on shadows of the canons of John of Lignières and at two types of comments, essentially mathematical, produced by John of Saxony on them. The first are very close to the redaction of the treatise and the second, more systematic were produced more than 10 years later. The differences in the material presentation of the comments, the content they point to in the commented text, the way they extend, precise or interrogate it, will be clues to explore how stabilities and innovations are related at a micro-level in this particular situation.

Hirose, Sho (ETH Zürich)

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SUNDAY 16 SEPTEMBER, 09.00-10.30

S03 BETWEEN UNITIES AND DISUNITIES, CIRCULATIONS AND DISRUPTIONS: THE MOVEMENT OF MEDICAL KNOWLEDGE ACROSS TRADITIONS AND CONTEXTS IN THE EARLY MODERN WORLD

Location: IoE – Room 826

Chair: Brixius, Dorit

Organiser(s): Brixius, Dorit, and Kroupa, Sebastian

This session seeks to explore the movement – and the lack of it – of medical knowledge across vastly different geopolitical spaces and cultural traditions over the course of the seventeenth century. Drawing on the writings of European medical professionals stationed in Southeast Asia and on medical recipes of royal physicians in Europe, the papers in this session seek to bring together material, social, local, and global approaches to the history of medical knowledge, as well as point to the overlaps between medicine, power and politics. Encompassing the epistemic, cultural, political and economic relevance of healing and remedies, each paper explores the unities and disunities underlying the mobility of early modern medical knowledge. Rather than reiterating practices involved in its circulation and running the risk of privileging knowledge which travels over its other forms, the aim is to point to the processes which led to incompatibilities in knowledge traditions and disruptions in knowledge flows. The first two papers explore the world of island Southeast Asia. Looking at the works of the VOC agent and naturalist Georg Everhard Rumphius (1627–1702), Genie Yoo examines his understanding of ‘magic’ and ‘superstition’ in the context of Malay cosmologies of healing and supernatural power. Through a comparison of the information found in Rumphius’ *Kruydboek* and the Malay *Kitab Tibb/Kitab Obat-Obatan* (Book of Medicine), she explores the scales of difference and similitude in the Dutch and Malay writings about magic and medicine. Secondly, Sebastian Kroupa focuses on the Jesuit pharmacist and missionary Georg Joseph Kamel (1661–1706) stationed in Manila, and his strategies to mobilise Philippine materia medica from the local to a European context. Drawing on Kamel’s treatise of the St Ignatius bean, Kroupa will discuss how and why certain instances of the hybrid knowledge in question successfully made the move between the Philippines and Europe, while others proved inherently incongruous and were lost in translation. Looking at the role of (non-) European remedies in England and France, papers three and four present case studies revolving around the practices of court physicians, highlighting the political implications of their endeavours. Examining the work of three royal physicians, Tom Tölle investigates royalty and imperial knowledge as a source of political conflict. In so doing, he brings together imperial medical knowledge and the politicisation of healing practices at the court, which have been traditionally treated largely in isolation from one another. Lastly, Dorit Brixius explores the practices of Noël Vallant (1632–1685), who worked as a physician and secretary to prominent courtly figures in Paris and whose medical correspondence network involved the exchange of treatments, recipes, and remedies at a pan-European level. Here, Brixius discusses to what extent the needs of Vallant’s patients – females in particular – shaped his medical practice and incited his search for novel knowledge and therapies, the purpose of which was not necessarily to cure but to maintain the body’s vitality. In sum, this panel provides insights into factors which governed whether early modern medical knowledge travelled – or not – across different contexts and traditions.

Yoo, Genie (Princeton University)

Between Tongues: Magic and Medicine in G.E. Rumphius’ *Het Amboinsch Kruydboek* and

SUNDAY 16 SEPTEMBER, 09.00-10.30

Malay Kitab Tibb/Kitab Obat-Obatan

Among descriptions of stems and petals, leaflets and pods, one will also find, in Rumphius' *Het Amboinsch Kruidboek* (*The Amboinese Herbal*), a strange account of a plant that gave the young a more 'subtle tongue'. Schoolmasters recommended it and students eagerly took it. Whether medically or magically induced, the dexterity of the tongue was believed to be a gift—in this case, a holy gift that helped Malay-speaking children pronounce Arabic correctly. Rumphius named the plant *ABC daria* and mentioned that plants like it were called *oebat moerit*, the 'scholar's drug' in Malay, by 'Moorish Papists' that populated the archipelago. The difficult link between magic, religion, and medicine in Rumphius' *Kruidboek* has yet to invite an analysis of how this European naturalist tried to negotiate cosmologies of knowledge in the East Indies with a writer's expectations of a European readership for his texts. Living on the island of Ambon from the age of 25 until his death, Georg Everhard Rumphius (1627-1702) explored, experimented, and wrote about the natural world of the Indies while working as an administrator for the United Dutch East Indies Company (VOC). Through his engagement with local Muslim practitioners of medicine, not only was he able to procure recipes of healing and perform local experiments that tested the efficacy of natural material, but he was also able to document practices he described as magical and superstitious. While this invites easy critique, I suggest that by reading Malay textual sources, variously titled *Kitab Tibb/Kitab Obat-Obatan* (Books of Medicine), alongside Rumphius' *Kruidboek*, one might get a better sense of how scales of difference and similitude—for example, between magic and medicine, the superstitious and the supernatural—came to be manifested through the process of documentation.

Kroupa, Sebastian (University of Cambridge)

Jesuit beans and vomitory nuts: Philippine materia medica on the move

When stationed in Manila at the turn of the eighteenth century, the Jesuit pharmacist and missionary Georg Joseph Kamel (1661–1706) produced extensive accounts about the Philippine flora, which were later printed in Europe. Drawing on the example of the St Ignatius bean, a medicinal plant native to the Philippines monopolised by the Jesuit order, I will explore Kamel's strategies in mobilising Philippine *materia medica* from the local to a European context. I will argue that in introducing this unfamiliar plant to his European readers and in convincing them of the credibility of his accounts, Kamel downplayed the novelty of the 'Jesuit bean'. Instead, he identified it with the *nux vomica* of the medieval Arabian physician Serapion, whose work had been adopted into European traditions of medicine centuries ago. This association endowed the plant with a clear place within European frameworks of knowledge, as well as with specific virtues: *nux vomica* means literally a 'vomitory nut'. To bolster this carefully constructed link, then, Kamel relied on his own medical practice and provided accounts of medical cases which clearly attested to the emetic qualities of the plant, asserted by Kamel. Perfectly blending erudite and empirical evidence in this fashion, he thus managed to smoothly transplant the St Ignatius bean in Europe. I will suggest that this attitude in treating Philippine medicinal plants stemmed directly from his Jesuit education which, on the one hand, was rooted in canonical texts endorsed by the Church, but on the other, fostered active and practical methods in conjunction with high esteem for utility, mundane labour and individual initiative. The latter raises the question of a distinct, Jesuit empirical culture. At the same time, I will discuss the traces of non-European traditions in Kamel's treatises of Philippine *materia medica* and highlight some instances of hybrid knowledge which, conversely, were lost in translation and failed to successfully make the move between the Philippines and Europe.

Tölle, Tom (Princeton University)

The Heir, the Empire, the Jesuit's Bark: Royal Physicians and the Politics of Imperial Knowledge in Augustan England

Early modern subjects used avenues of empire to produce medical knowledge. Healing practices became politicized wherever they concerned 'ruling' families. Historians have

SUNDAY 16 SEPTEMBER, 09.00-10.30

discussed both statements, by and large, in isolation from one another. My paper is concerned with the connection between the two. Around 1700, during a period of intense domestic conflict over imperial politics, I discuss to what extent 'empire' featured in the treatment of British royalty. I argue that the imperial origins of medical knowledge, be they real or imagined, shaped the partisan politics of royal physicians.

Bracketed off into distinct sub-disciplines, Augustan historiography does not treat royal health as a political concern. Only a slowly growing number of historians concern themselves with political implications of medical practice: despite the fact that William and Mary and also Anne and George suffered periods of unstable health, as well as that both royal couples failed to produce a single surviving heir. Historians of (party) politics saw the importance of the 'royal closet' waning. Even seminal works on Anne's household famously conceded that parliament, not the court increasingly mattered after 1688. Anne's body (and the Queen's body more generally) continue to attract scholarly attention, but cultural historians often pay little attention to those seeking to remedy royal frailty. And while works on political economy have recently challenged the centrality of domestic politics and the clear-cut party dualism, most historians have studied royalty disconnected from imperial knowledge.

This paper homes in on three royal physicians, John Radcliffe, John Arbuthnot and David Hamilton. I raise three questions: To what extent did medical knowledge become a source of political conflict in Augustan England? What advantages did the use of imperial knowledge promise royal physicians? Lastly, why should the use of medical knowledge, be it practices, material objects or texts, concern historians of European political history?

Brixius, Dorit (Institut historique allemand Paris)

The medical practices of Noël Vallant (1632–1685): Healing, superstition and the maintenance of the body

The French physician Noël Vallant (1632–1685) worked as both a physician and a secretary to some of the most prominent courtly figures in Paris (the duchess de Sablé, the duchess de Guise), who were closely connected to Jansenism and the Fronde. Looking at the noble household as a site of illness and medical care, I explore Vallant's medical correspondence network, which involved an exchange of treatments, recipes and remedies at a pan-European level (France, Italy, England). I will argue that Vallant relied on his networks for both the acquisition of knowledge and remedies, as well as discuss to what extent the duchess de Sablé and her needs in particular incited Vallant to look into new therapies and fashionable remedies, the purpose of which was not necessarily to cure but to maintain the body's vitality of (aging) women. These therapies were partly of a superstitious nature, employing namely human skull against heavy menstruation and children's blood to prolong life, but also closely connected to religion and God's grace (e.g. the balm called *manus dei*, or God's hand).

SUNDAY 16 SEPTEMBER, 09.00-10.30

SUNDAY 16 SEPTEMBER, 09.00-10.30

R70/1 BSHS OEC PROVOCATION 1: HISTORY OF STEM AND SCHOOLS

Location: SciM – TBC

Chair: Haines, Elizabeth

Organiser(s): BSHS Outreach and Education Committee

Participants: Castells, Marina
Davies, Karen
Massa Estève, Maria-Rossa
Wu, Huiyi

All over the world, science, technology, engineering, and mathematics are prioritised in education as a means to improve standards of living and to increase economic wealth. By offering social and cultural contexts to past scientific and technological discoveries, history of science can add richness to otherwise ‘dry’ curricula and increase students’ capacity to learn STEM. However, historians of science often contest simple stories of progress, and their narratives add complexity to already pressured curricula. How is that managed in different contexts? This session will take advantage of an international meeting to invite experts to discuss how history of science is presented in secondary schools in different national education systems, and through informal settings such as museums.

This ‘provocation’ session complements the official conference programme, and is organised by the British Society for the History of Science Outreach and Education Committee (<http://www.bshs.org.uk/outreach-and-education>).

S56 UNIT AND DISUNITY OF THE MODELS OF LEARNING ENGINEERING: CASE STUDIES FROM FRANCE, PORTUGAL AND SPAIN (1808-1930)

Location: SciM – Dana Study

Chairs: Cardoso de Matos, Ana; Sampaio, Maria de Luz; and Roca-Rosell, Antoni

Organiser(s): Roca-Rosell, Antoni

This symposium dedicated to engineering education aims to present studies of four authors in three different countries: France, Portugal and Spain and to strengthen the units and links between the approaches as well as to disseminate their results. We intend to contribute to deepening the chapters of the history of engineering dedicated to analyzing the circulation of the teaching process and their impact on the production of technical and scientific knowledge. The current research allows to identifying the theoretical - practical models of this teaching engineering and aims to connect them to the needs of industrial and technological development. It should be remembered that the establishment of formal schools to provide this engineering learning is relatively recent and was adopted in late nineteenth century, after many controversies. In this symposium, we would like to gather several case studies to contribute to the debate on unity and disunity of engineering education. The comparative analysis of some cases in Portugal, Spain, and France will present the tendencies and its theoretical framework. We will analyze the international alignment and the unity between different options and models, or its disunity, given by the need of adjustment imposed by the local cultural, political and economic contexts.

Gouzévitch, Irina (Centre Maurice Halbwachs, EHESS (Paris)) and Gouzévitch, Dmitri (CERCEC, Ecole des Hautes Etudes en Sciences Sociales)

The “Model of Ecole polytechnique” and the national systems of technical education in Europe: From general reference to local peculiarities

This paper highlights the misconceptions and abusive interpretations that were developed about the “model of the Ecole Polytechnique” in connection with the rise of several national education systems. Simultaneously we will make a summary review of the international studies devoted to the Ecole Polytechnique that is indisputably associated with the history of the processes of spreading knowledge and its different interpretative and terminological connotations. Conceived on the principle of “circulation of models” it benefits the country that houses it and focuses the analysis on the choice and adaption of teaching models according to local interest. Considered from the point of view of “foreign influences”, it amplifies the role of the donor-country and provides an abundant rhetoric about appropriation and foreign experiences. The use or rejection of certain terminologies varies according to the discourse intended. The comparative studies about the ‘model’ revealed and underlined the influences, and appropriations of the national studies. The problem worsens due to the polysemy of the terms: each researcher contributes with a particular nuance about the meaning of the «model». Some historians of the Ecole polytechnique are conscious of the difficulty of the term, and they conclude that polysemy makes the study almost impossible. This paper is a contribution to enlighten this polysemy, trying to define the semantic field that it covers and establish a hierarchy of points of views for its use.

Bettahar, Yasmina (LHSP-Archives Henri Poincaré, UMR 7117 /CNRS & Maison des Sciences de l’Homme Lorraine)

[Industrial teaching in Algeria during the French colonial period]

In this presentation, I intend to focus my approach on the implementation and the development of industrial teaching in Algeria during the French colonial period (1830-

1962). After a fast introduction of the model of technical education established by the colonial authorities, I'll try to prove (with few examples) that the institutionalization of this technical education was mostly oriented to the European populations and they were very concerned to « Indigenous » populations. This technical education doesn't really contribute to the mobility and to the circulation of the scientific knowledge and its model between the French metropolis and Algeria.

Montava, Maria (Universitat Politècnica de Catalunya)

First steps to establish Mechanical Schools in Spain

In this paper we are going to highlight the design and first's steps in the constitution of the mechanical schools in Barcelona framed in a project that enclosed all the Spanish provinces. We will expose the initiative that was carried out by a doctor from Barcelona; Francesc Santponç (1756-1821). This early project took place in the first years of XIX century with the sponsorship and approval of the Junta de Comerç of Barcelona. The Junta de Comerç was an institution that represented the interests of the commercial and industrial bourgeoisie and promoted the renewal of economic activity in Catalonia. It started up several free schools since 1769. Francesc Santponç was involved in Mechanics and was elected member of the Royal Academy of Sciences and Arts of Barcelona in 1786. By 1804, he acquired a deeper knowledge in Mechanics after designing and constructing a Steam Machine which worked a spinning factory in Barcelona. His mechanical knowledge facilitated the creation in 1808 of the Mechanical School of Barcelona, which attracted many students (artisans, young gentlemen). He drove the project with enthusiasm translating into Spanish two books for teaching mechanics and mathematics that were edited by himself. During the Peninsular War, Santponç proposed the extension of the school of Barcelona to other Spanish cities. The experience of the Barcelona School is considered as the early establishment of mechanical engineering in Spain. The aim of this paper is to go-in-depth in the Barcelona School. This work was developed within the frame of Spanish project HAR2016-75871-R.

Sampaio, Maria da Luz (Universidade Nova de Lisboa)

Engineering schools in Portugal in the first decades of the XX century: The unity and framework of their models

This paper intends to highlight the process of creation of the Faculdade Técnica do Porto, (later on Faculdade de Engenharia da Universidade do Porto) and of the Instituto Superior Técnico in Lisbon, in the period from 1911 to 1926. The study of these two engineering schools in Portugal in the twentieth century, born of the Polytechnic School created in the nineteenth century, allows us to analyse its practical and theoretical framework and find the links to international models and practices. The economic and technological context boosted the reorganization of the existing model of higher education and their traditional courses, but also demands the creation of others like electrical engineering. In the core of the curriculum we found new disciplines like "Electric machines", "Construction machinery" "Reinforced concrete - Bridges". They were implemented in order to train qualified engineers, capable of answering the needs of new projects in public works and the installation of public networks of water, gas and electricity supplies that were taking its first steps in the biggest urban centres in Portugal. This comparative study between the educations provided by the two engineering schools allowed us to ascertain the unity and disunity between the different models and schools.

R62 PAPER INSTRUMENTS AS TOOLS OF UNIFICATION IN EARLY MODERN PRACTICAL MATHEMATICS

Location: SciM - Dana Study

Chair: Kremer, Richard L.

Participants: Axworthy, Angela (Technische Universität Berlin)
Gaida, Margaret (University of Oklahoma)
Jardine, Boris (University of Cambridge)
Tracey, Kevin (Swansea University / Science Museum)

Proof of the interconnectedness of early modern mathematical practice and its consumers, paper instruments belong to a vibrant continuum unifying expert and amateur, producer, user, and product. The design and construction of such instruments were natural facets of many mathematicians' careers, and of many users' introductions to – and appreciations of – the mathematical sciences. Companion artefacts to the externalised practice of 'doing' mathematics, they were found in print and in manuscript, in the leaves and fold-outs of texts and notebooks. These material constructions point to recognizable sites of mathematical practice with shared disciplinary methods and techniques, in which engravers, instrument makers, and printers, as well as cartographers, astronomers, and surveyors, all interacted. Paper instruments were emblematic of early modern mathematics, and studying their production and use is therefore a means to more successfully unite the theory, pedagogy and practice of disciplines such as astronomy, navigation, dialling (or time finding) and cosmography in the period. Despite a pronounced and vibrant interest in the 'visual' culture of early modern science, an appropriate characterization of mathematical instruments – and, in Jim Bennett's term, a suitable awareness of what they were for – remains fertile ground for enquiry. To this can be added a consideration of instruments' accompanying texts as hybrid objects, particularly when in the hands of a user: objects which are not simply textual presentations, but instead material artefacts in which is found evidence of intention, interpretation, and of use. At the same time, the practices of modern collecting institutions have seen instruments and texts on or containing instruments divorced, both intentionally and otherwise. This has in part contributed to difficulties in methodological practice in the history of science, with a number of recent studies calling for unified modes of study that more appropriately reflect how these material objects existed and operated in tandem. By attending specifically to the users of these hybrid artefacts, a truer history of instruments in print and practice - and the interconnectedness of their theorists, practitioners, makers, and amateurs - can come to light. By considering the methodological and disciplinary problems and opportunities presented by the study of paper instruments, this roundtable will move from a consideration of the apparatus (visual, textual, and instrumental) used by mathematical authors to users' experiences of their finished material products. By redirecting the focus from the figure of the 'mathematical practitioner' toward the users of the instruments themselves, it will discuss ways to shed more light on the manipulation of mathematical instruments and texts by such audiences, whether hobbyist, amateur, or professional. We will consider how paper instruments helped to unite the mathematical elements of disciplines including navigation and time-finding in new studies such as cosmography, and will question the role of such instruments in driving the structures of practical and theoretical knowledge. Tracing early modern artefacts to their modern day collections will allow for a discussion on the methodological issues of the definition and historiography of scientific instruments, their use, and their subsequent collection.

I109 MATERIAL CULTURES OF MEDICINE

Location: SciM - Dana Studio

Chair: Werrett, Simon

Avelãs Nunes, José Carlos (CIUHCT - Interuniversity Center for the History of Science and Technology, Faculty of Sciences, University of Lisbon)

An [white] elephant in the room: entanglements between medicine, politics, architecture and expertise in the Great Sanatorium of Lisbon, 1936-1946

At the turn of the 20th century, following new medical developments, tuberculosis could be fought on a global scale, catering renewed attention of experts. By the 1930s, medical and architectural paradigms for tuberculosis shifted, giving way to radically new plans for sanatoria conceived within innovative political agendas. In Portugal, during the 1933-dictatorship, the vision of the minister of Public Works (Duarte Pacheco) and the empowerment of the private National Assistance for Tuberculosis (Lopo de Carvalho) were behind the project by the architect Vasco Regaleira of the construction of the Great Sanatorium (1936-1946) in the Portuguese capital - Lisbon - prone to high rates of tuberculosis. This sanatorium was an imposing building of unprecedented scale and morphology. Its various plans were developed following scientific travels to international reference sanatoria by a special committee composed of physicians, architects and engineers, and directly sponsored by Salazar's government. Various reasons account for dictatorship new commitment in the fight for tuberculosis, not restricting the appropriation by the Portuguese dictatorial regime of the Modern Movement of architecture. A plurality of motives, culminating with the development of proficient chemotherapy at the end of the 1940s, which overcame the confinement imperative and implied a drastic change in the public image of sanatoria, account for the non-materialization of the project. This failure enables one to discuss how the confluence of continuities and discontinuities, uniting or disuniting current options vis-à-vis past medical, political, architectural and urban choices became emblematic of this "elephant in the room" meant to control the white plague.

Nott, John (Maastricht University)

Technology and the teaching hospital: objects, concepts and curricula in Ghanaian medical education, c. 1923-2018

Established in 1996 in order to address the dearth of medical education in Ghana's northern savannah, the University of Development Studies (UDS) hosts an innovative medical school curriculum developed in conjunction with Maastricht University. Such international collaborations must, however, be considered in view of the history of European involvement in African medical education. By offering a broadly defined and ethnographically informed history of teaching technologies at UDS this research will provide insight into the assumptions of universality which underpin an internationalized medical education – itself an under-investigated medical technology – as well as its translation into an African context. Drawing on historical and ethnographic study at UDS, this paper explores how pedagogical technologies – both material and conceptual – have traveled to northern Ghana. Rarely produced with a mind to students in the Global South, material technologies found in African medical schools are imbued with assumptions relating to the presentation of disease, to cultural preconceptions of health, to environment and to infrastructure. However, STS scholars have shown that a technology's inscription does not equate to its use (e.g. Akrich 1992; de Laet & Mol 2000). The process of technological translation is further complicated by abstract technologies of ethnicity and language which collude to skew medical knowledge toward national and international standards. Using concepts borrowed from STS as well as medical anthropology, this paper intends to explore the histories of disunity which are implicit within an ostensibly universalistic but ultimately postcolonial systems of medical education.

Tybjerg, Karin (Medical Museion, University of Copenhagen)

Surgical instruments and scientific instruments

SUNDAY 16 SEPTEMBER, 09.00-10.30

Surgical instruments sit in an uneasy relation to scientific instrument and these tensions – the unities and disunities – make them a tool for casting light on ways of understanding scientific instruments and their relations to technology, collection sciences and historical instruments. Surgical instruments are like standard tools – scissors, knives – but treated in groups or collections they become scientific instruments for uncovering the body's inner working or specialized technologies for treatment. In groups the instruments are also used to create taxonomic order in surgery and used like natural history collections or ethnographic collections to exhibit resemblances and developments. Considering surgical collections reveals connections between experimental and collection sciences and the importance of viewing instrumentation in groups as well as in single entities. The paper draws on a history of the surgical collections at the Surgical Academy in Copenhagen (founded 1787) and the Medical Historical Museum (founded 1907). One collection was used to teach surgery and display surgical knowledge. The other was collected for a museum for the cultural history of medicine. The two collections evolved independently, but merged at the middle of 20th century. Following the parallel history of the two collections shows how historical instruments were employed in both teaching and public displays. Surgical instruments, which have often been excluded from accounts of scientific instruments (van Helden and Hankins, Bud and Warner), highlight how instruments often work in groups, how instruments may be used taxonomically and how historical instruments play important roles in teaching.

Guarrasi, Ivana (University of California, San Diego)

Hybrid Instruments and Non-medical Excess in Patient Simulations

This paper examines contemporary standardized patient simulations as hybrid instruments of medical training. Medical educators use “standardized patients” to train patient interaction in simulation laboratories. The term standardized patient refers to a live performer in a clinical simulation who portrays a patient with a disease for training purposes of medical students. Using feminist epistemology in science and technology studies and medical humanities, the analysis engages with the qualities of human patient models that are perceived as necessary to negotiate lifelike medical simulation that is acceptable as a rigorous medical training. I propose that the lifelike qualities of patient simulations generate the sense of human that exceeds the narrowly defined understanding of the patient body as an object of biomedical gaze. In doing so, I analyze a comparative case of using Florentine wax models in the eighteenth-century medical training in Vienna. I consider both types of patient models as hybrid instruments of medical training. Building on these presumed - or collapsed - boundaries between subjects and objects in patient simulation, I draw attention to the function of corporeal non-medical excess. I call non-medical excess the proliferation of cultural meanings in patient simulation that extends beyond its intended instructional function. This historical case suggests that patient simulation as a tool of medical training puts the authority and credibility of the physician's profession at stake. This paper considers the ways in which cultural configurations become meaningful for the acceptance of patient simulation as a legitimate instrument of medical training.

SUNDAY 16 SEPTEMBER, 11.00-13.00

R17 POPULAR SCIENCE IN FRANCO'S SPAIN

Location: IoE – Room 802

Chair and Commentator: Nieto-Galan, Agustí
(Universitat Autònoma de Barcelona)

Participants: Florensa, Clara (Universitat Autònoma de Barcelona)
Gorostiza, Santiago (Universitat Autònoma de Barcelona)
Carandell Baruzzi, Miquel (Independent Scholar)
Gil-Farrero, Judit (Universitat Autònoma de Barcelona)
Ferran Boleda, Jordi (Independent Scholar)

Although, in the last decades, the historiography of popular science/science popularization has significantly evolved from the “deficit model” legacy to “knowledge in transit” and the “participatory turn” (Secord 2004, Bucchi, Neresini 2007, Topham 2009, Nieto-Galan 2016), not much is known about the role of popular science in 20th-century Western societies (Bowler 2009, Schirrmacher 2013), and even less about the role of science popularization in dictatorial regimes, in the “age of extremes” – as historian Eric Hobsbawm defined the century-. Since non-democratic, dictatorial regimes have a very weak “public sphere”, often submitted to strict government control and censorship, the audiences’ epistemological role remains highly problematic. To what extent did readers, visitors, patients, users, and consumers, among other audiences, shape science in that kind of top-down, vertical and hierarchical political contexts? Was there “knowledge in transit”, if any, under a strict social control and repression? Was popular science/science popularization a tool for the legitimation of a dictatorship? This round table will try to answer these questions through the analysis of several cases studies in Francoist Spain (1939-1975) (Riquer, 2010). The regime resulted from the fascist victory in the Spanish Civil War (1936-39), and lasted up to the 1970s (Preston 1995), in a country, in which, after years of totalitarian rule – 1940s and 1950s-, the introduction of economic liberalism – from the 1960s onwards- was fully incompatible with political freedom in the public sphere. Papers on environmental controversies (Santiago Gorostiza), national parks (Judit Gil), Darwinism (Clara Florensa), popular astronomy (Pedro Ruiz-Castell), science on the air (Jordi Ferran), the public image of the chemical industry (Agustí Nieto-Galan), among other examples, will contribute to build up a stronger interpretative framework on how and why did popular science circulate in that dictatorial regime.

I135 PHYSICS 2

Location: IoE – Room 804

Chair: Reed, Peter

Mitchell, Daniel Jon (RWTH Aachen)

Concepts of Virtual Entities in the Bohr-Kramers-Slater Interpretation of Quantum Theory

Historians have reached the consensus that the Bohr-Kramers-Slater (“BKS”) interpretation of (the “old”) quantum theory offered a diversion from the main theoretical route to matrix mechanics. On a conceptual level, however, the virtual entities invoked in BKS remain the subject of divergent interpretations, in particular (a) whether virtual oscillators provide the basis for an alternative model to the state-transition picture of the atom, or merely serve an interpretive function dependent upon this picture; and (b) whether virtual radiation is ontologically distinct from classical electromagnetic radiation, and, related to this, whether it transmits energy and momentum. No single work handles both these issues accurately. They are resolved here by adopting a historiography that is consistent with a conception of BKS as a research program based upon a reinterpretation of Bohr’s postulates of quantum theory, and which draws upon recent scholarship on the correspondence principle and dispersion theory. In particular, the development of the concept of the virtual oscillator is given a historical structure consonant with a Kuhnian analysis of scientific discovery. The findings lead to a stress upon continuity over “crisis,” at least insofar as Bohr and Kramers perceived the BKS research program. Finally, suggestions are made for the study of the conceptual origins—and by implication the interpretation—of other virtual entities in physics.

Okuda, Kenzo (Independent Scholar)

UK and US Atomic Energy Strategy towards Japan and British Psychological Warfare in the 1940's-1950's

During World War II, the US and the UK closely cooperated in developing atomic bombs, and after the war, the both countries continued their developments. In 1948, Britain established the Information Research Department (IRD) as a part of its political warfare. Its first objective was “to use international propaganda to fight against the Soviet Union and Communism.” The UK’s policies and actions, however, were limited in the US occupied Japan. In 1953 when the US President Dwight Eisenhower came to power after Japan became independent, British Prime Minister Winston Churchill reviewed the IRD’s political warfare and concluded that the UK needed to cooperate with the US on psychological warfare. Accordingly the UK developed policies that emphasized overt propaganda using BBC service to penetrate the Iron Curtain in cooperation with the US. It expanded this political warfare also to Japan. In May, 1955, Japan invited “the Atomic Energy Peace Mission” from the US. However, after that, it greatly changed its policy of the introduction of atomic energy because the US was behind in substantial nuclear energy development. The UK promoted the introduction of nuclear reactors while being conscious of the US. It allowed a Calder Hall type reactor to be adopted in Japan. This was the first commercial nuclear reactor in the Japan. Britain was able to do this thanks to its mutual understanding with the US regarding nuclear energy that began before the war and continued after the war with psychological warfare.

Panoutsopoulos, Grigoris, and Arabatzis, Theodore (National and Kapodistrian University of Athens)

The (Dis-)unity of CERN

In this paper we will employ Ian Hacking’s insight that “unity” has a double meaning, singleness and harmonious integration, to revisit the recent history of CERN. CERN is an extremely complex institution, where diverse groups (experimentalists, theorists, engineers, and technicians) are called upon to cooperate. This lack of singleness confers upon CERN a diverse dynamics of multiple goals, perspectives and ideas. Nevertheless, if this diversity were not counterbalanced by specific mechanisms of integration (particular hierarchies, shared modes of

SUNDAY 16 SEPTEMBER, 11.00-13.00

communication, cohesive publication policies, uniform research policies, etc.), CERN could not retain its standing as a unified organization and would deteriorate into a formless sum of diverse groups. This case study will reconstruct a major CERN episode that highlights this tension between unity and disunity: the UA1 and UA2 experiments in the early 1980s, which led to the discovery of the W and Z bosons. The UA2 experiment was designed and carried out in order to confirm the validity of the results obtained by UA1. Both experimental teams, working independently and with different mentalities, built separate detectors and refrained from systematically sharing their data. This gave rise to strong antagonisms and diametrically opposed opinions over what conclusions could legitimately be drawn from the resulting data. Our analysis will focus on the mechanisms which compensated for this disunity and eventually led to a unified consensus between UA1 and UA2. We thus aim at understanding how the competition between the two experiments reinforced the credibility and robustness of the experimental process as a whole.

Romano, Luigi (University of Bari, Italy)

Unity and disunity in Foundations of Relativity Theory: Franco Selleri's 'Weak Relativity'

Franco Selleri (1936-2013) played an important role in the modern research of Foundations of Physics. After his research in Particle Physics and Foundations of Quantum Mechanics, Franco Selleri showed an increasing interest in Relativity Theory since 1990. He built an alternative theory to the Special Relativity Theory, the Weak Relativity, based on the so-called Inertial Transformations, a generalization of Lorentz Transformations. He always showed a 360° wide angle sight, combining his meaningful sight to history and philosophy of physics, with his deep theoretical research on physics. He always searched for unity between theory and experiments as, for instance, in his intervention to PIRT VII, September 2000, concerning Relativity-the experimental situation. In his last work, whose title is *The Weak Relativity*, after explaining his whole theoretical work, he introduces several practical applications as, for instance, clocks synchronization, time on rotating platform, Sagnac effect, absolute simultaneity, and so on, that could have in his thought a better explanation with the inertial transformations than with Relativity Theory. In the present work I am going to introduce very briefly Franco Selleri, his contribution to critical studies on Special Relativity Theory and the eight practical applications he made. Eventually I am going to introduce well a peculiar application field of his theoretical results, the explanation of the Sagnac Effect.

Laguens, Florian (Panthéon-Sorbonne University)

Unity and Relativity. Unification and friction about spacetime

Dès la publication de la version finale de la relativité générale, l'espace-temps courbe à quatre dimensions posé par Einstein fit l'objet de vifs débats. S'il a unifié deux concepts jusqu'alors considérés comme indépendants, l'espace et le temps, il a provoqué une série de dissensions parmi les physiciens. On se concentrera – en invoquant notamment des archives inédites – sur les discussions au sein de la communauté britannique, qui ont opposé par exemple A. S. Eddington, J. Jeans, O. Lodge ou encore E. A. Milne. Einstein lui-même a remarqué que l'espace-temps n'allait pas sans susciter un « frisson mystique ». Il est vrai que sa théorie heurte l'intuition et bouleverse un usage hérité de Newton. La fameuse éclipse de 1919 a largement contribué à élever la théorie d'Einstein au rang de nouveau paradigme. Si les rayons lumineux sont déviés en passant près du Soleil, c'est en vertu de la courbure de l'espace-temps. Il faut donc dire que ce dernier est capable d'agir sur la lumière. Est-ce à dire qu'il existe ? Au carrefour de la relativité générale et de l'expérience, le débat autour de l'espace-temps se cristallise donc autour d'une question : s'agit-il d'un simple artifice mathématique permettant de « sauver les phénomènes » ou bien faut-il affirmer que le monde est réellement un espace-temps courbé ? Si Einstein a unifié le réel, il a divisé les physiciens britanniques.

SUNDAY 16 SEPTEMBER, 11.00-13.00

18TH CENTURIES)

Location: IoE – Room 822

Chairs: Massa-Esteve, M. Rosa, and Serfati, Michel

Organiser(s): Massa-Esteve, M. Rosa, and Serfati, Michel

This research on the symbolic language is framed within the context of a more extensive investigation concerning the transformations of mathematics and natural philosophy and their relationship from the sixteenth century to the eighteenth century. The publication in 1591 of *In artem analytice isagoge* by François Viète (1540–1603) constituted an important step forward in the development of algebra. As his work came to prominence and spread at the seventeenth century, other authors also began to consider the utility of symbolic language and algebraic procedures for solving all kinds of problems, and mathematics, to a very considerable degree, became algebraized. After Viète, the two major stages were completed by Descartes (1596-1650) and Leibniz (1646-1716). Indeed, Descartes' *Géométrie* of 1637 marked the breaking point with the writing of mathematics in natural language. It served during the XVIIth century as the model for deciphering new symbolic texts (according to the so-called "principle of the Rosetta Stone"). It is the first historical text directly readable by mathematicians and scientists today. Leibniz then theorized this practice. This process of algebraization allowed and promoted the invention of what is now called analytic geometry (via Descartes) and the development of infinitesimal calculus (via Leibniz). One aspect that we have to consider is the unity and disunity in the establishment of specious logistics as a new language in mathematics that was fundamental to this process. In this perspective, Leibniz has developed a philosophical doctrine of harmony, that is to say, unity in diversity. Therefore, we would like to analyze the significance of the symbolic language in this process of algebraization of Mathematics. Relevant research questions include: Could the manipulation of this new language be considered an art or a procedure? Moreover, was it a useful means of obtaining new results or only a different way to arrive at known results? In some cases, it is possible that symbolic language was only a way of expressing ideas that already existed? Nevertheless some authors thought that this language was useful to clarify the understanding of these ideas. We wish to discuss the evolution of symbolic language considering these aspects. In order to do this, we will show and compare the representation they used for unknowns, the way they operated with numbers that were expressed by letters, the way they solved equations, the organization of the mathematical calculation (and hence of thought) according to a tree structure, and how the different symbolic representations contribute to development of mathematical reasoning and invention. The symbolic notation is not a transcription in signs - nor a form of shorthand - of the natural language. This issue is a key element in the philosophy of language.

Serfati, Michel (Université Paris Diderot)

The constitution of mathematical symbolic language. A philosophical study

Communication between scientists today is undoubtedly made through mathematical symbolism. Symbolic writing is actually a new language, and has become a practice that is both specific and universal, regardless of the part of the world that it concerns (i.e., it is not limited to Europe). In this lecture, I will briefly describe - within the frame of my previous works on the symbolism — what I have called the "symbolic revolution"; that is, the historical passage, from the writing of mathematics in natural language to the new mathematical symbolic language. This was done in the XVIth and XVIIth centuries with Viète, Descartes and Leibniz as its main protagonists. The final organization of symbolic representation involved six patterns, which I

SUNDAY 16 SEPTEMBER, 11.00-13.00

will briefly describe, with an emphasis on what I have called the “dialectic of indeterminacy”, that is the representation of ‘arbitrary but fixed’ numbers (introduced by Viète). If I have time, I will also briefly comment on the (very important) practice of substitution in the symbolic language, which is carried out in a radically different way from its production in the natural language.

Romero Vallhonestà, Fàtima (Universitat Politècnica de Catalunya)

Symbolism and Algebraic Thought in Early Spanish Algebraic Treatises

In 1552, the *Libro Primero de Arithmetica Algebratica* by Marco Aurel was printed in Valencia. This was one of the books that contributed to the introduction of algebraic procedures in the Iberian Peninsula. The work of Aurel is divided into two parts; the first is about arithmetic and the second, about algebra. This form was to be followed by Juan Pérez de Moya in his *Arithmetica Practica y Speculativa* (1562) and by Antic Roca in his *Arithmetica* (1564). Despite their differences, these three works have many aspects in common, not only regarding the structure but also the specific content. All share the idea of algebra and emphasize the relevance of continued proportion in the algebraic procedures. The continued proportion reveals the relationship between the unknowns, which the symbolism used in these works does not express. Symbolism is crucial in the process of algebraization of mathematics, but symbolism and algebraic thought do not necessarily go hand in hand. In this communication, we analyse some passages of these works and of other works of the second half of 16th century written in Spanish. This analysis allows us to discern if symbolism only has the role of shortening some rhetorical expressions, or if they led to the creation of new objects. These new objects will enable new results to be obtained as well as contributing to transform mathematical reasoning.

Mellado, Antonio (University of Murcia)

The Role of Hérigone’s Symbolic Language in the Numerical Resolution of Equations

From the end of the 16th century, the use in mathematical procedures of a new symbolic language was gradually replacing the predominantly rhetorical used until then. Two works historically mark the crucial moments of this process, so-called algebraization of mathematics: “*In artem analyticen isagoge*” (Viète, 1591) and “*La Géométrie*” (Descartes, 1637). Between these two works, Pierre Hérigone (1580-1643) wrote a mathematical course divided into six volumes, the first four of them published in 1634, the fifth one in 1637 and the sixth volume in 1642, entitled “*Cours mathématique, démontré d’une nouvelle, brieve et claire méthode, par notes réelles et universelles, qui peuvent être entendues facilement sans l’usage d’aucune langue*”. One of the goals fixed by Hérigone was the introduction of a method of demonstration by employing a new symbolic language applicable both pure and mixed mathematics. Hérigone spread Viète’s work in his mathematical course with his new symbolic language, which allowed him to express ideas and mathematical procedures with more clarity and brevity, as well as generalize results and get new proofs. The study of Hérigone’s work is relevant in relation to the process of algebraization. We present a general account about the features of Hérigone’s symbolic language and we compare it with the one used by Viète. In this contribution our aim is to analyze Hérigone’s numerical resolution of equations showing its advantages with respect to Viète’s procedure appeared in “*De numerosa potestatum*” (1600).

Massa-Esteve, M. Rosa (Universitat Politècnica de Catalunya)

Symbolic Language in Mengoli’s *Geometriae Speciosae Elementa*

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. Viète used symbols to represent both known and unknown quantities and was thus able to investigate equations in a completely general form. As his work came to prominence at the beginning of the 17th century, other authors, like Pietro Mengoli (1626/7–1686), also began to consider the utility of algebraic procedures for solving all kind of problems. Mengoli followed the algebraic

SUNDAY 16 SEPTEMBER, 11.00-13.00

research of Viète in order to construct geometry of species that allowed him to use algebra in geometry through the study of infinite procedures of computation. In this communication we focus on the specific role of symbolic language in Mengoli's *Geometriae Speciosae Elementa*. Mengoli considered his algebra as a technique in which symbols are used to represent not just numbers but also values of any abstract magnitudes. He dealt with new mathematical objects, new procedures, species, and summations of powers, forms, triangular tables, quasi ratios and logarithmic ratios. However, the most innovative aspect of his work was his use of letters to work directly with the algebraic expression of the geometric figure. This allowed him to study geometric figures via their algebraic expressions and at the same time through triangular tables and interpolated triangular tables to derive known and unknown values for the areas of a large class of geometric figures.

Martinez, Domingo (Universidad de Murcia)

The use of symbolic language in the treatment of infinity in the Algebra by Benito Bails (1731-1797)

In 1779, the Spanish mathematician Benito Bails (1731-1797), born in Sant Adrià de Besós (Barcelona), published the first three volumes of his mathematical course *Elementos de Matemáticas* (Elements of Mathematics). This work was composed of 11 volumes, the first three of which were dedicated to Pure Mathematics. Bails had studied mathematics at the University of Toulouse and later moved to Paris where he collaborated with D'Alembert (1717-1783). This collaboration allowed him to introduce in his course the current contents of the European mathematical thought of the time, becoming a text of reference in the military Academies and civil Institutions. In fact, the text of Bails was reissued in Spain and South America until well into the next century. In the volume dedicated to Algebra, Bails considered this subject as the most portentous discovery of mathematics, and perhaps the most fundamental, although he pointed out, for example, the difficulty of managing, defining and representing the concept of infinity or the concept of non-existent numbers and imaginary. Our aim in this communication is to analyze how Bails, with a clear didactic intention and following, the Englishman Emerson (1701-1782) and the Frenchman D'Alembert, used the symbolic language and the non-symbolic language closely related to a geometric vision. We will show how he tried to define and explain clearly the abstract concept of mathematical infinity, differentiating it from the ambiguous concept of metaphysical infinity of the time.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S04/1 INTERPRETING ANCIENT EGYPT: THE ONE AND THE MANY

Location: IoE – Committee Room 1 **Chair:** Navratilova, Hana

Organiser(s): Navratilova, Hana; Bednarski, Andrew; Dodson, Aidan; and Lewis, Clare

Commentator: Gold, Meira (University of Cambridge)

The study of ancient Egypt embraces a wide range of academic disciplines, from archaeology and historical scholarship, through a multiplicity of ‘scientific’ approaches, from anthropology to zoology, straddling the humanities and sciences divide. As with other humanities and scientific disciplines, modern social and political attitudes and opinions have impacted on Egyptology, affecting how ancient Egypt has been interpreted over time. In recognition of the resulting fluctuations in the theoretical principles underlying the practice of the discipline, there has been a growing trend in international Egyptology to reflect more rigorously on its own history, which has exposed both continuities as well as discontinuities of practice. The historiography of Egyptology is thus a multifaceted endeavour, embracing research paradigms concerned with an ancient civilization, and their subsequent application of knowledge in modern contexts. Egyptology has addressed its own conceptualization and practices since at least the beginning of the twentieth century, including reflection – or the lack thereof – on sociological and political perspectives. Studies have both diversified and intensified over the past two decades, with a more conscious appreciation of Egyptology as fundamentally interdisciplinary endeavour, with established geographical, chronological, and cultural boundaries. The time-boundaries embrace the period from pre-history to the Islamic conquest, the geographical ones the Nile-valley and surrounding areas. Cultural boundaries are set wide, encapsulating all those which have impinged on this chronological-geographical area, but in particular on users of the ancient Egyptian language, both in its hieroglyphic form, and in its final Coptic incarnation. Egyptological historiography benefits from histories of other disciplines; vice versa, it complements other disciplinary historiographies, as well as broader intellectual and cultural history. For example, colonial and postcolonial studies have highlighted aspects of Western (or European) interest in the ancient and modern history of the colonised regions that were a result, as well as a tool, of national competition and control, which extended into the realms of local memory and history. The productive element of thinking along these lines is obvious: a widening of the scope of the history of science induces a research reflexivity that sensitises practitioners of archaeology and Oriental studies to the context of their activities, and the formation of their practices. However, the approach may be also be developed in a reductionist mode, explaining the production of knowledge predominantly in terms of politics, power and control, offering a rather selective intellectual history. In a mostly sensible attempt to de-mythologise the history of Egyptology, complexities, constraints, as well as individual agency of researchers may be lost, and new ‘myths’ created by over-application of theoretical approaches. A diversified methodology might be more productive, including the adoption of a global concept of the history of science that emphasizes a hybrid production of knowledge. The symposium intends to address the position of Egyptology among histories of humanities and sciences, and the diversity of approaches to Egyptological historiography. Fundamentally, the panel seeks to probe the permanence and disruption of interpretive frameworks and their social and political situatedness, to develop and inform a wider understanding of Egyptological historiography.

SUNDAY 16 SEPTEMBER, 11.00-13.00

Gertzen, Thomas (Selma Stern Zentrum, Berlin)

“Germanic” Egyptology? – Scholarship and politics as resources for each other and their alleged binary relationship

The interdependency of scholarship and politics is a striking characteristic of German academia. The humanities as well as science benefited from state funding from the wars of liberation and the reforms of Wilhelm von Humboldt onwards. Research was expected to further national goals, culminating in the “mobilisation” of science during the two world wars.

German humanities in particular upheld the concept of “*Freiheit* [= freedom] *der Wissenschaft*”. The alleged “purity” of research led to positivism and to self-sufficiency, especially of “*Orchideenfächer*” (= exotic disciplines). To justify continuing public support German Egyptologists created the concept of their discipline as a means to achieve “*Weltgeltung*” (= international standing). National rivalries (mostly with France) and reciprocal effects of national decline (after the loss of World War I) were the immediate consequences.

In the 1920s Egyptologists therefore tried to re-model their discipline as “*völkisch*” (= folkish), shifting the focus of their research from (positivist) philology to (racial) anthropology.

Remarkably, this did not lead the National Socialists to view the “Semitic discipline” positively perhaps because some of its foremost representatives were of Jewish descent. Consequently, others underwrote the concept of Egyptology as a “national” discipline as a source of international prestige, which was still effective at least until the earlier phases of East-German Socialism.

This presentation analyses the interdependence of scholarship and politics as complimentary resources (MITCHELL ASH). It will also address the observation of British historians that in the historiography of German Egyptology, research and politics appear as “two stable worlds” or “binary” system.

Omar, Amr, and Haikal, Fayza (both American University in Cairo)

Egyptian Egyptology: The Founding Institutions

The modern history of Egyptian Egyptology has been deeply impacted by two major events in the Twentieth Century: The opening of the Higher School for Egyptian Archaeology in 1923 and the appointment of the first Egyptian Director of the *Antiquities Service* in 1953. The School, which developed in what became later Cairo University, offered perpetual courses in Egyptology for the first time, after all previous efforts to open an Egyptology school in Egypt since 1869 failed. Graduates of this University and its preceding schools taught and trained young Egyptian students with the academic knowledge, professional experience and technical skills necessary to develop a career in the *Antiquities Service* or in academia. Many among them were internationally recognized and respected because of their publications and excavations they conducted in several sites within Egypt and Nubia. They founded new Egyptology and archaeology departments in Egypt and the Arab world, in addition to teaching and conducting research projects in several European Universities as well. This presentation seeks to demonstrate how the vivid spectrum of programs at both the undergraduate and graduate levels, which Cairo University regularly renewed and adapted to new needs for the proper formations of future Egyptologists, has been making Cairo University Egypt's primary research, teaching and learning center in Egyptian Egyptology.

The appointment of Dr. Moustafa Amer, Director-General of the *Antiquities Service* in 1953 marked a major turning point for this institution, and transformed it into one large organization, managing Egyptian archaeological heritage from Prehistory down to the 19th Century, including Islamic & Coptic Archaeology. This presentation will also give a comprehensive survey of the development of the *Antiquities Service* since 1954, and highlight how far this *Egyptianisation* movement gave the Egyptians the long awaited opportunity to actively excavate, preserve and protect the heritage of their own land, with the support and collaboration of their international counterparts.

Loktionov, Alex (University of Cambridge)

SUNDAY 16 SEPTEMBER, 11.00-13.00

A revolution in Egyptology, or an Egyptology of the Revolution? Changing perspectives on Ancient Egypt in Russia, 1880 – present

Profound change in official state ideology often drives developments in academic culture, whether through voluntary evolution or state coercion. The changing theoretical basis of Egyptology in Russia, from the late Empire to the present, provides an interesting insight into how practitioners of this field negotiated the various intellectual demands of their time. Egyptology in Imperial Russia was heavily influenced by Western European scholarship, concentrating on expanding collections and producing new translations. Research was therefore overwhelmingly focused on Egyptian 'elite' culture, which dominates the evidential record. However, Soviet rule saw theories of historical materialism and class exploitation rapidly gain influence. On the one hand, this sparked a novel interest in hitherto under-researched themes, such as 'non-elite' domestic life, mechanisms of administrative and judicial order, and the economic functioning of the Egyptian state. On the other hand, the reality of Soviet rule compelled researchers to interpret evidence in ways amenable to Marxism, often resulting in pre-determined conclusions or suppressed findings.

This paper looks at how Egyptological knowledge has been constructed in Russia in view of these developments, and what this can reveal about both the creative and destructive influence of state ideology. This is achieved through several short case studies of Egyptological projects carried out in Russia before and after the onset of Soviet rule.

Bednarski, Andrew (University of Cambridge) (in absentia)

Building a Disciplinary History: the challenge of Egyptology

The past decade of work on the history of Egyptology has made one thing very clear: writing such a history is no mean feat. This statement is not surprising, given how painful disciplinary self-reflection can be in general, and given the complexities intrinsic in making sense of an international, interdisciplinary area of study in particular. Such an historical investigation is not helped by the lack of consensus amongst professionals on what constitutes Egyptology, how and why one should do it, and how it should be taught. Barring a few exceptions, professionals tend to shy away from even debating such things. Yet despite these factors, Egyptology remains a vibrant, relevant, and productive area of study within the humanities. This paper will explore current and past definitions of Egyptology in an attempt to address challenges now facing the discipline. Such an exploration is central to understanding the motivations that drove, and continue to drive, figures and events that have created, and continue to create, knowledge of mankind's shared, ancient past. In the face of upheavals affecting the study of the humanities in general, such an investigation, highlighting the historic importance of the discipline and the value it continues to offer, is particularly pertinent.

S57 THE FABULOUS 1930s IN THE HISTORY OF SCIENCE AND TECHNOLOGY

Location: IoE – Committee Room 2 **Chair:** Simões, Ana

Organiser(s): Simões, Ana, and Sánchez, Antonio

The role of artisans, of various shared practices and legitimizing discourses, vernacular sources, hegemonic discourses, the historicity of concepts and practices, popular cultures, context and locality, social influences, grand narratives, are all historiographical concepts, to name just a few, which have informed currents such as historicism, social constructivism or cultural studies of science, and have impacted on the history of science and technology, from the 1980s onwards and still do presently. However, they are far from new. During the fabulous 1930s, individually or integrated in groups or schools, several scholars anticipated many of them, albeit with different trappings and with diverse purposes. Such is the case of Robert Merton, Boris Hessen, Michael Polanyi, Edgar Zilsel, Henryk Grossman, Franz Borkenau, Ludwik Fleck, Antonio Gramsci or Lewis Mumford, to name just a few. We propose to revisit this amazingly rich decade from the perspective of the history of science and technology, not just as an act of historical retrospection, but mainly as a methodological exercise which enables us to reflect on the main historiographical trends shaping presently our discipline, at the same time reassessing their theoretical limits. Many problems faced presently by historians of science (and also by philosophers of science) were tackled and discussed by them as is the case of the debates around the old dichotomy unity vs. disunity of science, putting forward impressive insights, both at the empirical and theoretical levels. Engulfed by the ravages sweeping Europe at the time, language and ideological constraints, many simply passed by unnoticed or were progressively forgotten. Presently, a fresh look at their contributions informed by today's concerns and agendas promises to offer rich vistas and a salutary exercise on disciplinary auto-reflexivity.

Sánchez, Antonio (Autonomous University of Madrid)

Rethinking early modern Europe from “the fabulous 1930s”: Leonardo Olschki, Edgar Zilsel and the artisanal knowledge

The 1930s were particularly significant for the development of the history and philosophy of science and technology. This paper is based on the idea that some authors from this period introduced influences on historiographical categories of analysis that hegemonic narratives have deliberately left out of the mainstream for different reasons, whether historical, historiographical or even ideological. This is especially noticeable in the history of early modern science and in debates surrounding the “Scientific Revolution” and the origins of European scientific modernity. These categories, which often occur in the form of dichotomies (vernacular vs. Latin, craft cultures vs academic cultures, amongst other), provide a new look at both geographical spaces and epistemological communities that have traditionally and systematically been neglected. For instance, the relations between science and empire in the Iberian world, the native communities of America, Africa and the East in the constitution of a global science, amongst other, are scarcely considered in history of science studies. In short, the aim of this communication is twofold: to highlight the historiographical virtues that some of the categories of the 1930s have for the historian and the philosopher of science and technology today; and to illustrate this phenomenon through the work of two authors: Olschki and Zilsel.

Raven, Diederick (Utrecht University)

[The Problem with Zilsel's Explanation of the Emergence of Early Modern Science]

In this paper, I will take up the vexed question of the why Zilsel's detailed historiographical

SUNDAY 16 SEPTEMBER, 11.00-13.00

work on the emergence of early modern science stands in such a sharp contrast to the shallow theoretical illumination of the central social argument that drives the hybridisation process of the intellectual and artisanal resources that is central to the Zilsel thesis. I will go into the genesis of the Zilsel thesis in Zilsel's own work, and based on a close reading of his own work spell out how Zilsel argued for the theoretical plausibility of the thesis. Crucial step in my argument will be that although Zilsel is an astute philosopher, he never showed any acumen in the finer details of what a sociological explanation should amount to. To put a less finer point to it at best he was casual and hence unsophisticated in his sociological thinking. The reason is that, to put it in anachronistic terms, he subscribes full heartedly to what is known today as the orthodox consensus. The crucial flaw in the traditional Zilselian argument about the merging of brain and hand as the essential step in the emergence of modern science is that it makes science into theoretical practice. This is the inverse position of the better known but equally incorrect thesis that practice is applied science. Both are untenable positions. A brief look at Diderot's attempt to appropriate the arts in the *Encyclopédie* will be used to illustrate what is the fatal theoretical flaw at work here.

Olesko, Kathryn (Georgetown University)

Ludwik Fleck, Alfred Schütz, and the Social World: What They Mean for Us

The 1930s marked some of the darkest days in Central Europe, home to Alfred Schütz (1899-1959) and Ludwik Fleck (1896-1961). They probably never met or corresponded. Yet both published groundbreaking works in that decade—Schütz's *The Phenomenology of the Social World* (1932) and Fleck's *The Genesis and Development of a Scientific Fact* (1935). Decades later, after the untimely deaths of both authors, these works became powerful foundations for understanding how facts are constructed through human interaction. Although Schütz was concerned with the construction of social facts and Fleck with scientific ones, they shared similar approaches. Both examined how facts relied on the communication of intersubjective meaning; how individuals behaved and changed as they learned; and how historical contingencies impacted fact production, individual development, and group communication. This essay examines how the work of Fleck and Schütz can be used to break new ground in the history of science education. To date Fleck's importance in the history of science education has been overshadowed by Thomas Kuhn's *Structure of Scientific Revolutions* (which was probably inspired by Fleck), while Schütz's work as well as that of his successors in social constructivism (not social constructionism) like Peter Berger and Thomas Luckmann have remained nearly unnoticed. Yet both offered powerful ways of understanding how meaning is constructed through mutual engagement, a process of central importance in both teaching and learning.

Bertoldi, Nicola (University Paris 1)

The Modern Evolutionary Synthesis between positivism and materialism: which lessons from the 1930s for contemporary history and philosophy of biology?

Recent advances in developmental biology, genomics and ecology have challenged the adequacy of the Modern evolutionary synthesis (MES), which has constituted the dominant paradigm of evolutionary biology since the 1930s. A growing number of biologists, philosophers and historians have thus started to call for an "Extended evolutionary synthesis" (Pigliucci & Müller 2010). Such attempts to revise the MES raise some crucial problems: which lessons should we draw from the most recent advances in the life sciences for assessing existing historical accounts of the MES? How to combine such lessons with those that can be drawn from the historiography of science, or even the philosophy of history? This paper will focus on such questions, by assessing the historical account of the MES given by V. Betty Smocovitis (1996). Such an account sets the origins of the MES in the broader context of the "science unification program" launched by the Vienna Circle, in the light of three fundamental concepts: "system", "progress" and "materialism". This paper will evaluate the relevance of such concepts for interpreting the history of evolutionary biology in the 1930s, by drawing both from contemporary scientific criticisms of the MES and from the way in which the question of the

SUNDAY 16 SEPTEMBER, 11.00-13.00

relations between history, materialism and knowledge has been articulated by Antonio Gramsci (1996).

Lopes, Quintino (Nova University of Lisbon)

The contribution of Portugal to the fabulous 1930s: the History and Philosophy of Science in a Europeanised Portugal

In the early 1930s the Portuguese academic community enjoyed a level of official support which enabled it to keep abreast of scientific developments and participate in international science communication networks. Support was mainly provided by the Junta de Educação Nacional (National Education Board, 1929-36). The aims of the board were to Europeanise science and pedagogy of Portugal in the 1930s. In pursuit of these aims, the board granted scholarships both at home and abroad, provided funding for research centres and promoted the dissemination of knowledge produced in Portugal. One researcher funded by the board was Delfim Santos. With a view to setting up a History and Philosophy of Science course at one of the Portuguese universities, which would prevent the type of education that identified science with the results produced, Santos obtained funding to take part in the Vienna Circle seminars. His growing disenchantment with neopositivist ideas led him to follow the teachings of Nicolai Hartmann in Berlin in 1936, where he returned after a visit to Cambridge in 1937. After producing a work entitled *The Evaluative Stance of Positivism* in 1938, he submitted it to the University of Coimbra as his PhD thesis. However, a baseless accusation of lack of originality prevented him from obtaining a doctorate and joining the teaching staff of the University of Coimbra. Despite resistance by Portuguese universities to the innovative dynamism of the National Education Board, it enabled Portuguese researchers to actively participate in "the fabulous 1930s in the History of Science and Technology".

SUNDAY 16 SEPTEMBER, 11.00-13.00

1127 SCIENCE AND RELIGION

Location: IoE – Room 736

Chair: Jenkins, Bill

Bovolo, Carlo (University of Eastern Piedmont)

A Catholic Science: Apologetical Uses and Attitudes on the Italian Catholic periodicals (1848-1914)

My paper deals with the attitudes toward, the uses and the receptions of the science on the Italian Catholic press in the second half the the 19th Century. During the nineteenth century and particularly in the second half of the century, science started having a growing influence on Italy's society and culture, threatening the authority and the influence of the Church and of Catholicism in Italy, which was in turn already under pressure because of the slow but gradual secularization and the national unification process (1861), which led to the end of the pope's temporal power with the conquest of Rome (1870). The centrality of science in the nineteenth century, moreover, put Catholics up against the question on how to react and face modernity, which had its strength in science and in the positive method, thus safeguarding the role of the Church and orthodoxy. Hence the spreading in some sectors of the catholic movement, especially in some clerical periodicals, of the need to build a science in accordance with Revelation, with the idea of developing strategies to embrace scientific matters through a Christian perspective, to respond to the lay and positivist materialistic theories of scientists, to strengthen a Catholic public opinion also in the sciences, and to strive for a scientific dissemination harmonised with faith. The paper analyses how the science was faced and used by the clerical press, focusing in particular on three main topics: the evolution, the technological progress, and the medicine.

Petakos, Dimitris (Independent Scholar)

Re-inventing the boundaries between natural philosophy and natural theology: The correspondence between Samuel Clarke and Joseph Butler

The aim of this paper is to examine the correspondence between Samuel Clarke and Joseph Butler, which took place between 4 November 1713 and 8 April 1714. The correspondence is of high importance, if we want to understand the intellectual processes through which Newtonian natural philosophy was appropriated in the first decades of the eighteenth century. The main question is: What drove the two thinkers to think differently of the Newtonian natural philosophy? This correspondence took place in the multifaceted British sociopolitical context and was related with the wider discussion concerning the relationships between mathematics and natural world, theology and natural philosophy. Was this battle a symptom of the theological pluralism of the first half of the eighteenth century in England? We should examine whether the differences between thinkers mark specific ideological (religious and sociopolitical) contexts. Were Clarke's and Butler's theological commitments imprinted on the concept of absolute space and time? Clarke was deeply persuaded that the Newtonian natural philosophy was more than a proper natural-philosophical language which described the mathematical relations among the natural phenomena. It was the undisputed proof for the existence of a God of "Dominion". On the other side, Butler's theological agenda drove him to appropriate Spinoza's philosophy so as to argue, quite surprisingly, against anti-trinitarianism. Did God and nature remain the same after the mathematical developments of Newtonian natural philosophy? The intellectual boundaries between theology and philosophy began to erode. Philosophers elaborated different theological approaches, reinterpreted older ones and questioned the self-evident theological truths.

Wagner, Michał (Cardinal Stefan Wyszyński University in Warsaw)

Unity of reception of Darwinism in Polish Church - from total denial to total acceptance

The first complete Polish translation of Charles Darwin's "Origin of Species" was published in 1884. It initiated the first confrontation of Polish evolutionists with creationists, who were

SUNDAY 16 SEPTEMBER, 11.00-13.00

mainly represented by the Church. Attacks on Darwinism were so ferocious that the main promoter of evolutionary theory Bronisław Rejchman began to doubt whether this theory would ever be accepted by Poles. These fears were justified, because the Church as an institution connecting Poles when their country was under the partition, had a huge impact on public opinion. However, the Church's position on the theory of evolution changed dramatically in the second half of the twentieth century. Christian intellectuals began to make attempts to reconcile the theory of evolution with Christian dogma (mainly because of the teachings of John Paul II). But these attempts were disrupted when prof. Maciej Giertych began to popularize the views of American creationists in the years 1986-1987. The answer of the Catholic intellectual environment was unequivocal - the condemnation of creationism promoted by Giertych and defense of the theory of evolution. And so, the Polish church environment, which was attacking Darwinism in the first half of the nineteenth century, took over the role of its main advocate. In my speech, I will present how this change in the position of the Polish Church in relation to Darwin's theory took place and what were the main reasons for this evolution of opinion: from condemnation to defense.

Borgato, Maria Teresa (University of Ferrara)

Galileo and the Jesuits: divergences and convergences on free fall

The subject of this communication concerns a case of scientific rivalry between Galileo and the Jesuits which, however, brought about significant contributions to the study of free fall on the part of the Jesuits. Direct verification of Galileo's law of free fall was carried out for the first time by the Jesuit, Giambattista Riccioli, with the help of his brothers, in Bologna between 1645 and 1650. This fact is emblematic of the contradiction the Jesuits themselves were subjected to, caught between free research and fidelity to orthodoxy. The Galilean law presented different points of discussion (independence of speed from weight, difformity of motion, law of odd numbers ...) that came into conflict with the Aristotelian tradition. We will retrace some stages of this problem, which was central to the renewal of natural philosophy, and closely linked to many other physical and cosmological questions.

Rosenblatt, Louis (Independent Scholar)

On the Fleeting Unity of Sacred, Civil, and Natural History

By the early years of the 19th century, the long-standing project of a universal history uniting sacred, civil, and natural history was revitalized by the likes of William Jones, William Mitford, and Georges Cuvier. This was a matter of both bold claims and a common historiography. In the 1820's this project began to be criticized, and soon a new project emerged which also unified sacred, civil, and natural history, but in a wholly new spirit. For example, a biblical chronological framework was abandoned altogether. In this new scholarship, notably Adam Sedgwick's systems geology and the historical writings of Connop Thirlwall, the spiritual aspects were less matters of fact than a quality, a sense that the gods are not indifferent. By the 1860's the spiritual character of this second project faded from view, a matter witnessed for us by William Whewell. What had changed so that the analytical unities no longer carried the unity of scientific and providential history? One factor was, no doubt, Darwin's theory...even the miracle of miracles could be explained without God's intervention. We turn to a letter from Sedgwick to Darwin expressing his sorrow that Darwin had abandoned final causes: it was God's purpose which linked matter and morality. And we close by showing, contrary to common understanding, that Darwin too envisioned a universe that was not indifferent to our plight. Evolution, for Darwin, guaranteed humans are innately good.

I116 EARLY MODERN ASTRONOMY

Location: IoE – Room 790

Chair: Mosley, Adam

Carolino, Luis Miguel (Lisbon University Institute (ISCTE-IUL), CIES-IUL)

The Heritage of Clavius: Unity and Dissent among Jesuit astronomers in the 1610s and 1620s

In the last edition of his famous Commentary of the Sphere (1611), Christoph Clavius alluded in a somewhat enigmatic manner to the consequences of the recent astronomical observations, which seriously undermined the notion of the solidity and immutability of heavens he held for decades. In the face of those observations carried out by Galileo and others, Clavius pleaded "since this is so, astronomers will have to see how the celestial orbs may be arranged so that the phenomena can be saved". After the death of Clavius, in 1612, Jesuit intellectuals provided different and, in some cases, contradictory answers to this plea. If Christoph Scheiner recognized that the astronomical observations urged astronomers to accept the fluidity of heavens, his confrere Christoph Tanner argued that celestial novelties did not contradict the solidity of heavens. Some years later, the Italian Jesuit Cristoforo Borri accepted both the notions of celestial fluidity and imperfection based on the same astronomical observations. This led to different planetary rearrangements. This paper examines the dispute over the astronomical legacy of Clavius, an author usually recognized to have played a crucial role in the Jesuit astronomical conservatism. By analyzing the different astronomical and cosmological theories put forward by Jesuit intellectuals in the 1610s and 1620s, it argues that there was a strong dissent among the Jesuit community which coexisted with vigorous efforts to establish doctrinal uniformity by Jesuit authorities. This led to the elaboration of particular cosmologies such as that of Giovanni Paolo Lembo, which shall be analysed here.

Débarbat, Suzanne (Observatoire de Paris)

Observatoire de Paris-Bureau des Longitudes: Union-Désunion, 1795-1877

A la création de l'Académie Royale des Sciences (première réunion officielle le 22 décembre 1666) et celle de l'Observatoire Royal (achat du terrain le 7 mars 1667), ce dernier se trouve sous la tutelle de cette académie. Le financement de ses astronomes et de leurs voyages dépend alors directement de Louis XIV et de son ministre Colbert. Cette situation va durer jusqu'à la nomination, en 1771, du troisième des Cassini par brevet de directeur général de l'Observatoire. Son fils lui succède en 1784, mais -suite à la Révolution de 1789- il abandonne ce poste et quitte l'Observatoire en 1793. A la création du Bureau des Longitudes, par la Loi du 7 Messidor an III (25 juin 1795), et le renouveau de l'Académie des sciences en octobre suivant, l'Observatoire de Paris est bientôt placé sous la tutelle collégiale de ce Bureau; le poste de directeur en titre n'est pas rétabli. Cette situation durera jusqu'au décès d'Arago, en 1853, circonstance qui sera saisie par Le Verrier pour obtenir la séparation des deux entités. Après sa mort, en 1877, l'indépendance des deux institutions sera conservée, situation qui se perpétue de nos jours. La communication se fonde sur les archives et documents de l'Observatoire de Paris et du Bureau des longitudes.

French, Linda (National Science Foundation)

John Goodricke, Edward Pigott, and their Changing Interpretation of Stellar Variability

In late 1782, John Goodricke and Edward Pigott of York began a project of observing "stars which are variable or are thought to be so" (Goodricke journal). On 12 November, Goodricke observed a sharp diminution of the brightness of the star Algol over several hours. In his report to the Royal Society, Goodricke wrote: "...I should imagine [the cause of this variation] could hardly be accounted for otherwise than either by the interposition of a large body revolving round Algol, or some kind of motion of its own, whereby its body, covered with spots or such like matter, is periodically turned towards the earth" (Goodricke 1783). Privately, in their journals, Pigott and Goodricke speculated that the "large body" might be a planet. Nearly a

SUNDAY 16 SEPTEMBER, 11.00-13.00

century later, spectral analysis showed that Algol is, in fact, an eclipsing binary star, with a fainter star regularly transiting in front of its brighter companion. Today, observation of such transits is the technique by which most extrasolar planets have been discovered. In Goodricke and Pigott's own time, however, the "starspot" hypothesis was favored by such prominent astronomers as William Herschel and Nevil Maskelyne, the Astronomer Royal. Gradually, the two came to accept starspots rather than transits as the correct explanation for Algol as well as the other variable stars they studied during Goodricke's short lifetime. The reasons for this change are never stated explicitly; they seem to stem from both observational concerns and social pressure from prominent astronomers.

Gambaro, Ivana (Università di Genova, Italy)

Jesuit science and internal censorship in the 17th century cosmological debate

During the 17th century the Societas Jesu has been one of the religious order most engaged in pedagogical and scientific activities. However, only recently the nature and the extent of the Jesuit contributions to the scientific knowledge have been object of historical studies. Among the relevant investigations due to Jesuit astronomers or mathematicians I concentrate on the ones developed in post-Galilean period, and analyzing some of them through books, letters and other sources, the lack of a monolithic, rigid uniformity of views emerges. In fact, among mathematicians, philosophers and theologians belonging to the order, we can find a continuous tension between the necessity of adherence to the Aristotelian-Thomistic tradition and the interest to the innovative ideas developed in mechanics and/or cosmology by researchers external to the religious milieu. Besides the internal supervision achieved by the "Revisori Generali", the individual researchers were often forced to find a complex equilibrium between personal interests and innovative research on the one side, and the true doctrine on the other. I illustrate here briefly the case of C.F.M. de Chales, H. Fabri, G. B. Riccioli, G. Schott, A. Tacquet with reference to the cosmological debate.

Bienias, Barbara (Institute for the History of Science, Polish Academy of Sciences)

Edward Gresham's "Astrostereon" (1603) and the 'Copernican Paradox'

In his unpublished astrological treatise "Astrostereon, or a discourse of the falling of the planet" (1603), Edward Gresham (1565-1613) expresses hope that the heliocentric views regarding the system of the world 'which hath be[e]n hitherto paradoxall and incredible shalbe most opinionable and orthodoxall'. Gresham – a London astrologer, mathematician and almanac maker – alludes to the so-called 'Copernican paradox' which is defined in John Bullokar's "An English expositor..." (1616), though as a concept can be found in much earlier works. 'Paradoxall' – that is 'beyond the common opinion and belief' – is burdened with exclusion and periphery, and it is in itself a paradox that early modern culture seems to be centred around the notion of 'paradox'. The purpose of this paper is to situate Gresham's outlook on the 'Copernican paradox' in a broader context of what Peter G. Platt called 'the culture of paradox' and Rosalie Colie 'an epidemic of paradoxy in the Renaissance'. Gresham's views and rhetorical devices will be presented against the background of the writings of Guillaume du Bartas, Thomas Nash and Thomas Peacham – in order to investigate the aesthetic roots of the 'scientific paradox'. My aim will be to show a 'paradox' as a form of disunity of thought striving at the unity with the acceptable worldview in England in the early 17th century.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S21/1 CONTINUITY AND DISCONTINUITY OF UNIVERSITY EDUCATION AND RESEARCH ACTIVITIES OF CENTRAL EUROPEAN SCHOLARS DURING WORLD WAR II

Location: IoE – Room 784

Chair: Sekyrkova, Milada

Organiser(s): Jůnová Macková, Adéla; Sekyrkova, Milada; and Kokowski, Michał

Commentator: Ash, Mitchell

World War II changed and challenged generations of European researchers, and impacted on the existence of research institutions. Several occupied countries had to close their higher education institutions in 1939 (Protectorate Bohemia and Moravia, Poland), scholars lost jobs and students opportunities. One solution that maintained a research career as a viable option for scholars consisted of teams in non-university research institutions. It was a way of survival that offered work, and sustenance, even though with limited teaching opportunities, and limited publication outlets. A generation of students had to leave the universities, and their younger followers did not have a perspective – army life and factory work was an imposed solution. An alternative applied in Austria, Hungary, and Germany itself was to embark on research projects and teaching plans deemed acceptable to the regime and to war conditions. Across Nazi-controlled Europe, racial laws, army conscriptions, and enforced exile exercised a considerable influence, next to a reorientation of research programmes to contributions to the war effort. Historiography mapping and interpreting a profound war impact in occupied regions concerns both institutional histories and individual, more biographically oriented aspects. Personal histories of Central European researchers on diverse sides of the conflict included also resistance to the Nazi regime. The symposium panel is concerned with a continuity and discontinuity of research institutions, disciplines, and research interests of Central European researchers during the war. Both institutional and individual aspects have been incorporated, mapping diverse strategies and outcomes. The individual perspective also includes everyday existence, and very personal aspects of habitus, with practices and representations set in highly complex situations, such as exile, resistance, war effort, or survival in a totalitarian regime.

Simunek, Michal (Czech Academy of Sciences)

Outlines and Limitations of Nazi Science Policy Towards the Czech Scientific Community in the Protectorate of Bohemia and Moravia, 1939–1945

Nazi science policy in countries occupied by Nazi Germany varied both in its ideological premises (esp. the racial doctrine) and with respect to the level of violence and exploitation (financial, technical, and aimed against the personnel) or utilitarian pragmatism. In some cases, however, there also existed plans for incorporating and utilising the potential of local scientific communities. The aim of this contribution is to outline their development and limitations – both internal and external – using the example of the Protectorate of Bohemia and Moravia. This territory, occupied in 1939–1945, was the longest occupied part of Europe where the majority of population was non-German. At the same time, it included centres with a tradition of scientific research going back to the Habsburg monarchy. The paper will also touch upon the issue of a significant shift towards applied and departmental research.

Jůnová Macková, Adéla (Masaryk Institute and Archives of the CAS, v. v. i.)

The Oriental Languages School and the Oriental Institute during World War II

The Oriental Institute (OI) in Prague was established as a research institute and a learned society in 1922, and provided a platform for Oriental studies specialists (conceptualized broadly, from Orientalist disciplines to business studies related to the 'Orient'), based either in

SUNDAY 16 SEPTEMBER, 11.00-13.00

the academe or outside it as independent scholars. As a research platform, the OI functioned well, however, it was not in position to provide funded research posts. Its main activities included a fellowship programme, an outreach programme, and specialist classes. The fellowship programme supported both business experts and researchers visiting 'Oriental' countries (covering a broad selection from Northern Africa to Eastern Asia), conducting fieldwork, or staying in research institutions abroad. The outreach programme covered more specialised talks for the fellows, and lectures for general public. The specialist classes included 'Oriental' language modules. The language teaching element was strengthened during WW II, as other academic institutions were either closed or found their activities severely curtailed. The Oriental Languages School secured a continuity of Oriental studies in Czechoslovakia (in terms of teaching and subsistence for the teacher generation), and primed a future generation of scholars for their subsequent work in the Czechoslovak Academy of Sciences, founded in 1952. The continuity of professional publishing was secured via a periodical, *Archív Orientální*. The OI Languages School illustrates a case study in strategies, scientific and financial possibilities and limits of Central European scholars during World War II.

Gecko, Tomáš (Masaryk Institute and Archives of the CAS, v. v. i.)

Survival, Adaptation and Opportunity. „Habitus“ of three Scholars in Czech Lands in 1930s and 1940s

Proposed paper deals with the question of continuity and discontinuity of scholars' professional careers in the Czech lands during the late 1930s and the early 1940s. Those „troubled times“ of the Czech history included not only the severe economic crisis (the so-called Great Depression of 1929) but also the dissolution of Czechoslovakia in 1938/1938 and creation of Protectorate Bohemia and Moravia. Incorporation of the Czech lands into German economic and political sphere of influence in 1939 (Großraumwirtschaft) created a rather hostile environment for scholars teaching at universities as well as those concentrated around the non-university research institutions, who had to maneuver very carefully to stay clear of German occupation authorities. This research subject offers a broad range of survival and negotiation strategies (the question of adaptability, conformity and opportunity), from which the paper will select the most essential ones on the example of three highly influential scholars (such as the indologist Vincenc Lesný, the japanologist Gerolf Coudenhove-Kallergi and the archaeologist Jaroslav Böhm). Using the archival and statistical sources as well as theoretical framework of „habitus“ concept of Pierre Bourdieu, the paper aims to analyze the efficiency of preferred strategies in context of broader economic, social and political changes in central Europe.

Mészáros, Andor

Relocation, Evacuation and Stability: Hungarian Universities during the World War II

The war age was a highly hectic period for the Hungarian higher education; it was present simultaneously the institutions' network expansion, the limiting of the number of students and the evacuation of the institutions and their students in the final period of the war. The first and second Vienna Award also affected the institutional network of the Hungarian higher education. The most significant change was the reorganization of the former second Hungarian university, the University of Kolozsvár (Cluj) following the return of Northern Transylvanian territories to Hungary. This institute has worked in Szeged in the interwar period, therefore also a new, but narrower; Szeged University of Science was created at the same time. In 1941, there were nearly 2500 students at the Kolozsvár institution, but the predominance of Budapest did not decrease in higher education at this time, and even increased until the end of the World War. This meant the stability of the higher education system in the first part of the war period. However, the number of students significantly decreased and restructured in the final period the war and the last war months were already the period of the evacuation of institutions and the mobilization of students completely rearranged and destroyed the previous system of higher education. In my paper I would like to present the history of these processes on the basis of the most typical example, the history of the Szeged/Kolozsvár University.

SUNDAY 16 SEPTEMBER, 11.00-13.00

Oset, Željko (University of Nova Gorica)

Life trajectories of three professors of the University of Ljubljana: The impact of the Second World War on their careers

The Slovene university professors as elite national representatives was during the WW II under substantial pressure, on one they were pressured from the occupation authorities and the other hand from underground liberation movement with a communist at the helm who was expecting public support for the liberation movement. After the war, new communist regime rapidly redefined understanding of academic freedom, hence several university professors were sacked from the University and academic freedom was endangered. The paper focuses on careers and life trajectories of three university professor of University of Ljubljana: Fran Ramovš (1890-1952, slavacist, assistant professor in University of Graz – 1917-1918, a professor at the University of Ljubljana – 1919-1950, rector of the University of Ljubljana – 1934/1935, president of the Slovene Academy of Sciences and Arts – 1950-1952), Maks Samec (1881-1964, chemist, a professor at the University of Ljubljana – 1919-1945, rector of University of Ljubljana – 1935-1937, purged from the University after Second World War but later became head of the newly established Institute of Chemistry at the Slovene Academy of Sciences and Arts – 1946-1964) and Ljudmila Dolar Mantuani (1906-1988, geologist, in 1940 became Assistant Professor, and before the end of the war in 1945 emigrated to Canada where she established herself in the private sector.

S59 FROM DISUNITY TO UNITY: A LONG WAY OF WOMEN'S INTEGRATION INTO SCIENTIFIC COMMUNITY (17TH – 19TH CENTURIES)

Location: IoE – Room 784

Chair: TBA

Organiser(s): Baum, Elena Zaitseva (Moscow State University), and Trofimova, Violetta (Independent Scholar)

The seventeenth century was crucial for European culture in its turn to rationalism and freethinking. At that time learned women started to take active part together with learned men in the free association of intellectuals, or The Republic of Letters, existing in virtual space of communication. In this light we would like to re-evaluate women's presence in the intellectual circles of the 17th and early 18th centuries, to find new intellectual spaces or networks based on correspondence, created by female amateurs of natural sciences. While intellectual networks were the basis for the first scientific academies (e.g. Royal Society of London and French Academy of Sciences), our task is to understand women's connections with scientific academies from their foundation to their heyday in the nineteenth century. Gradual integration of women into university corporation also started in the seventeenth century (Elena Cornaro was the first woman who received Ph.D. from the University of Padua in 1678). In the Age of Enlightenment the salon became the "home" for the citizens of the Republic of Letters. It was in this intellectual space where women could get acquainted with the leading scientists of their time. Parisian salon of Madame Paulze-Lavoisier became the space for the "new chemistry" ideas in the second part of the 18th century. Women were becoming active members of various scientific circles, and their works were published in scientific journals and presented at academy meetings. Nevertheless, most of the female amateurs of sciences were not professionals; they did not have university education and degrees, although there were several exceptions. What was the percentage of female participation in such intellectual spaces in different countries in the Age of Enlightenment? Which scientific disciplines showed highest female representation? These questions, together with female admission into universities as professors (e.g. first women professors in Italian universities), are the subject of this part of the symposium. The rise of female professionalization in sciences in the late 18th and 19th centuries was connected with the new possibilities for their self-education, such as the wide spread of public lectures and journals on natural sciences, and in the second part of the 19th century with the new opportunities to enter universities. In numerous countries women received academic degrees and became equal members of scientific societies and academies. It was not just the process of women's inclusion into scientific masculine community; it was its gradual transformation under the feminist wave. We propose to estimate gender element in the development of scientific societies as specific scientific research centres and in reinforcement of their scientific potential. Such connection of female and male competencies based on partnership that took place in the nineteenth century definitely stimulated the productivity of their activities.

Martins, Ana Cristina (New University of Lisbon)

Women and archaeology in Portugal during the 19th century: a long and unknown way of integration

The historiography of archaeology in Portugal has been focused mainly in the role played by major institutions and their leading figures, mostly men. Nevertheless, and even if less than men, there were women interested in archaeology; attending conferences and libraries; visiting

SUNDAY 16 SEPTEMBER, 11.00-13.00

museums; collecting artifacts and donating artifacts to museums; promoting temporary exhibitions; becoming members of erudite societies, both local and national; drawing artifacts to be included in special editions; teaching and guiding pupils to museums; financially supporting excavations. It is therefore our purpose to analyze and characterize women who contributed to the development and spreading of archaeological knowledge in the country during the second half of the 19th century. In order to do so, we will scrutinize the archive of the Association of Portuguese Archaeologists, founded in Lisbon in the year of 1863; cross analyze these data with the ones obtained from secondary sources, such as newspapers, journals and monographs. Only then we will understand their social, cultural and scientific nets and networks; their motivations; putative consequences of their involvement in such a recent science as archaeology; and how men evaluated their presence and probable contributions, comparing this specific reality to the ones already known from other countries.

Werner Soukup, Rudolf (University of Vienna) and Rosner, Robert (University of Chicago)

“Fräulein Doktor!” Scientific contributions of the first female chemists of the University of Vienna

In 1897, the first female students were admitted at the Faculty of Philosophy at Vienna University. The first dissertation in chemistry was approved in 1902. In the next few years only one or two women were annually enrolled, while the number of male students of chemistry fluctuated around 22. In the first year of WWI four women completed their doctorates, six in 1917, and ten in 1919. In that year the number of female students exceeded that of male colleagues. Margarete Furcht, the daughter of a Jewish stockbroker, was the first women chemist with a doctoral degree certificate in the Austro-Hungarian Empire. Her paper „Über die Veresterung von Sulfosäuren...“, published in 1902 together with her academic supervisor Prof. Rudolf Wegscheider was one of the first scientific chemical publications of female authors in Austria. After her promotion Dr. Furcht was employed at the „Technologisches Gewerbemuseum“. Regarding the women graduates within the next two decades only a small number worked as chemists: Rosa Stern wrote together with Fritz Feigl the first comprehensive review on spot test analysis. Rudolfine Menzel, nee Waltuch characterized together with Ernst Zerner ketoxylose. Susi Glaubach found an adequate employment at the Pharmacological Institute and Elisabeth Lant, nee Ekl became assistant at the Technische Hochschule. The main sources of the investigation were the university archives and the Shoa Names Database of Yad Vashem.

Loyson, Peter (Nelson Mandela University)

First Woman Doctorates in the World: Italy leading the way!

A study carried out in the 1970s by Maria Tonzig from the University of Bologna in Italy and other more recent research work by Logan, Frize, Guernsey and Cavazza showed that the first three women in the world who qualified with a Doctorate from a recognized University were all Italian. Elena Piscopia from Venice received her qualification in Philosophy from the University of Padua in 1678 at an elaborate ceremony attended by the cream of high society. The second lady was Laura Bassi who obtained her qualification from the University of Bologna, also in Philosophy, in 1732. She was particularly interested in physics and became the 1st Professor of Applied Physics at the University of Bologna. The third lady to qualify was Cristina Roccati from Rovigo in 1751, also from the University of Bologna with a Doctorate in Philosophy, specializing in Physics. Italy was the first country in the world to have women qualifying from a University with its highest award. This lecture will cover the lives of these brilliant Italian ladies, who broke tradition and carried the torch for women education. A time-line will also be presented showing a list of Universities across the world where a woman first qualified with its highest degree. This data will be based on a survey carried out by Tonzig in 1973 and on recent research by the author in the Archives of Padua and Bologna.

Taddia, Marco (University of Bologna)

SUNDAY 16 SEPTEMBER, 11.00-13.00

The broken dreams of Clara Haber

Clara Immerwahr Haber (1870-1915) put dramatically an end to her life in the garden of the house where she lived with Fritz Haber, Nobel Prize 1918 for Chemistry. The event has inspired films, documentaries and novels but the fact that Clara, before marriage, was launched towards a promising scientific career is less known. She was the first German woman to achieve the PhD in Physical Chemistry on December 12, 1900. Her thesis supervisor was Richard Abegg (1869-1910) a chemist who contributed as few others to the affirmation of the theory of valence and to the octet rule. After gaining her doctorate, Clara became assistant of Abegg and wanted to pursue a scientific career. Within a couple of years she published six scientific papers both in the field of electrochemistry and photochemistry, some of them in collaboration with her thesis supervisor. The present communication will discuss not only the results of her researches but also the Clara's deep involvement in popularization of science especially among women. It's known she gave popular lectures on physics and chemistry in the household (Physik und Chemie in Haushalt) under the auspices of the Breslau Society for the Welfare of Women, helping to bring women closer to the scientific community.

Erman, Sarah (Université Paris Diderot)

Women botanists at the *Jardin Botanique* and the *Université Libre*, Brussels, 1880-1920

This contribution offers a glimpse at Belgian women in the field of botany in the late nineteenth and early twentieth century in Brussels by looking at the work they performed at the Brussels *Jardin Botanique* and the *Université Libre de Bruxelles*. The specific aims of these institutions – i.e., the expansion of collections, teaching of students in the natural sciences, and the performance of lab- and field-based research – led to a complex division of labour, in which women's involvement took a variety of shapes and forms. Women's work in those places of knowledge-making was marginal but nevertheless instrumental in various ways. Women also slowly but firmly started joining the *Société Royale de Botanique de Belgique*, where they encountered biologists, naturalists and amateurs from everywhere in Belgium. In this long story of contrasted participation, women's ability to engage in university studies, to join learned societies and to maintain a network of scientific collaboration through letter-writing played an important role in the slow development of their careers, especially those deemed feminine, such as teaching, without ever escaping the gendered power relations at stake. In the specific scientific *milieus* that the Société, the university and the botanic garden, the status of «amateurs» and «professionals» was under constant negotiation, without necessarily creating opportunities for (aspiring) women scientists. This state of affairs also prompted women to become active in parallel, new naturalist and excursionist societies.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S20/2 SCIENCE AND SPIRITUALISM IN THE MODERN AGE

Location: IoE – Room 780

Chair: Rocha, Gustavo Rodrigues

Organiser(s): Sera-Shriar, Efram

Traditionally, scholars and an interested public have attributed the rise and growth of spiritualism over the past two centuries to the so-called nineteenth-century crisis of faith. However, when conflicts did occur within discussions regarding ghosts, spectres or psychical forces, the cruxes of the arguments often revolved around issues of evidence (or lack of it), rather than around beliefs or disbeliefs per se. The central question to emerge was: who had the burden of proof, believers or sceptics? Therefore, this panel will suggest that when studying the phenomena of spectres, spirits and psychical forces the emphasis should not be on their relation to a crisis of faith, but instead to a crisis of evidence. By asking more insistently what the methods and ideas of spirit investigators and psychical researchers were, this panel aims to develop a more rigorous understanding of how our modern conceptions of ghosts, spectres and psychical phenomena have been formed over the past two centuries. Such an approach will help to better contextualise the relationship between spirit studies, psychical research and other sciences, showing how scientific fields such as physics, psychology, anthropology and physiology have influenced spirit studies and psychical research, and how spirit studies and psychical research have influenced them.

Sera-Shriar, Efram (Leeds Trinity University)

Challenging the Master: Andrew Lang, Spiritualism and the Limits of Animism

Andrew Lang was one of the most prolific folklorists and popularisers of anthropological theories in Britain during the second half of the nineteenth century. He had a particularly keen interest in both the anthropology of religion, and psychical research, and over the course of many years, he had been collecting ghost stories from all over the world. This material was eventually worked up into the book, *Cock Lane and Common-Sense* (1894). The title referred to one of the most famous British-based hauntings of the modern period: the Cock Lane ghost. Lang identified this alleged haunting as a prime example of spiritualism in modern society, and it acted as a starting point for his anthropological investigation of spirits and psychic forces. Originally following in the footsteps of his mentor, Edward Burnett Tylor, Lang examined the history of ghost stories through a cultural evolutionary lens, arguing that the continued presence of these stories in modern society were potentially a survival of 'primitive' thought. However, he had some reservations about this conclusion, and he questioned whether animism alone could account for the survival of ghost stories in the 'civilised' world. Was the spirit hypothesis deserving of more consideration than anthropologists were willing to give it? This paper will examine Lang's writings from *Cock Lane and Common-Sense*, linking it to larger discussions in Victorian anthropology on the modern spiritualist movement and evidential standards.

Sommer, Andreas (Independent Scholar)

Women at the Margins: Eleanor Mildred Sidgwick, Alice Johnson, and the Society for Psychical Research

Historical scholarship on the Society for Psychical Research (SPR) has tended to focus on prominent early male representatives such as physical scientists William Crookes and Oliver Lodge, and psychologists such as Edmund Gurney and Frederic W. H. Myers. In comparison, historians of the sciences have paid little attention to the most active female workers within the early SPR at Cambridge, Eleanor Mildred Sidgwick (a mathematician, former collaborator of Lord Rayleigh's at the Cavendish Laboratory, and second Principal of Newnham College), and the embryologist and first director of the Balfour Biological Laboratory, Alice Johnson.

SUNDAY 16 SEPTEMBER, 11.00-13.00

Sketching the unusual careers of these women in conventional, as well as in heterodox science, this talk will connect to the panel theme 'crisis of evidence' by highlighting some of the responses by critics of the SPR, who dismissed its work arguing that a society encouraging female participation could not be scientific. Moreover, by restoring visibility to hitherto understudied figures who chose the pursuit of hotly disputed fields of study over comparatively low-risk scientific careers, I will address historiographical problems with traditional perspectives focused on 'great men of science' active in marginalized disciplines such as psychical research.

Noakes, Richard (University of Exeter)

Mechanical Objectivity versus Psychic Subjectivity: The Problems of Instrumental Evidence in Spiritualism, Psychical Research and Parapsychology

The emergence and growth of Modern Spiritualism coincided with what Lorraine Daston and Peter Galison have described as the rise of mechanical objectivity in the sciences. From the mid-nineteenth century photographic cameras, self-registering barometers and a host of other instruments were employed to produce representations of nature that were believed to be devoid of the subjectivities weakening representations arising from purely human agency. For many nineteenth century spiritualists, however, this goal of the sciences was of questionable importance in their own enterprise: soulless machines were not as effective as specially gifted human subjects (mediums) in apprehending spirits and were thought to be too expensive and complex for most spiritualists to use. However, some spiritualists regarded spirit photographs, mechanical tests of levitation, and spirit communication devices and similar approaches to be critically important in their struggles to distinguish 'objective' evidence of psychic effects from evidence of fraud and delusion. Many spiritualist arguments for the importance of instrumental evidence were developed later in the nineteenth century by psychical researchers and moreover, by parapsychologist from the 1930s onwards. This paper suggests that that while proponents of these newer approaches to psychic effects embraced instrumental evidence more vigorously than spiritualists, they doubted whether such evidence could ever replace the experiences of psychic subjects, who appeared to be connecting to a realm (the non-physical) largely transcending that to which instruments were sensitive.

Ambrosio, Chiara and Cristalli, Claudia (UCL)

Revisiting Charles S. Peirce's 'Telepathy'

'Telepathy' (1903) is one of Peirce's most enigmatic manuscripts. Often interpreted as a philosophical contribution to Peirce's theory of perception, the text has been rarely connected to the historical context in which it was produced. In 1887, the American Society for Psychical Research commissioned Peirce a report on Gurney, Myers and Podmore's *Phantasms of the Living* (1886). Peirce produced a scathing assessment of the authors' misapplication of probability in conducting experiments on telepathic phenomena, which led to a lively controversy with Gurney on how to interpret the existing evidence and testimony in the *Proceedings of the American Society for Psychical Research*. It is to this controversy that Peirce returns in 1903. We argue that Peirce's mature theory of perception in 'Telepathy' is functional to a larger epistemological and methodological aim, which places Peirce firmly into the debate around the status of empirical evidence in psychical research. In a much discussed passage, Peirce states that dreams, hallucinations and telepathic phenomena are real insofar as they are types of perceptions. Predictions about telepathic phenomena can still be 'rational', but they are 'apt to be falsified'; this is because when placed in relation with other perceptions they lead to judgements that do not pass the test of experience. In taking telepathy seriously, Peirce embarked on a project for expanding perception that ultimately functioned to reassess and expand the limits and scope of empirical science and of the scientific attitude.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S38/5 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES: CRITICISMS AND CHALLENGES

Location: IoE – Room 731

Chair: Kury, Lorelai

Organiser(s): Silva, Matheus Alves Duarte

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945.

Gesteira, Heloisa (Museum of Astronomy and Related Sciences, Rio de Janeiro)

[Maritime Currents, Astronomers, and Rio de Janeiro]

The position of Rio de Janeiro placed the city on the path of the maritime currents of the South Atlantic, and for this reason it was an obligatory stop for the ships going to India, both through the Magellan Strait and when going around the Cape of Good Hope. Of interest here are the reflections of Richard Drayton, when he argued that the maritime currents were important agents in the shaping of overseas networks, stimulating connections between places and individuals, initiating the flow of goods. According to Drayton, it is important to understand how “natural facts, written into the structure of the seas, shaped how the British, and not the British alone, made both knowledge and Imperial power” (Drayton, 2005:72). It should be noted that the same maritime current which shaped imperial routes allowed more autonomous connections on the part of the astronomers on board and the ones established in some specific point, as Bento Sanches D’Orta in Rio de Janeiro between 1781 and 1788. Although they were at the service of their respective states, could take advantage of the circumstances, which could sometimes result in personal advantages, but which certainly promoted a type of exchange of ideas and information that escaped imperial control. For all of these reasons, Rio de Janeiro, where numerous ships were obliged to stop, cannot be considered through the prism of cultural

SUNDAY 16 SEPTEMBER, 11.00-13.00

isolation, inherent in the colonial condition, which will be demonstrated in our reflection.

Goodman, Jordan (University College London)

Circulating Knowledge, Maritime Assemblage and Moving Plants: The St Vincent-London-Calcutta Circuit, 1790-1800

Whose circulating what, where and why are the questions that I wish to ask. I have chosen to try and answer this question by looking at a particular exchange of living plants between three sites of knowing and growing – the British Government’s botanic garden in St Vincent, west Indies; the royal gardens at Kew; and the East India Company’s botanic garden in Calcutta. This plant exchange was one of the most ambitious in the history of botany, organized but only partially initiated by Joseph Banks. It involved the transfer of around one thousand living plants indigenous to the west and east Indies, Europe, Africa, India and China, and growing in the three habitats, using Royal Navy and East India Company ships, especially altered to carry the plants during the long and often perilous voyages. These ‘floating gardens’ were the key to the whole project. They were sites where knowledge, like objects and people, was placed on board, and consequently remade, negotiated and circulated anew as the ship sailed. Living plants, each variety carrying its own ‘care instructions’, were placed in a specially constructed greenhouse on the quarterdeck, in a sensitive space normally reserved for the intricacies of sailing the ship and providing a social area for the ship’s officers. The plants and those who tended them, and their instructions for the completion of the oceanic trajectories, similarly contributed to the process of knowledge making, which continued until the plants reached their final destination and beyond.

Charles, Loic and Orain, Arnaud (Université de Paris 8 Saint-Denis)

Scientific knowledge, governance and political economy: Reshaping the French Colonial Empire in the second half of the 18th century

The aim of this paper is to discuss how the French colonial policy evolved in the second half of the eighteenth century. The disastrous outcome of the Seven Years War as well as the growing critique of the French colonial policy either by political writers or by a part of the political elite created a vacuum at the highest level. Torn between the necessity to reform and the tight knot of the patronage system that ruled at the top of the royal administration, the French government organized a series of colonial experiments. These experiments were placed under responsibility of enlightened administrators – such as Pierre-Paul de la Rivière, Pierre Poivre, Thibault de Chanvallon and Etienne de Turgot. Moreover, these men were handed the task to define a comprehensive program of reform that encompass large scale experiments in the domains of government as well as that of science, especially natural history. On the one hand, they prepared and sometimes conducted political reforms such as free trade and representative government. On the other hand, they design scientific experiments such as the implementation of new plants and cultivation, the circulation of knowledge throughout the French colonial empire and the implementation of botanical gardens. Drawing on Pamela O. Long’s work, our thesis is that these experiments are best understood when they are interpreted as ‘arenas’ in the context of a French colonial empire that became in the second half of the 18th century a ‘trading zone’.

Kent, Stacie (University of Chicago)

Colonization by Numbers: Commercial Statistics in Late Qing China

Beginning in the second half of the nineteenth century, a new routine of statistical customs reporting translated the particularities of commercial circulation in China into just such a set of abstractions: commodities born by the vicissitudes of markets accumulating into values and transforming into government revenues. In doing so, they rendered commerce in China formally equivalent to commerce elsewhere: navigable by the numbers. The agency producing the numbers was the Qing Empire’s primary interface between itself and global capitalism: an institutional innovation, established in 1861, led by a British subject, and designed along

SUNDAY 16 SEPTEMBER, 11.00-13.00

European lines. This paper examines the processes through which these statistics were made and their effects, both material and discursive. Comparing these reports with other forms in which knowledge about commerce in China was produced — Chinese-language local gazetteers and official memorials as well as English-language guides and dictionaries, I argue that the statistical reporting was unique in its ability to simultaneously deterritorialize and reterritorialize Chinese space. This paper seeks to better understand the extent to which the effects of the statistical project inhered in the abstracting project and its universalizing, numerical form or issued from the hands and offices that held the information. It is part of a larger project thinking about the relationship between forms of circulation and the global.

Van Wickeren, Alexander (University of Köln)

Ignorance and Knowledge: Agronomic Tobacco Science and the Atlantic Space of Circulation around Mid-19th Century

Around mid-19th century in many parts of Europe and its tropical empires, entrepreneurs, state officials and private experts experimented with import substitution of Cuban cigar tobacco by transferring agricultural and industrial know-how from tobacco farms and workshops of the Spanish colony to various sides in Europe, Africa and Asia. Thereby, they deeply transformed a scientific culture of tobacco improvement that had gained importance in the realm of European colonialism since late-18th century. While historians of science have mostly shown how the creation of modern science depended on the circulation between 'colonies' and 'metropolises', my paper takes up such strands, yet also analyzes bodies of knowledge that did not move. Focusing on France where engineers of the state monopoly for tobacco production showed interest to imitate Cuban ways of cigar production, my account understands Paris as a contact zone for Cuban and French agronomic scientists' exchange on contemporary methods of tobacco improvement. Secondly, I argue that this scientific was heavily shaped by the experience of African slaves, Chinese 'coolies' and local farmers operating in the Cuban cigar production. Yet, as the third part of my paper shows, a certain part of this 'practical' experience remained outside of the Atlantic trajectories of scientific circulation and was not mobilized at all. French and Cuban scientists especially perceived indentured Chinese 'coolie' laborers as cigar experts with skills that could hardly be translated into an abstract scientific discussion. Thus, my case study reveals the importance of non-transfer, ignorance and exclusion of knowledge.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S43/4 WHEN SCIENCE DIPLOMACY DIVIDES

Location: IoE – Room 828

Chair: Turchetti, Simone

Organiser(s): Robinson, Sam, and Adamson, Matthew

The concept of science diplomacy has gained traction in recent years, as the foreign offices of various nations have appreciated and begun reassessing the influence and importance of the soft power of science and technology. Scientists themselves are also recognising the diplomatic roles they have played historically and how they have contributed to global relations. This symposium (divided in five sessions), focusing on the history of science diplomacy, draw together a variety of scholars exploring different aspects of science, technology, and diplomacy at the international and transnational levels. Rather than merely echoing and reifying the scientists' own accounts about the benign effects of science diplomacy, they challenge them with provocative case studies and newly proposed interpretative frameworks.

Lalli, Roberto (MPI, Berlin)

Spacetime Diplomacy: Unifying the international general relativity community during the Cold War

Historians of modern physics and physicists agree that the theory of general relativity underwent a major transformation during the post-World War II period. After a long phase of stagnation, in which Einstein's gravitation theory occupied only a marginal position in the scientific enterprise, by the end of the 1960s it had returned to the mainstream of physics. This shift looked so magnificent to some actors that it was dubbed the "renaissance of general relativity." One of the most striking aspects of this process was that it was fuelled by numerous attempts at explicit community building pursued at the transnational level. When these activities began, research related to the theory of general relativity was highly dispersed both at the epistemic and the social level. Epistemically, research in this field was split in many different agendas with only loose connections between each other. Socially, the growing number of research centers involved in topics related to general relativity worked in isolation, especially because of geopolitical and cultural divides. By the mid-1950s some scientists launched a series of initiatives with the explicit purpose to unify the field by increasing the international cooperation between the various groups. Shortly, these attempts were institutionalized through the establishment of the *International Committee on General Relativity and Gravitation* (ICGRG) in 1959, which transformed into a full-fledged scientific society called the International Society of General Relativity and Gravitation in 1974. Since its inception, the pursuit of building an international community of 'relativists' with an identifiable institutional framework was characterized by a strong mixture of scientific and political agendas, for the ideal to build a unified field called 'General Relativity and Gravitation' (GRG) came to coincide with the goal to bridge the geopolitical divides of the Cold War via the diplomatic actions of the involved scientists. In the talk, I will discuss the multiple intentions behind the diplomatic efforts aimed at unifying the GRG field as well as the major tensions that undermined this endeavor between the mid-1950s until the mid-1970s. Idealistic views about the emergence of a unified international community working in peaceful cooperation had to face a myriad of tensions of a surprisingly varied nature, ranging from cultural differences to generational conflicts, from epistemic divisions to political contrasts, which all showed how much disunity still characterized the research field as well as the related community. In particular, I will focus on the different views the actors exposed as to where to draw the boundary between scientific and political matters in the activities of the committee and what this boundary-work implied in the historical development of these scientific-diplomatic efforts. Building on This focus, I will argue, shows that, while these diplomatic efforts enjoyed a certain degree of success with the establishment of the International Society, the emerged community and the related institutional representation was very different from what had been originally envisioned.

Barrett, Gordon (University of Oxford)

'In the Spirit of Democratic Consultation, Solidarity, and Cooperation': Chinese Science Diplomacy at the Peking Science Symposia and the Sino-Soviet Split

In 1964, Beijing hosted the largest international scientific event to have been held on Chinese soil since the Chinese Communist Party (CCP) took power in 1949. The Peking Science Symposium brought to the People's Republic of China (PRC) hundreds of scientists from throughout Asia, Africa, Latin America, and Oceania whose areas of research were as diverse as their places of origin. The symposium's organisers not only pointedly excluded participants from the USSR, the USA, and Canada, but also Europe as a whole in an overt bid to challenge the superpowers and establish the PRC as the centre of scientific gravity in the developing world. The CCP intended it as first of many such biennial conferences to be held under the Peking Science Symposium banner, but the chaos of the Cultural Revolution derailed these plans following the follow-up Summer Physics Colloquium held in 1966. Both conferences contained a heady mix of science, politics, and propaganda, thereby providing a window on the CCP's strategies for utilising science diplomacy to help advance its increasingly radical foreign policy agenda during the 1960s. These conferences in particular highlight scientists and scientific organisations' evolving role within the country's foreign affairs system. Indeed, this paper demonstrates that these were collaborative undertakings by the PRC's foreign relations and scientific communities, notably drawing on recently declassified internal documents from the Ministry of Foreign Affairs Archive in Beijing and government archives in Beijing and Shanghai. While senior foreign affairs officials bore ultimate responsibility, individual scientists, working alongside personnel from national and local science organisations, were primarily responsible for organising and executing the events. For all that these conferences were billed as academic events aimed at building unity and collaboration within the socialist and developing worlds, in actuality they were rooted in Sino-Soviet competition for influence in these regions and the failures to make breakthroughs at the expense of the Soviets in left-leaning international organisations such as the World Federation of Scientific Workers.

Lunteren, Frans Van (University of Leiden)

The International Bureau of Weights and Measures and the Politics of Science

On May 20, 1875 diplomats of 17 nations convened in Paris to sign an international treaty, known as the Metre Convention. Its aim and outcome was the replacement of the existing French metre and kilogram prototypes by new international standards, as well as the establishment of an international Bureau of Weights and Measures in Paris. Three years earlier an international commission of weights and measures had appointed a committee of 12 experts that was to supervise the construction of the new prototypes and to prepare the way for the diplomatic convention. The negotiations leading up to the convention clearly reflected the European transfer of power from West to East. Above all, they show a striking contrast between the political scheming of the scientists involved and the more disinterested stance of the politicians. Surprisingly, the secretary of the said committee, the Dutchman Johannes Bosscha, sided with the wronged French experts, who strongly rejected another German intrusion into French territory. He did everything in his power to thwart the foundation of the planned Bureau. The final result of his failed attempts was the complete isolation of the Netherlands in international metrology.

Eckhard, Wallis (Université Pierre et Marie Curie)

Setting standards in timekeeping – a case of science diplomacy

The two decades after 1945 were a period of profound transformation of the international system of time metrology, most prominently represented by the spread of the new technology of atomic clocks. What had initially been an activity of collective astronomical observation coordinated exclusively by the International Astronomical Union (IAU) gradually integrated new practices coming from other disciplines like physics and radio engineering. Likewise, other

SUNDAY 16 SEPTEMBER, 11.00-13.00

international organization entered the scene, notably the International Telecommunications Union (ITU) and the organs of the Meter Convention. A central institutional actor in this process was the Bureau International de l'Heure. Functioning since 1919 as a department of the Paris Observatory, this central bureau of the UAI occupied a key place in international timekeeping. In this talk, I will analyze the international activity of its director André Danjon during this transformative period. I will argue that the establishment of metrological and practical standards in time measurement needs to be understood as a simultaneously scientific and diplomatic activity, serving disciplinary, institutional and national ends. In accordance with Arnaud Saint-Martin's works on the *Astronomie d'État* 1900-1940 this shows how the conflation of scientific and diplomatic-bureaucratic practices in French astronomy persisted and evolved after World War II. From 1945 onwards, Danjon actively worked to strengthen the Observatory's position, that had suffered from the isolation during the German occupation. Inside the traditional UAI setting, the Paris Observatory had to face a logic of informal, yet routinized competition, incited through regular comparisons of the precision of time services that participated in the works of the BIH and the International Time Commission, commission 31 of the UAI. At the same time, the position of said UAI commission was questioned altogether by developments in the International Telecommunications Union (ITU). At the 1947 ITU conference in Atlantic City, US proposals for a new network of standard frequency broadcasts and time signals threatened to marginalize the importance of the UAI's astronomical Time Bureau BIH. The Paris Observatory's response to this situation involved both local improvements of its time service and international action: In a process beginning in 1948, Danjon advanced a first formal definition for the until then traditionally defined unit of time. Despite being of astronomical nature, the definition eventually was adopted by the General Conference for Weights and Measures in 1960, thus becoming legally binding among adherents of the Meter Convention. Moreover, an instrument designed in Paris, the Impersonal Astrolabe, became an internationally renowned apparatus during the 1950s. The recommendation of the Astrolabe for use in the International Geophysical Year showed that the Paris Observatory had remained able to set international theoretical and practical standard. My case study will show the multiple functions of Danjon's science diplomacy: It may be read as a part of the defense of the French position against American advances in ITU, as a strengthening of the Paris Observatory inside the network of international astronomy and as the defense of astronomer's ideas about time measurement against those of radio engineers.

Robinson, Sam (University of York)

Anticipating Ocean Exploitation and the Law of the Sea (1968-84)

The UN Law of the Sea (1968-1984) was intended to legislate for the new capabilities that developments in underwater science and technology opened up for developed nations. In reality the negotiations became a point when the superpower technological hegemony of the global ocean was challenged by the 'Group of 77' – nations that saw the negative potential of new technologies in terms of the external exploitation of their resources. Science policy was formed in response to the anticipated capabilities of such technologies which far outweighed the realities of extracting deep-sea minerals and resource exploitation in remote and inhospitable environments. Thus, the discussion of ocean science and technology within the treaty negotiations were built on anticipatory understandings of the potential exploitation of the oceans. This paper will argue that international law-building for science and technology can be framed as an anticipatory response to claims made for potential future use. Thereby these negotiations, based on unsettling scientific futures, are themselves forms of scientific imaginaries. The navigation of potential uses of science, by diplomats, reveals the role of science communication within complex negotiations, and the importance of the distinction (and sometimes the blurring) of the real and the imagined in international relations. The Law of the Sea was a site where scientific futures were imagined in several contexts; a uniquely challenging moment in international law creation where lawmakers looked to the future rather than responding to their past or present situations.

SUNDAY 16 SEPTEMBER, 11.00-13.00

SUNDAY 16 SEPTEMBER, 11.00-13.00

S42/2 THE GREEN AND DARK SIDE OF ENVIRONMENTAL ISSUES IN CITIES (1850-1950)

Location: IoE – Room 709a

Chair: Duarte Rodrigues, Ana

Organiser(s): Gomes, Inês; Miralles Buil, Celia; and Duarte Rodrigues, Ana

In 1984, the expert on French urban history, Bernard Le Petit, stated that “the city is neither a context nor an environment, but the expression of practices and social relations”. This symposium's ambition is to bring back “la part du milieu” (Braudel, 1949; Massard-Guilbault, 2002) into the cities, focusing on the question of hygiene. Hygienic issues in cities have been studied by different scholars, through different lenses. We argue for a change of perspective, connecting urban history of sciences and technology, garden history and urban environmental history. In particular, this symposium focuses on the role played by nature and/or environment (concepts that we want to clarify during discussion) in the healthy/unhealthy city. On the one hand, bringing “nature” (e.g. trees, plants or animals) and its natural elements (e.g. sun or air) into the city was considered a solution to solve some of its hygienic problems. On the other hand, the “nature” in the city was, periodically, considered as a source of danger for dwellers' health. What kind of “nature” inhabitants, municipal authorities, doctors or other actors which addressed urban problems wanted in the city? Who were, in fact, the leading actors claiming for healthier cities - doctors, gardeners, engineers, or others? Did they agreed or disagreed about the necessity and effectiveness of the proposed measures? What policies were required to transform the city from dark to green? Are there similarities among those policies in different cities dispersed worldwide? How did, different actors, in their discourses and practices, try to unify or des-unify nature and city? These are the main questions addressed in this symposium. The diversity of case studies covered seeks a comparative analysis between cities – with different size, political importance or economic affluence - in Europe, America, Russia or India, highlighting the importance of experts', ideas and models circulation, at a global scale. Furthermore, it also emphasizes the importance of local exchanges between different social groups in the construction of healthier cities, challenging the traditional center-periphery model. The variety presented in this symposium offers an overview of the significance of environmental urban history to our understanding of the history of science and technology in the city.

Poerschke, Ute (Pennsylvania State University)

The Architect as Hygienist

The German architectural critic Adolf Behne stated in 1930 that the “architect today is easily more hygienic than the hygienist” and further explained that “hygiene” in the design of mass housing “is exclusively sun orientation.” Indeed, European architects and urban planners of the late nineteenth and early twentieth century were deeply engaged in discussing the best orientation of single- and multi-family dwellings in metropolises and satellite garden cities as a main factor of healthy living. Particularly in the 1920s, many famous architects, such as Walter Gropius, J.J.P. Oud, Alexander Klein, Le Corbusier, and the CIAM group included sun studies not only in technical drawings but also in illustrative renderings, backed with writings about the necessity of correct building orientation. But not only architects and urban planners raised their voices on best solar orientation of housing: hygienists and doctors, too, for example Arthur Korff-Petersen, wrote extensively on the benefits of solar exposure of rooms, facades, and streets in medical journals. The discussion was fueled by two controversial opinions: While most studies before that period stated that the best orientation of housing is facing the building's long side toward South, a majority of architects and hygienists preferred the

SUNDAY 16 SEPTEMBER, 11.00-13.00

orientation of the building's long sides to East and West. The paper will describe the course of this controversy and analyze the reasoning for the modernist orientation preference that contradicts with most studies before and after High Modernism, including today.

Salazar Marulana, Carolina (Universidad Nacional de Colombia)

The English company Pearson and son and hygienization in the Latin American city at the beginning of the 20th century

With the construction of modern urban equipment in the late nineteenth and early twentieth centuries, recommendations for public hygiene were applied with scientific vision by professionally trained engineers, who designed and built infrastructures to produce healthy and hygienically urban environments, putting into practice the main advances of the Second Industrial Revolution. In this modernizing scenario, the role of European companies that developed projects in Latin America was fundamental, as they not only contributed to the sanitation of cities, but also fostered the homogenization of knowledge and the market. This situation was the result of the transfer of knowledge generated by the migration of professionals and the dissemination of techniques and products achieved in publications and universal exhibitions. One of the main companies was the British Pearson & Son, who built important sanitation works in American countries such as the United States, Mexico, Brazil and Colombia in the first decades of the 20th century, introducing the advances of British engineering in projects for water supply and treatment in overseas Europe. In doing so, the concepts of order, sanitation and social control, began to appear in Latin American cities as reflections of progress. Likewise, they became the guiding threads for reforms applied in favour of urban health and, in which, sanitation networks in Colombian cities like Bogotá, Medellín y Cartagena, became one of the main projects in charge of European engineers.

Chakravarty-Kaul, Minoti (University of Delhi)

Hygiene in New Delhi. The last Imperial capital of British India (1857-1947)

Delhi, although ceded to the British in 1857 by the last Moghul Emperor became the capital of British India only in 1911 when it was 'gifted' to the people by King George the V. Uniquely, an Asiatic city became politically peripheral to London and European metropolis. Delhi as a tropical metropolis had to necessarily be re-assessed to suit hygienic norms required for a European Viceroy in Delhi who was a direct representative of the King. The Viceroy and the Secretary of State Crewe in London set the stage for the transformation of the new capital. Such an exercise revealed some historic similarities in trends between London and Delhi specially in matters of environmental norms of hygiene and the science of municipal planning of cities and governance. Such comparison was interesting because both the capital cities had inherited centuries' old architectural wonders as buildings and fortresses; and canals with decorated gardens and parks. The ancient parks of the city like Lodi Gardens and Qudisa were embellished, by the services of a Forest Department. Characteristically the architects Lutyens and Baker were inspired by the greenery so much a part of the city. The city's physical environment despite being green even in the British period experienced disastrous famines and pestilence. New Delhi from 1911 aroused enquiry from London's Parliament. Consequently, the city appropriately responded by means of municipal administration of water supply, drainage and primary health precautions which were becoming essential in metropolitan London.

I124 CULTURE AND SCIENCE

Location: IoE – Room 777

Chair: Fyfe, Aileen

Aven, Håvard B. (Oslo Metropolitan University, Centre for the Study of Professions)

'A particle of angst and a wave of hope': Nuclear Physics, 'The Two Cultures' and Environmental Futures in the Technoscientific Public Sphere

The paper explores the transnational transfiguration of the 'two cultures' idiom, popularised by CP Snow (1959), by studying how it was received, construed and circulated in the meetings and journals of the Nordic techno-scientific communities. The idea of a split between (natural) scientists and literary intellectuals – more commonly referred to as technoscience or industry and the humanities in this setting – was invoked in (and shaped) a host of heated controversies: over the destructive potential of nuclear physics (1940s-), the reinvigorated environmental movement (1960s), Limits to growth and futures studies (1970s) – and, continuously, technical journalism, popular science, and the relationship between technoscience and the public. By studying these exchanges, I respond, first, to the conference's call to study unity and disunity in the public culture of science, notably how the engineering and techno-scientific associations discussed, negotiated and blurred the boundaries between engineering, physics, the humanities and the public (cf. Bensaude-Vincent 2001; Shapin 2012). Second, the paper addresses the question of unity and disunity within and across diverse sciences, notably by discussing the claim that modern environmentalism has been all but inseparable from the development of futures studies and a concomitant new interdisciplinary meta-expertise (Andersson 2012; Blanchard 2015; Warde & Sörlin 2015; Seefried 2017).

Meyer-Spasche, Rita (MPI für Plasmaphysik)

Science Fiction Meets Reality: Hannes Alfvén's 1966-Vision of Future Computers

Under the pseudonym OLOF JOHANNESSON, the Swedish-American plasma physicist HANNES ALFVEN (1908-1995, Nobel Prize in 1970) published a science fiction story about the future impact of computers, in Swedish (1966), English (1968), and in German (1970), describing how the development of computers did lead to a global world society in which EVERYTHING is automated and organized by computers. Finally computers even reproduce themselves and some computers service the others and prevent the whole system from breaking down. It is amazing to read this text today: some of Alfvén's predictions did become real in the meantime, others are still desirable for the future, and others are strongly unwanted or clearly a satire. It is unclear how much Alfvén's booklet influenced the development of technology and society. In Germany, KLAUS BRUNNSTEIN (1937-2015) used it in 1973 to start a public discussion about the future role of computers. Brunnstein (computer scientist, politician and IFIP officer) had strong influence on German legislation with respect to IT security, social accountability and information privacy.

Pihlaja, Päivi Maria (Independent Scholar / Finnish National Committee for the History of Science, Technology and Medicine)

Narratives of scientific discovery and visual strategies in promoting and popularizing late nineteenth-century theories of the Aurora Borealis

This paper seeks to contribute to discussions bridging science and art by investigating through visual means popular narratives of scientific discovery and effects that these may have on scholarly careers. As case study, it uses visual and narrative reports given by physicist Selim Lemström (1838–1904) who in the late nineteenth-century received, both in popular press and within the scientific community, acceptance for his new theory concerning the origins of the aurora borealis (a phenomenon of light also known as the northern lights, which at the time remained scientifically unexplained). The origins of the theory will be detected in powerful personal impressions or a 'key experience' of the author while performing direct observations in nature. It will also be shown how the images in which the author sought to capture and

SUNDAY 16 SEPTEMBER, 11.00-13.00

mediate this event and its settings were transformed into a scientific argument, drawing especially from visual analogies with laboratory experiments with electric currents. The ideas conveyed through these images will then be analysed against certain archetypal nineteenth-century narratives of scientific discovery, where scientific truth or breakthrough unfolds like an instantaneous 'vision'. It will be proposed that adherence to such visual and narrative strategies when promoting his (later refuted) theory may partly explain the course of Lemström's later career, including his incapability to adjust his views in front of new paradigms.

Pyenson, Lewis (Western Michigan University)

Ut pictura mathesis: Vision and Perspective in Picasso's and Einstein's Education

A close examination of Picasso's and Einstein's formal education reveals a number of themes in common. Picasso and Einstein attended schools sharing a number of attributes in architecture, teaching collections, and curriculum. Both Picasso's and Einstein's teachers were accomplished in science and mathematics, on the one hand, and drawing on the other hand. Both young men received instruction in the tradition of projective and descriptive geometry: Picasso practically in his drawing lessons, Einstein both practically and theoretically so. Picasso's and Einstein's schools were adorned with full-scale copies of classical statuary used for drawing lessons. Einstein's schools had fine collections of copies and photographs of classical and medieval works of art and architecture. In his student years and especially in the years leading into general relativity, Einstein would have been familiar with three-dimensional models of higher-dimensional surfaces, and it is likely that similar models were familiar to Picasso's close artist colleagues. It seems that around ten years after leaving school, Picasso and Einstein came back to lessons overlooked when they set out as an independent artist and theoretical physicist. The lessons had been internalized by many of their contemporaries, however, who were quick to embrace Cubism and general relativity because the new work resonated with what they knew but could not express well. The paper is based on one chapter in a forthcoming book, *The Shock of Recognition: Motifs of Modern Art and Science*; related discussion in the volume *Being Modern*, ed. Robert Bud, et al. (London: UCL Press), in press.

Fulford, Tim (De Montfort University)

Romantic Science: the Culture of Enquiry and Dialogic Form in the 1790s and 1820s — Humphry Davy and his Circle

I will publish this year *The Collected Letters of Sir Humphry Davy*. This paper will investigate the model of enquiry forged in 1790s Bristol between Davy and his poet friends, and show how it a. persisted beyond the two developments that Davy has been credited with by recent critics and historians — 1. promoting the figure of the scientist as the heroic master of nature through laboratory experiment (see Schaffer on experiments and automatic registration) and 2. precipitating the institutionalisation of knowledge-production into separate disciplines (see Klancher) b. was reconstituted in remodelled form in a number of works that revived the long quiescent dialogue form (The Excursion, Sir Thomas More, Salmonia, Consolations in Travel). That later works of Southey, Wordsworth and Coleridge as well as Davy should have revived a dialogue form, and invoked 1790s' writing modelled on conversation, is itself a significant though oft-neglected development in Romanticism. This formal turn shows that the shared culture of enquiry that the Bristol circle had forged in earlier years was still the most powerful model of discovery they could create. Davy's dialogues are conversational, poetic, digressive, situated: as such they reveal that Romantic-era science was not increasingly a discourse of the solitary experimentalist in the laboratory produced from a position of disciplinary separation. It was in dialogue with literary discourse as a means of demonstrating that the subjectivity of the enquirers was to be included in enquiry: experiment narratives were not in opposition to poems and travel narratives but intersected with them.

SUNDAY 16 SEPTEMBER, 11.00-13.00

S19/2 MATHEMATICS EDUCATION IN EUROPEAN MILITARY ACADEMIES (18TH AND 19TH CENTURIES): UNITY OR DISUNITY?

Location: IoE - Room 826

Chair: Bruneau, Olivier

Organiser(s): Blanco, Monica, and Bruneau, Olivier

It is well known that military academies and schools contributed essentially to the production and circulation of higher mathematics in 18th- and 19th- century Europe. Over the past thirty years there has been a fair amount of historical work on mathematics education in European military academies, approaching the subject matter in a variety of ways. A number of studies focus on the mathematical courses produced and used at the Spanish military academies and pinpoint their outreach. Others address the importance of the military academies of Woolwich and Sandhurst in the circulation of mathematics in Great Britain and in the appropriation of mathematical knowledge across the Channel. Meanwhile, recent works on the American military schools (e.g. West Point) consider the mathematical exchanges between France and the United States. Finally, the *École Polytechnique* and its school of application in Metz played a central role in the development of mathematics early in the 19th century. Throughout the eighteenth and nineteenth centuries, these military schools and academies underwent several evolutions regarding their status, their ways of recruitment and changes in their curricula. So far such evolutions have been studied mainly individually, from a local or national perspective exclusively. Such a simplistic pattern has led up to a lack of case studies dealing with the mathematics education in military academies with a wider global perspective, and studying the local obstacles within the pedagogical, institutional or diplomatic framework. Through this symposium, we envisage exploring the local and national dynamics involved, and assessing their impact on mathematics education in the military context. More cross-national and comparative case studies will doubtless contribute to improve our understanding on the construction and circulation of mathematical knowledge in 18th- and 19th-century Europe. Hence, the circulation of mathematical knowledge between a number of military schools and academies, not only within national boundaries, but also across borders, will be considered. We are also interested in discussing whether changes in mathematics curricula took place simultaneously or rather independently. That is, if one school underwent a change of curriculum, could the same change be tracked down at other national or international schools? Or did they prefer to stick to a more traditional education? In short, the aim of this symposium is to provide a cross-national comparative analysis of the production and circulation of mathematics in European military academies through a number of case studies from the 18th and 19th centuries. This crossnational comparative analysis can help identify points of unity or disunity in the military educational context.

Domingues, João Caramalho (Universidade do Minho)

Mathematical curricula and textbooks in Portuguese military engineering education in the 18th century

There are no explicit regulations on mathematical curricula for Portuguese military engineering education before the middle of the 18th century. A few textbooks were published and were traditionally the only source in reconstructing these curricula. However, recently it has become clear that until about 1760 students relied (probably on an exclusive basis) on manuscript notes, that included much more pure, elementary mathematics than previously acknowledged. These notes confirm and reinforce the influence of French authors – despite the fact that

SUNDAY 16 SEPTEMBER, 11.00-13.00

Portugal was a constant ally of Britain, and that Portugal and France were on opposite sides of the War of the Spanish Succession and of the Seven Years' War. We will present the evolution of these mathematical curricula, as they can presently be reconstructed, as well as the textbooks adopted or adapted into lecture notes.

Navarro Loidi, Juan (Cátedra Sánchez Mazas)

Foreign influence in Mathematics in the Spanish College of Artillery (1764-1842)

Founded in 1764 following the model of the Accademia militare di Artiglieria of Naples, the Spanish College of Artillery of Segovia had for head of Mathematics from 1777 to 1803 the Italian Pedro Giannini, a disciple of Vincenzo Riccati, who published *Curso Matemático*. This Italian influence was not usual, Spanish mathematicians followed ordinarily French authors. For instance, Bezout's *Cours de mathématiques* used in French military academies inspired Benito Bails' *Elementos de Matemáticas* a celebrated book in Spain. This circumstance changed in 1803 when Francisco Datoli replaced Giannini. He began the publication of a new manual for the College following the French mathematician S. F. Lacroix. The Peninsular War stopped his publication. After 1814, translations of Lacroix's manuals were employed. For specific matters books of Francoeur, Monge or the Spaniards Zorraquin and Vallejo were used too. The College was closed by the king in 1823. When it reopened in 1830 the adopted manual was *Curso completo de matemáticas* by José Odriozola, where the French influence can be noticed, but less strongly than before. In 1837 the syllabus had to be reduced to get faster new officers to fight in the Carlist War. Lacroix, and Monge were again recommended, beside Odriozola. In 1842 a general military academy was created to be a first step for all the branch academies of the army, and the college became an Application School of this military academy.

Puncher, Sebastian (Royal Military Academy, Sandhurst)

Royal Military College Mathematics: Useful Skill or Self-Indulgence?

This paper examines the central part that mathematics played at the Royal Military College in the regulation of the course of studies between 1802 and 1870. It touches upon contemporary perceptions, often differing, of the importance of mathematical training for the British infantry or cavalry officer. That there were differing opinions was symptomatic of the understanding of British society, and its army, of what constituted an effective military education and how this was best obtained. It will look particularly at whether the type of mathematics taught was meeting, or on the other hand, confirming, observations of critics.

This paper argues that it was the position of Army educationalists to set about creating a college in 1802 in which the position of mathematics was not dissimilar to that held traditionally in France for its potential infantry officers. The intention was to create a large subset of future officers in the army destined for high appointments. However, as time progressed the 'neo-feudalist' position of prizing practical skills and moral attributes increasingly put the position of mathematics at the RMC under pressure. However, it retained its place partly due to the poor level of secondary education in mathematics throughout the country - meaning the RMC needed to 'level' the cadets before starting their professional subjects - and secondly, there were irrefutable uses for mathematics in fortification, surveying and various staff work which could not be dismissed. Indeed, the attitude to mathematics at the cadet college was bound up with its perceived relevance at the Staff College. This conflict is borne out by the fact that even after the adoption of the French-inspired changes to education after the Crimean War, which should have seen the RMC as a purely practical School of Application, the college was still not able fully drop mathematical teaching. For almost a decade after the War, owing partly to a series of aborted changes, it retained vestiges of its previous function as a sort of 'Junior Staff College'. Not until the War Office authorities were pondering the implications of the Franco-Prussian war did mathematics finally disappear from the course with a narrower focus on purely professional subjects.

Rinaldi, Elena (University of Ferrara)

L'Istituto dei Cadetti Matematici Pionieri (1823-1848): an example of a polytechnic school

SUNDAY 16 SEPTEMBER, 11.00-13.00

in pre-unification Italy

The Istituto dei Cadetti matematici pionieri of the Duchy of Modena (1823-1848) is an example of a school with the role of university in pre-unitary Italy. In this presentation I propose to show that it is possible to consider it as a prototype of an Italian polytechnic school that trained both the engineers and the ruling class of the Duchy. Studying the lessons given in the institute, it was possible to reconstruct the teaching programs, the weekly tests to which the students were submitted, the textbooks used and the teaching methods of mathematics and science. We also compared the teaching with other contemporary military institutes - in particular those of Turin - and with the universities of the time. With this study I tried to make a new contribution to the study of the history of mathematics teaching in military contexts and I tried to understand the role it played in the formation of the nineteenth-century Italian ruling class, protagonist of the process of the unification of Italy.

Preveraud, Thomas (Université d'Artois)

Considering and reconsidering the role of France in the mathematics education within American military academies (1800-1850)

In the beginning of the nineteenth century, American engineers and officers were trained in West Point Military Academy, the only engineering/military school of the country between 1800 and 1820. In its early years, the Academy featured few standards for teaching contents - above all for mathematics - and organization and the cadets' training was therefore very deficient both in extent and structure.

For reasons this talk will detail, French teaching structures and contents were carefully considered by Secretary of War and used to reform West Point organization, including its governance, the routine of cadets, its curriculum and the textbooks list (not only in mathematics, but also in military tactic or in natural philosophy). This French influence can also be noticed in the edification of curricula in opening new military academies, for instance at the American Literary, Scientific and Military Academy (Norwich, Vermont, 1819) or at the Virginia Military Academy (Lexington, Kentucky, 1839).

But mapping in such a manner the French presence in the mathematical training of American officers and engineers erroneously depicts a strongly polarized history, with so-called beaming French science and retarded American continent, the later benefiting from knowledge coming from the other side of the Atlantic. Yet, this transfer was associated with a set of deep and active transformations to fit the local needs and contexts, and of which the communication will discuss.

S11/1 HISTORICAL MOMENTS IN THE PUBLIC UNDERSTANDING OF SCIENCE (c.1600-1900)

Location: SciM – Lecture Theatre

Chair: Nielsen, Kristian H.

Organiser(s): Ampollini, Ilaria; Gouyon, Jean-Baptiste; and Nielsen, Kristian H.

These two panels are intended to bring together studies of historical instances related to the construction of the public cultures of science. Taken together, the papers presented in these two panels highlight the variety of the aims, contexts, outcomes, and actors—audiences and producers—of an endeavour—the communication of scientific knowledge in public contexts—consubstantial to the development of modern science, which has remained a constant since the 17th century. As a whole, the papers presented in these two sessions intend to highlight the value of historical enquiry, and of an historical sensibility, for the development of current scholarship in and about science communication and the public understanding of science. The first panel lines up case studies from c. 1600 to 1900, the second panel concentrates on the 20th century. The title for these two panels is borrowed from the title of a rubric in the journal *Public Understanding of Science*. Since 2016, this rubric offers short essays on the history and the historiography of science communication on a regular basis.

Ampollini, Ilaria (University of Trento)

The Emergence of Risk Communication in the XVIIIth century

As many scholars have shown, in the XVIIIth century crucial changes in the perception and cultures of risk occurred, also following the mathematicalisation of probability. But what about the communication to the wide public of these relatively new, hard-to-explain notions? This paper aims at analysing the emergence of risk communication, focusing on the French area in the period between 1720 and 1780 circa. We will first consider if there were any debates within the scientific community about the best ways to communicate the risk's values to lay people. We will then investigate if and how the risk communication developed in the gazettes, penetrating the public arena. Finally, we will try to identify some instances of the early practices of risk communication. One of the most significant examples comes from 1773, when the Académie des Science discussed how communicate small values of risk. The debate was triggered by an essay by J. Lalande about the likelihood of an impact between comets and the Earth, that had produced a *terreur panique* throughout Paris. Starting from here, we will broaden the analysis to the previous decades and to those after 1773. We will focus, for instance, on the case of smallpox inoculation: little attention has been given to date to the ways the risks associated to the inoculation were discussed and communicated to the broad audience. Other issues investigated in the present study will also include the communication practices related to the mortality tables.

Vaccari, Ezio (University of Insubria)

Popular knowledge and geological sciences: a comparative study in the history of scientific communication in France and Italy during the 19th century

The aim of this paper is to investigate how a new concept of natural environment developed in the 19th century society in France and Italy through the growing of a new literature of popular science, which reached a great number of readers, also creating a new audience for naturalistic subjects related to the history of Earth. Within this context, linked to the history of modern scientific communication, the new science of geology had a relevant role, very little studied to date. Consequently, works by L. Figuier, C. Flammarion, L. Simonin and other French scholars will be analyzed and compared with Italian contemporary authors such as A. Stoppani or P. Liroy. Their contribution to the popularization of natural sciences will be considered with particular reference to the establishment of a new concept of natural environment: an

SUNDAY 16 SEPTEMBER, 11.00-13.00

environment with a very long history (shown by the recognition of several geological changes and by the discovery of the "deep time"), extraordinary and powerful natural phenomena (discovered by studies in volcanology and hydrology), a great variety in the development of life (demonstrated by new research works in palaeontology, botany, zoology), a significant richness in subterranean resources (described by mineralogy and mining studies). This extended concept of natural environment comes from a new kind of scientific knowledge based on books and periodicals of 'popular science', which adopted specific narrative styles and visual languages.

Turbil, Cristiano (KCL)

Medicine and politics in post unified Italy: Paolo Mantegazza's medicine in the public square

In the second part of the nineteenth century the Italian physiologist, anthropologist, politician and populariser of science Paolo Mantegazza (1831-1910) was becoming an internationally recognised figure due to his extravagant scientific and political ideas. In just over thirty years of activity Mantegazza produced more than 1500 publications on various topics including public medicine and hygiene, food science, love, sexuality and physiology. Mantegazza aimed his work at two different types of audiences. He produced cutting edge research for the Italian medical community while actively contributing to convincing politicians to fund medical research. Nonetheless, Mantegazza also considered it extremely important to medically educate the general public. As an advocate of positivism and hygiene, Mantegazza recognised that the only way to modernise Italy was by starting with medically educating the whole population. In the 1860s, Mantegazza began a long-term plan to change the way Italians approached scientific and medical knowledge. He organised and delivered medical talks about hygiene, published short popular volumes called almanacs and wrote several fictional works where he presented controversial medical ideas. This paper will offer an insight into late nineteenth century Italian medicine in both its professional and popular forms. The analysis of Mantegazza's work, in particular, will show the link between medicine and the political function of its popular understanding.

Hjermitslev, Hans Henrik (University College South Denmark)

Circulating natural knowledge in rural and urban Scandinavia 1870-1900

In the 19th century, the three Scandinavian countries, Denmark, Norway and Sweden, established compulsory education for all children. Moreover, public enlightenment initiatives such as the folk high school movement blossomed from the 1860s. It resulted in relatively well-educated rural as well as urban populations and very high literacy rates compared to other European countries. However, it was only from around 1880 that natural science took centre stage in the education of the people. By then knowledge of the natural world became relevant to educators for a variety of reasons. Religious educators realised the utility of natural science in their attempt to modernise agriculture, while urban freethinkers applied scientific theories such as Darwinism in their ideological struggle against Christianity. From the 1890s, moreover, Scandinavian publishers realised the fiscal potential of natural science when they launched successful popular science journals and book series that reached more than 100.000 readers. In this paper, I will discuss the appropriations and applications of natural science in the Scandinavian countries from 1870 to 1900. I will focus on how natural knowledge became part of both modernisation processes and cultural struggles and how both ideological and economic factors influenced the establishment of a vigorous scientific marketplace.

S49 NINETEENTH-CENTURY PRACTICES OF COLLECTING NATURE

Location: SciM – Dana Study

Chair: Secord, James

Organiser(s): Dubald, Déborah, and Madruga, Catarina

Commentator: Nieuwland, Ilja (ING, Roy. Neth Acad. Sc.)

The presenters in this panel contribute to the historiographical shift that moves away from looking at large natural history collections in established institutions to considering what took place outside the museum's walls. The topic of this panel is a valuable, but under-explored part of the formation of natural history collections, that is, the role of collaborators who do not necessarily fit usual categories of museum practitioners. In our papers, we examine the practices and motivations of different types of collectors and collators, and analyse what happened in the worlds of collection and collation outside of the museum.

During the nineteenth century, natural history collections and museums were often depicted as representative of regional, national, or imperial projects. Collections of local flora and fauna were used to crystallise nationalist discourses and the personal successes of men hailed as national heroes. For various reasons and in multiple settings, natural history museums became the centres around which these identities cohered. Centres of calculation, however, required the gathering of considerable amounts of data and specimens.

By looking at practices of collecting we reveal that not all the contributions to museum collections were systematic, whole, homogeneous, or obsessed with completion.

Sending, shipping, or selling materials to a museum were not politically-neutral acts, and it is possible to identify many different typologies of suppliers of specimens who were neither professional nor amateur collectors. These different types of collators were not necessarily the learned explorers or collectors usually associated with large-scale museums. Most museums' 'agents' in the field were, in fact, mediators and facilitators, or even retailers of nature in the field or colony. They became recognised centres for accumulation in their communities, active nodes of a larger network, preparing, shipping, and corresponding with the museum.

Acknowledging such collators as valuable contributors, museums issued sets of instructions according to which collection, preparation and shipment were standardized. In addition, museums would pay for shipments, and provide instruments and materials for the field, in the hope of enticing more collaborators. Thus, relations of power and authority between the museum and its network of collaborators were reinforced. However, the papers in this panel will show how colonial administrators, diplomats, or more occasional contributors would in their turn be very aware if the materials supplied were or not incorporated into museums. The negotiation of authority over the specimen's value, and its role inside the museum once offered, is shown to be complex. Many museum collaborators entered a relationship with museums in terms of a gift economy that has not received sufficient attention.

As places of standardizing, sterilizing, and crystallizing knowledge, natural history museums constructed their authority to transform nature into knowledge, encapsulated in the collected objects and specimens. The study of the logistics of practices of collecting nature as seen from the outside of the museum will hopefully contribute to a better understanding of how the authority of museums and herbaria was built and negotiated.

Béllego, Marine (Ecole des Hautes Etudes en Sciences Sociales, Paris)

SUNDAY 16 SEPTEMBER, 11.00-13.00

Local Ambiguities: Collecting, Drying and Classifying Plants for the Calcutta Herbarium at the end of the Nineteenth Century

The Calcutta Botanical Garden was created at the end of the 18th century by the East India Company to acclimatize and cultivate economically-useful plants. By 1900, it had become a major institution of botanical knowledge and evolved into a showcase for imperial botanical achievements. Inside the Garden, the herbarium was central to the elaboration of what European botanists considered to be scientific botanical knowledge, and at the turn of the 20th century, it was considered one of the main herbaria in the world. Collecting, identifying, and classifying plants contributed to the imperial project of territorial appropriation, and the project of establishing an exhaustive list of so-called Indian plants was meant to reinforce the claim that botany was a European enterprise. However, most workers contributing to herbarium work were not European. Collectors sent to remote places had to rely on the knowledge of 'natives'. While most work was performed by Indians, Europeans kept complaining about the workers they were dependent on. This fraught relationship with local workers mirrored the ambiguous way in which British botanists considered all things local. Their interest in local plants existed only through a denial that local people were able to benefit from what grew on their lands, be it in terms of taxonomy or agriculture. This paper shows that in the particular colonial conditions of Calcutta, Herbarium operations epitomised the biased imperial relationship with the local.

Brassington, Laura (University of Cambridge)

Corresponding and Collecting across Classes, Nations, and Empire

In October 1872, John Scott, the son of a tenant farmer from rural Scotland, wrote to Joseph Dalton Hooker, 'It has always been my wish to refund the sum Mr. Darwin so kindly gave me to enable me to come to India.' Corresponding from Calcutta Royal Botanical Gardens, where Scott worked as curator, he thanked Charles Darwin for securing him the position. A station otherwise beyond someone of Scott's means, Darwin's patronage involved not only a disinterested recommendation of Scott's scientific ability, but also financial support. Yet when Scott assumed their mutual interests transcended class boundaries and suggested they go into business together, the gentleman quickly reinforced hierarchies. Darwin enabled Scott to contribute to science, but blackballed him from elite societies. In the nineteenth century, British naturalists depended upon correspondence networks to collect information and specimens. The importance of these networks to eminent figures has been widely studied, but, even whilst relied on by men such as Darwin, networks of working-class naturalists remains neglected. This paper draws on the work of the Darwin Correspondence Project (Cambridge University, 1975-present) to ask what it meant for the most celebrated gentleman naturalist and a humble Scottish artisan to cooperate in botanical collecting. I address unity and disunity by exploring how status, class, and professionalisation were mediated through correspondence across Britain and Empire. Arguing that participation in a shared scientific culture could reinforce social stratifications, I support histories of science approached simultaneously from above and below.

Dubald, Déborah (European University Institute)

Nobody's Collection? Collecting for the French Municipal Museums, 1800-1870

There is always a local hero whose generosity 'made' the museum collection. These stories were key to the fashioning of the prestige and authority of the museum. However 'big' donations cannot be taken for granted as the essence of museum collections which were rather the result of a complex interplay between a multitude of actors: the museum conservator, private collectors, merchants or more random suppliers of specimens. Practices of collecting were less straightforward than they seemed. Considering the interactions between the collectors and suppliers of the museum and the skill of the museum director in developing (or not) a method for collecting for the museum contributes to calling into question the centrality of the museum in the circulation of specimens by interrogating the making of its authority. This paper will

SUNDAY 16 SEPTEMBER, 11.00-13.00

draw attention on the multiplicity of objects and collectors involved in practices of collecting using some cases of the French provincial cities in the nineteenth century. The exceptional will be examined in light of the mundane of everyday collecting, in order to illuminate whether or not natural history museums can generate a typical form of collecting for museums. More specifically, the variety of natural specimen suppliers and strategies of collecting reveal a general but unsystematic shift from a more 'traditional' way of collecting inherited from natural history cabinets, to collecting for the sake a municipal institution, which posed the problem of collection ownership, standardisation and professionalisation.

Madrua, Catarina (University of Lisbon)

'It was of a beautiful celestial blue, when it was alive'. Practices of collating information and shipping zoological specimens from the Portuguese Colonies to Lisbon (1865-1885)

'It was of a beautiful celestial blue, when it was alive' was one of many details not available to nineteenth-century cabinet naturalists in zoology museums. This description accompanied a shipment of two flasks containing snakes from the Portuguese colony of São Tomé in 1869 to the zoological museum in Lisbon. Earlier, in 1862, the Zoological Section of the 'Museu Nacional de Lisboa' had issued a set of instructions that were distributed to the colonies. They called for the collation, preparation, and shipment of zoological specimens back to Lisbon. The instructions requested participation in an 'imperious need of science and national decorum' represented in zoological knowledge and reified in the national museum's collections. As expected, the instructions did not predict all complications in isolated territories, but nor could they have predicted the different agencies and creativity of some of the collaborators, who acted as go-betweens, mediating nature, colonial life, and research in the metropolitan museum. This paper identifies differences and commonalities between some of the contributors to the Lisbon museum, and unpacks practices of collation, preparation, and mediation taking place in a distant colonial setting. With these contributions, the Lisbon museum assumed a relevant role regarding other European museums. From the contributors' perspectives, on the other hand, the museum was a means to achieve social recognition and participate in the advancement of the imperial agenda.

I111 VISUAL CULTURE AND BIOLOGY

Location: SciM – Dana Studio

Chair: TBA

Almeida, Maria Strecht (Instituto de Ciências Biomédicas Abel Salazar, University of Porto)

Between staining and drawing – Abel Salazar’s microscopic explorations of the Golgi region in mammalian cells

The present paper addresses the place of visual representations in scientific practice and its role in knowledge production. Specifically, it looks at the research developed in the early twentieth century by the histologist Abel L. Salazar (1889-1946). Medical doctor, professor, scientist and visual artist, Abel Salazar is a multifaceted figure of the Portuguese cultural setting of his time. Expelled from academia by political reasons, his research career has been relatively short. This paper examines his effort in the implementation and improvement of methodological approaches for the study of mammalian tissue slices, and particularly the work focused on the Golgi region in mammalian cells. The tanno-ferric method on which Salazar based his research enabled him to identify a specific area in this region, highly tannophilic and which he conceived, observing at the resolution then possible, as a distinct organelle from the Golgi apparatus itself. In a time when the existence of the Golgi was still controversial, these results disclosed part of its structure as it became understood later. Salazar’s writings about the procedure of microscopic drawing are another expression of the methodological concern that seems to pervade his research work. Building upon published texts and archival sources, my analysis takes into consideration aspects of unity and disunity in the dynamics of science and attempts an integrated account of those two different aspects of representation in Abel Salazar’s research work. I will argue that staining and drawing are closely linked tools in his work, both present at the level of knowledge production.

Jardim, Maria Estela and Vera Jardim, Nádía (CFCUL; CQE; University of Lisbon)

Serial photography, cinema and the physiological body at the turn of the 19th Century

Serial photography and cinema were used to measure, segment and quantify pathological movements in neurological diseases. With the collaboration of Muybridge, the neurologist Dercum (1856-1931) did some quantification in abnormal gait of his patients based on his chronophotographic serial photography of human locomotion (Dercum, 1895). Similar methodology was used by Marinescu (1863-1938) in the Romanian Hospital Pantelimon with the Lumière cinematographer: the frames of his films were transformed into line drawings by his collaborator Neyliès for the analysis of the decomposed movements (Marinescu, 1900). In the early 1920s the Portuguese neurologist and later Nobel prize winner in Medicine (1949), Egas Moniz (1874-1955), undertook a task of obtaining the radiographic imaging of the human brain, in order to visualize cerebral abnormalities, thus launching a new technique named angiography. Serial angiography was later used to measure the speed of blood in the brain with an instrument designed by one of his collaborators, the physician Pereira Caldas (Moniz, 1932). In this paper we will examine medical cases in this period 19th-early 20th centuries when measurements were performed in clinics and hospitals using serial photography and cinema. We will discuss to what extent these new technologies improved knowledge on the physiological body.

Rego Robles, Miguel Ángel (Instituto de Filosofía, CSIC)

A drawing notebook for the neurosciences: SRyC’s visual epistemology

Notebooks have been useful research objects for the history of science as artists’ drawing notebooks have been for the history of art. Also scientific drawing books are original objects for historicizing both the sciences and the plastic arts. This is the case of a notebook by Spanish neuroscientist Santiago Ramón y Cajal (1852-1934), whose notes were drawings of the neurons, essays in images of inflamed tissues and nerve endings in vertebrate animals. The

SUNDAY 16 SEPTEMBER, 11.00-13.00

drawing and text notebooks are considered as knowledge acquisition practices that are, as Elaine Leong (2013) has defined them, processes of "knowledge codification". I consider these drawn elements of his notebooks as epistemic visual and textual objects. In this communication I will present a history of a particular notebook, the one entitled by Ramón y Cajal himself as *Diario de Observaciones*, and to reconstruct its contents. For this aim I will focus on particular cell drawings and their shapes so as to propose a trajectory of a style of representing cells at the end of the 19th century by histologists and cytologist. Cajal's drawings supposed the continuation of the growing field of histology during the 19th century but, at the same time, established a rupture from the understanding of the nervous system of the brain.

Worliczek, Hanna Lucia (University of Vienna, Department of History, DK "The Sciences in Historical, Philosophical and Cultural Contexts")

Visual Cultures and Epistemic Judgement in Cell Biology – Tensions between Basic and Translational Research in Image-based Knowledge Production of the 1970s

Immunofluorescence microscopy (IFM) was established as an epistemic tool for Cell Biology during the 1970s by a relatively small number of researchers, mainly based in the USA and Germany, leading to a substantial transformation of the visual culture of the field. In this period, primarily knowledge about subcellular architecture was produced by IFM, ultimately defining the "biochemical anatomy" of the cell. Questions about function and mechanisms, described as being characteristic for Cell Biology after World War II, could not be addressed as such. IFM can be interpreted as a unifying factor between two lines of inquiry: basic and translational research, each having different epistemic interests, but working collaboratively on developing and establishing IFM. From a descriptive and morphological quality of knowledge produced jointly to some extent, motivations for applying IFM parted quickly, leading to a separation after a short phase of unity and collaborative actions. In this paper I aim to explore how the epistemic qualities of IFM-images were utilized differently in research and publication practice, and how their epistemic value was judged: By scientists doing basic research and by those doing translational research, where differentiating the healthy from the pathological was equally important as the characterization of phenotypes of cancer cells. I aim to carve out the dynamics and effects of this alteration of unity and disunity in the field of Cell Biology with regards to the relevance of knowledge producible by the very same technique, that was accompanied by an alteration between morphological and functional epistemic interests.

Lovecchio, Nicola (Università degli studi di Bari "Aldo Moro")

Nature in art and art in Nature: the monistic unity in Ernst Haeckel's thought

During the conference held by Haeckel on 1892 in Altenburg, he has defined the biological monism concept. It has undergone an epistemological shift in the first half of XX century: its evolution starts from synthesis attempt to reality fragmentation in her single aspects. In fact, sciences have increased experiment activities and Haeckel's monism has failed meeting Ernst Mach's economical principle (1901). So, it has lost his main feature: the reality synthesis. The objective of this discussion is to get back the unity theme of science and sciences, in particular biological, which will be tracted in this venue according to art. With Haeckel's point of view, we will show the art and science ambivalent union. We will make so thanks to morphological descriptions about living beings and their illustrations which we find in *Kunstformen der Natur* (1900). This work will be as much subliminal as explicative because the biological law of recapitulation - heuristic complement of Darwin's evolution theory - will find an explication in artistic forms of nature. Finally, Haeckel can be a cause for reflection to discuss how the visual history of science is important to understand theories.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S37 UNITING AND DISUNITING RESEARCH THREADS: THE COLLABORATIVE RELATIONSHIPS BETWEEN GIUSEPPE LEVI, VIKTOR HAMBURGER, RITA LEVI-MONTALCINI, AND JOSEPH NEEDHAM

Location: IoE – Room 802

Chair and Commentator: Richmond, Marsha L.
(Wayne State University)

Organiser(s): Dröscher, Ariane

Our session will approach this year's general topic – Unity and Disunity – from the point of view of collaborative relationships. The lives of Giuseppe Levi (1872-1865), Viktor Hamburger (1900-2001), Rita Levi Montalcini (1909-2012), and Joseph Needham (1900-2001) intertwined in multiple ways, forming in some moments clusters and breaking up in others. A common scientific bond among the four scientists, who were active in Italy, Germany, Great Britain, and the US, were their innovative contributions giving rise to neuroembryology. Yet the investigative paths that led to this new field were complex. Very roughly speaking, the “Italian” approach, starting with Levi, focused on the phenomena of life and death, of senescence and immortality, and based its research on the methodology of cell culture, whereas the “German” one concentrated on Spemann's concept of the “organizer”. In the 1930s, these threads continued in Great Britain and the United States, where they developed in unexpected ways. The innovative investigations of Hamburger, Needham and Levi Montalcini elaborated on and combined methodologies and concepts from neurology, embryology, developmental biology, and molecular biology, eventually resulting in the seminal discovery of the nerve growth factor (NGF) in the 1950s. In particular, alongside with a comparison of the philosophical and cultural underpinnings of their scientific and experimental works, the session seeks to shed light on the complex collaborative relationships between the four researchers. Those relationships began with mentorship by Levi and Hamburger and concluded with the rise of Levi Montalcini to global leadership in science, science policy, and civic engagement. Needham, who started like Hamburger from a Spemannian fundament, represents an alternative path yet with numerous intersecting instances.

Dröscher, Ariane (University of Verona)

Death, immortality, and regeneration: Giuseppe Levi's dynamic approach to neuron development

Giuseppe Levi (1872-1965) is mainly remembered for his neurohistological studies, for his pioneering role in the development of cytological techniques like cell culture and microcinematography, and for having three Nobel students – Renato Dulbecco, Salvador Luria, and Rita Levi Montalcini. His relationship with Levi Montalcini was particularly strong and climaxed during the years of persecution, when they first flew to Belgium and then worked in a secret laboratory in Turin. They had many things in common: personal backgrounds, philosophical views, and scientific preferences. When Rita Levi Montalcini left for the USA, Levi's imprint continued to lead her way. My talk will analyse this “Italian” path towards neuroembryology and the discovery of the nerve growth factor (NGF). Special attention will be given to Levi's dynamic and holistic conception of structure and his studies on the phenomena of life and death, of senescence and immortality.

Jiang, Lijing (SHI) (in absentia)

Seeing Experiments Differently: Viktor Hamburger and Rita Levi-Montalcini's Study of Neuron Development before 1950

SUNDAY 16 SEPTEMBER, 14.00-15.30

In the late 1940s, Italian biologist Rita Levi-Montalcini (1909-2012) conducted a series of experiments in the laboratory of German-American embryologist Viktor Hamburger's (1900–2001) to assess their different views about how central neurons develop. Hamburger formed a hypothesis of inductive growth to explain the central neuron development in chick embryos in 1934. Around 1940, with evidences gained through silver impregnation technique, Levi-Montalcini nevertheless hypothesized that cell death, a phenomenon newly found in neuron development, is more important. Their collaborations resulted in a 1949 paper in which Hamburger revised his inductive view and incorporated cell death as one biological strategy in development. In the collaboration, Hamburger and Levi-Montalcini expressed disparate views about the same series of experiments. Having been trained in the Hans Spemann laboratory that embraced the idea of induction, Hamburger saw these experiments as empirical tests to solve a theoretical puzzle. Junior in her research field, Levi-Montalcini on the other hand was eager to establish a scientific career and felt insecure about the validity of classical experimental embryological techniques. She thus emphasized the technological power of experiments in constructing phenomena. As a result, the two researchers interpreted the phenomenon cell death with different emphasis. While Hamburger downplayed the novelty of the phenomenon, Levi-Montalcini saw the power of demonstrating new phenomena as a justification for the method. Their diverse view demonstrated the divergent disciplinary foundation of what we now know as neuroembryology.

Abir-Am, Pnina G. (Brandeis University)

A combination of Marie Curie and Maria Callas? Gender, ethnicity, & discovery in the life of Rita Levi-Montalcini, (1909-2012) superstar scientist

Rita Levi-Montalcini's (hereafter RLM) life and career, offer a rare opportunity to explore the intersection of 20th Century history & identity politics (gender, race/ethnicity, class) with scientific discovery. As a scientist she is best known as co-discoverer of the nerve growth factor, or NGF, with her collaborator Stanley Cohen, when both worked at the Wahington University in St. Louis, Missouri. Their discovery was recognized with major awards, such as the Lasker, the LG Horowitz/Columbia Univ., the Rosenstiel/Brandeis Univ. and the most coveted of all, the Nobel Prize in 1986. Since RLM's collaboration with her mentors Giuseppe Levi (at the University of Turin, Italy, until 1946) and Viktor Hamburger (at Wahington University in St. Louis, Missouri, 1946-1952) will be covered by speakers Ariane Cora Droescher (who is also the session organizer) and Jiang Lijing, respectively, this talk will focus on RLM's resourceful construction of her global persona as an embodiment of 20th Century history. Dimensions to be discussed include: - how a scientist can survive under a fascist regime without compromising oneself or one's research? - how a woman scientist can survive patriarchal society in both Italy and the US, as well as sexism in the scientific community, so as to persuade the world that despite debts to older and younger collaborators, the discovery reflected her own scientific genius? and last but not least, how a superstar scientist could promote civic international engagement in various causes ranging from science education to social justice.

Passariello, Alessandra (Ben Gurion University)

[Needham's search for the chemical identity of the neural organizer]

After examining the fate of Hamburger's inductive model of nerve growth through the encounter with Levi Montalcini's model of cell death driven neural development, we explore another, biochemical amendment to the inductive model: the search for the chemical identity of the neural organizer by Joseph Needham. In 1931 and again in 1933, Needham, together with the biochemist Dorothy Moyle Needham and the embryologist Conrad Hal Waddington, joined Otto Mangold's laboratory at the Kaiser Wilhelm Institute of Biology in Berlin-Dahlem. Those two stays condense Needham's first personal contact with the German tradition of Experimental Embryology, the same basin, which gave rise, under the supervision of Hans Spemann, to Hamburger's scientific career. Needham's aim was to gain mastery in the micro-surgical techniques, which allowed the experimental dissection of what was called at the time

SUNDAY 16 SEPTEMBER, 14.00-15.30

the “organizer effect”. At that time, following a longstanding tradition, the action of the organizer was framed under the explanatory concept of "induction" and Needham's first attempt as a biochemist aimed at finding the chemical identity of the inducing substance. Biochemical assays gradually made this concept shift into the more nuanced concept of evocation and finally into the model of a biochemical pathway in gear with the metabolism of the embryo. Needham's research thus provides another important shift in the explanatory role played by the concept of induction. While Spemann's heritage in Hamburger's research submitted to Levi-Montalcini's model, this same heritage followed in Needham a different though arguably parallel path.

S63 THE UNIFYING ROLE OF VISUALISATIONS IN EARLY MODERN SCIENCE

Location: IoE – Room 804

Chair: Basse, Christoffer Eriksen

Organiser(s): Basse, Christoffer Eriksen; Georgescu, Laura; and Present, Pieter

The sciences make use of a wide range of visual practices, aids, and devices to reason about phenomena, to represent theories, and to illustrate observations. Historians of art as well as historians of science have shown that imagery has been used in the most diverse areas of early modern science: from natural history to the mixed-mathematics disciplines, and from mechanics to natural philosophy (e.g. Baldasso (2006), Hunter (2010), Kusukawa and Maclean (2006), Mahoney (2004), Lüthy and Smets (2009)). Today, it is widely accepted that visual imagery – be they images, tables, or diagrams – is an important instrument for knowledge communication (e.g., Kusukawa 2006). What remains still somewhat controversial is claiming that visual media (and visualisations) are not simply *instrumental* to knowledge production, but have a substantial, non-trivial, and irreducible role to play in knowledge production. Differently put, visual media have *epistemic* value. The goal of this symposium is to substantiate the claim that visualisation is conducive to knowledge: it is by no means a redundant detour in the route to propositional knowledge, or to a propositional argument – it cannot be discarded without epistemic loss.

The individual papers of the symposium will present different cases in which visualisation plays a unifying role in early modern science: Diagrams were used to bridge theory and observation in the physico-mathematics of Petrus van Musschenbroek; Edward Wright reasoned with diagrams in order to specify a technique for finding the latitude at sea; and Nehemiah Grew used his botanical illustrations to negotiate the problem of scale.

Present, Pieter (Vrije Universiteit Brussel)

Cum Physica conjuncta fuit Mathesis: Petrus van Musschenbroek (1692-1761)'s use of diagrams in his physico-mathematics

Following the example of Newton, the Dutch natural philosopher and professor Petrus van Musschenbroek emphasised the indispensable role of mathematics in the practice of physics. At the same time, van Musschenbroek also warned that one should be conscious of the difference between physical demonstrations and the “pure demonstrations” provided in mathematics. Mathematics works by reasoning on “pure ideas”, disregarding the question whether or not these ideas correspond to physical reality. Therefore, mathematics can only be fruitfully applied in physics through the mediating role of experiments. In this presentation, I will analyse the role of diagrams and images in van Musschenbroek's textbooks in unifying mathematics with physics. On the one hand, I will explicate van Musschenbroek's own views on the relationship between mathematics and physics and how they were informed by his empiricist epistemology. I will then show what role, according to him, experiments could and should play in physical demonstrations. After that, I will analyse the functions diagrams can have in this view. On the other hand, I will analyse the way diagrams and illustrations were put to work by van Musschenbroek in the teaching of physico-mathematics. I will show how these visual elements played a unifying role, helping the student to link together geometry, natural philosophy, and his observations of demonstration experiments performed by van Musschenbroek in his courses.

Georgescu, Laura (Rijksuniversiteit Groningen)

Rotating magnetised needles diagrammatically: Edward Wright's use of diagrams in mixed mathematics

SUNDAY 16 SEPTEMBER, 14.00-15.30

Novel, but conceptual content does not come pre-made and already fit for the scientific problem at hand. It takes work to “make” a concept (or cluster of concepts) to be *that* concept and not another, to tailor a concept such that it responds to local problems, to be tuned to the other relevant concepts, and so on. In this presentation, I will focus on how diagrams (and diagrammatic reasoning) contribute to the scientific work of conceptual determination. More specifically, I defend the epistemic function that visualisations have in the sciences by showing that, sometimes, reasoning with and through diagrams is necessary in order to specify the relevant conceptual content at stake in the investigation at hand. I will do this by looking at how Edward Wright in his *Certain Errors in Navigation* (published in 1599 and republished with revisions in 1610) reasoned with diagrams in order to specify a technique for finding the latitude at sea. The technique makes use of Gilbert's account of magnetism– especially his conception of magnetic inclination combined with basic knowledge about spherical trigonometry. It involves the generation of tables of latitude calculated relative to values of magnetic measurements of inclination. The presentation will not delve much into the method of calculation itself. Instead, it will focus on explaining *why* the method looks the way it does. I will show that the relevant conceptual content informing the trigonometry relies on a distinction between arcs of rotation and arcs of declination, distinction which is not simply “given” in experience or “given” in an experimental setup, but it is construed in the diagrammatic interpretation of an experimental setup. If so, then the relevant conceptual content informing the trigonometry is determined by choices in the construction of the relevant diagram(s) and by the specific ways in which relevant empirical variables were transferred diagrammatically.

Basse, Christoffer Eriksen (Aarhus Universitet)

The “reall bignesse” of specimens: Nehemiah Grew's botanical illustrations as negotiation of scale

In a recently rediscovered notebook containing Robert Hooke's first sketches of what would become the schemas of the *Micrographia* (1665), some of the magnified insects are paired with drawings of the same insect, but according to its “reall bignesse”. This graphic strategy of representing both scales next to each other was taken up again and applied systematically by Nehemiah Grew in his *Anatomy of Plants* (1682). Here, all illustrations of roots, branches and seeds are accompanied by a small drawing representing the unmagnified specimen. In this presentation, I will show how early modern microscopists, and Grew especially, negotiated the scalar relationship between the visible world of unenhanced perception and the sub-visible world of microscopic observations. They did this, I argue, through visual as well as verbal description. The challenge for observers like Grew was that specimens could look very different when studied under the microscope. For instance, Grew showed that the sap-vessels of roots hitherto believed to be a continuous structure actually – when viewed through the microscope – was revealed to be discontinuous and consisting of small bladders. By being very careful to specify how objects looked with and without using the microscope and by presenting different scales next to each other in his tables, he was successfully attempting, I argue, to frame a unified conception of nature in which different scales were commensurable with each other.

S10/2 THE BUREAU DES LONGITUDES (1795-1932): COOPERATION AND COMPETITION NETWORKS

Location: IoE – Room 822

Chair: Fox, Robert

Organiser(s): Schiavon, Martina, and Rollet, Laurent

Created in 1795, the Bureau des longitudes was an international academy devoted to science and technology: a place for collective expertise and an advisory committee for the French government. It played a primary role in the organization and development of astronomy and celestial mechanics, the adoption of the decimal metric system, the

SUNDAY 16 SEPTEMBER, 14.00-15.30

definition and implementation of time standards, the production and transmission of time signals, the development of earth physics and geodesy and the organization of major scientific expeditions. In the 19th and 20th centuries, its prestigious members – scientists, military and naval officers, and precision instrument makers – organized and participated in various national and international projects: the international geodetic association, the spread of standardization and the study of units of measurement, the dissemination of time signals, the adoption of the Greenwich meridian, among others. The Bureau des longitudes is thus a crucial place to study various cooperation and competition processes: from science to technology via the military, from scientific diplomacy to politics through economy, and vice versa. This symposium will be devoted to the analysis of such questions, in particular: § Circulation and priority conflicts concerning instruments and scientific discoveries § The influence of war on scientific organizations § Cooperation, rivalry and priority disputes § Conflict and collaboration between amateur and expert § Editorial rivalries (for instance between *La connaissance des temps* and other ephemerides) § Metrology, the metric system, almanacs and annuaires § Professional and institutional rivalries (scientists, military men, precision instrument makers, etc.) § Unity and discord between centre(s) and periphery(ies) The weekly minutes of the Bureau des longitudes from 1795 to 1932 are available online at <http://bdl.ahp-numerique.fr>.

Schiavon, Martina, and Rollet, Laurent (both Université de Lorraine)

1919: War and Post-War debates inside the French Bureau des longitudes

The Bureau des Longitudes was created in 1795 in Paris by Henri Jean-Baptiste Grégoire. Since its foundation, this small academy has been in close contact with the French Academy of Sciences; indeed, until today, a large part of the members of the Bureau – be they mathematicians, astronomers, geographers, engineers, etc. – have been recruited within the Academy. During the First World War, the Bureau des Longitudes maintained its meetings but, because of their mathematical, technical and geographical expertise, its members had to deal with many military and diplomatic questions: the circulation of astronomical information (ephemeris, small planets, etc.) and the organisation of international scientific associations without German influences, the recovery of Alsace and its astronomical Observatory in Strasbourg. The purpose of this talk is to explore continuities and discontinuities between War and Post-War debates through the minutes of the Bureau des longitudes, a new and original source for the history of science (<http://bdl.ahp-numerique.fr>). We will do this focusing on one year of weekly minutes: 1919.

Le Lay, Colette (University of Nantes)

Hippolyte Fizeau's fight against a magnetic explanation of sunspots and solar flares

Everybody knows the Doppler-Fizeau effect and Fizeau's experimental determination of the speed of light. But we want to focus on a less-known episode: Fizeau's fight against a magnetic explanation of solar activity. As a member of the Bureau des longitudes, during the weekly meetings, he gave negative accounts of the hypotheses of William Ellis (1828-1916) and Johann Rudolf Wolf (1816-1893) drawing a link between solar activity and magnetism. He found an ally in William Thomson (becoming Lord Kelvin in 1892). The procès-verbaux of the Bureau des longitudes (now online) give a vivid image of Fizeau, thirty years after the apex of his career, resisting to a new «paradigm».

Soulu, Frédéric (Université de Nantes)

French Time and Maghreb Space: the factory of time in the empire

If the actors of French astronomy in the Maghreb during the colonial period and protectorate (19th and 20th century) are the manufacturers of the time, the State relies on the Bureau des longitudes in Paris which, as pointed out by the organizers of this symposium, plays "a direct

SUNDAY 16 SEPTEMBER, 14.00-15.30

role in the administration of the state". Tensions and competitions are structured along several axes: between European actors in the imperial territories and scientific rulers of the metropolis, between European occupants and indigenous populations. The communication aims to describe the slow emergence of an Algerian hour in the colonial era. In the 1840s, public clocks were supposed to compete with minarets. The coordination of clocks on the territory becomes possible only with the telegraph in the years 1860. With the help of the Bureau des longitudes, the astronomer of Algiers, connected to the port economy of the hour, impose little by little his clock. As distribution of time is strategic for the appropriation of Saharan spaces in the early 1880s, a group of scientists, some of them military, is installed in Algiers. Coming from Montsouris in Paris, they underlined a break with the past local practices. The Algerian time contributes to the construction of the empire under the Bureau supervision. This communication highlights the circulations between the metropolis and peripheries, actors and ideas, but also circulations within peripheries. It relies on unpublished sources of the General Government of Algeria, the Ministry of Instruction publique and the minutes of the Bureau des Longitudes.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S47/1 MEANINGFUL COLOUR: EPISTEMOLOGY OF COLOUR IN THE SCIENCES (EARLY MODERNITY TO TODAY)

1. COLOURS AS SYMBOLS: EXPLORING THE REPRESENTATIONAL-MIMETIC-DIVIDE

Location: IoE – Room 828

Chair: Berry, Dominic

Organiser(s): Bock von Wülfigen, Bettina

From amazingly colourful antique relics to the attempts to standardise colours in biomedical imaging – colour is gaining in relevance in the sciences. Yet the epistemic role of colour, its long-standing neglect due to historic symbolic, in part gendered, ascriptions, and the function of colour in visualizations for internal scientific use have not received much attention in the sciences and humanities to date. This is especially the case for non-mimetic colour use. With the term non-mimetic we refer to colours that are not applied to mimic colours of nature (such as the sky blue, urine, or plant colours) but are of (sometimes hidden and unintended) semiotic relevance. The internal use of colour in the sciences raises different epistemological questions to those that arise with images for external communication. The choice and symbolism of colour in the latter case is guided to a greater degree by a need for simplification and considerations as to the expectations of a broader public. Coloured images for internal scientific use emerge during the research process itself (as a medium for self-reflection) or are produced in appliances and used for intersubjective communication and to obtain feedback from the scientific community. Digital publishing has enhanced the use of colour in scientific images, in contrast to the costly use of colour in print media, whilst the globalisation of the scientific community challenges the idea of universal colour symbolism. Meanwhile standardisation of colour applications in scientific images seldom occurred and occurs, leaving a broad diversity of colour symbolism within fields. All this raises the need for colour awareness. The history of the ontology of colour has already gained some attention in history of science. It is of course not to disentangle from its meaningful use or non-use. Still, the session rather focuses on the meaningful application of colour and its interpretation by the sciences – and the history of such theorising. It explores the colour conventions and strategies in scientific images that predominate today as well as in historical perspective and across disciplines. This encompasses the issue of the neglect of colour as an object of scientific self-reflection and as an object of the humanities' research on the sciences. In brief: in this session we investigate the epistemic dimensions of colour in the sciences, across disciplines and across history.

Friedman, Michael (Humboldt University Berlin)

Coloring the fourth dimension? Polytopes and curves at the end of the 19th century

Starting from the 1850s, n - and 4-dimensional spaces were taken into serious mathematical consideration. This prompted questions regarding the visualization of 4-dimensional mathematical objects, being problematic to visualize. I aim to show, focusing on two examples: 4-dimensional polytopes and complex curves, that although these two belonged to different mathematical traditions, the solution that several mathematicians found for the problematic of visualization was via the usage of colour. To consider the first example, as just as in the 3-dimensional space one can find the five convex regular polyhedra (i.e. the Platonic solids), one can find six convex regular 4-dimensional polytopes. Ludwig Schläfli discovered this in 1852, but the question remained – how can one visualize these polytopes. In 1888, Alicia Boole Stott contributed to Charles Howard Hinton's book *A new Era of Thought*, describing ways to grasp the fourth dimension. In Hinton's book, one of the ways to visualize a 4-dimensional cube is via multicolored cubes; when assembled, they could be used to visualize a hypercube in the fourth

SUNDAY 16 SEPTEMBER, 14.00-15.30

dimension. Boole Stott was familiar with other models, which represented sections of all the four-dimensional polytopes, and built them accordingly. The question about the visualization of complex curves was answered similarly.

Moreau, Jean-François (Paris Descartes University); Pisano, Raffaele (Lille University); and Corr as, Jean-Michel (Paris Descartes University)

From Vesale to Pourcelot via Harvey and Pulsed Color Doppler Ultrasound

For centuries and except on blackboards and positive X-Ray films, anatomists and radiologists used shades of grey with the blood vessel walls in black and the lumen in white. "It has been shown by reason and experiment that blood by the beat of the ventricles flows through the lungs and heart and is pumped to the whole body", physiologist William Harvey said in 1628. Then, when printers could feature color scales, the oxygenated aortic blood has been colored in red, the caval venous system in blue, the lymphatic one in yellow. Color Doppler real-time digital ultrasound is the only medical imaging technique using blue and red coding for hemodynamics but this doesn't reflect the O₂ blood saturation. The ultrasonic probe recollecting the echoic waves plays the role of the "heart". In red the wave figures the blood flow coming to the probe, the wave in blue is centrifuge. Moreover the lighter the flow the faster. Heterogeneous structures induce the aliasing phenomenon. Pulsed Doppler ultrasound provides the associated vision of the curve of the blood flow. Artifacts induced by the sonographer malpractice are current causes of misinterpretation of intrinsic or extrinsic syndromes. Skilled dopplerists only are able to "think" Doppler's language.

Rossi, Michael (University of Chicago)

"Green is Refreshing": Colour and Healing in Nineteenth-Century Medicine

Among the many meanings of particular colours in the European and American medical literature of the early 19th century, the colour "green" was especially associated with qualities of healing, recuperation, and rejuvenation. From manuals on best nursing practices, to treatises on workplace health, to advice for better living, expert and popular healers alike tended to subscribe to the commonplace wisdom that the colour green was a salubrious and efficacious way of reviving both flagging spirits and ailing bodies. This paper examines the symbolic, semantic, and practical dimensions of the colour green in nineteenth century medicine — from its mimetic associations with nature and growth, to its place in formalising otherwise occult physiological processes, to its role in regulating visual and bodily health and conduct. Ultimately, the healing properties of the colour green for nineteenth century medical practitioners comprised part of a larger attempt to describe a novel relationship between mind and body, and science and sensation. This relationship was required at once to preserve the common-sense distinction between imponderable soul and material corporeality, while allowing for novel epistemologies of the sensing, feeling, thinking body – including (but not limited to) physiology, psychophysics, and (eventually) biomedicine.

Bock von W lfingen, Bettina (Humboldt University, Berlin)

Mimetic and Symbolic Colour Use in Scientific Diagrams: Biochemical Pathways

Scientists draw chemical pathways since Kekul s times around the end of the 19th century. Those were reaction pathways entailing only some elements. The terminology „biochemical pathways“ or „metabolic pathway“ begins to appear recently in the 1940s, labelling charts such as the one of the first metabolic path, the Glycolysis, which was then for the first time fully put together. In the following decades more and more charts of different metabolic paths in humans, animals and plants were published. Ultimately, these pathways used specific symbolic colour codes. One of the internationally best known had been set by Gerhard Michal who as a PhD student at B hringer in 1965 started to draw complete pathways integrating all metabolic paths known in organisms to that day into one map. These were updated in the next editions to come. All were hand-drawn until 2002. The colours used were red, green, blue and the achromatic black for the fleches between the metabolised molecules. Since 2014 a first online-

SUNDAY 16 SEPTEMBER, 14.00-15.30

version of this map was published and promoted as 'interactive', as different parts could be enlarged. Since the end of the 1990s however, and partly together with new cybernetically informed disciplines such as systems biology, different digital-tools for natural science's use appeared in publications in print and online.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S14/2 THE EMERGENCE OF COMPUTATIONAL SCIENCES

Location: IoE - Room 731

Chair and Commentator: Agar, Jon (UCL)

Organiser(s): Hashagen, Ulf

The digitization of the scientific world began after World War II when scientists started using the recently invented electronic digital computers to manage complex calculations and computation problems in science and engineering. While on the one hand computer science was established as a new scientific discipline in the following decades, on the other it became almost natural for scientists to use computers as a scientific instrument or research technology in the last third of the 20th century. As a consequence in some scientific disciplines novel computational methods were widely used. In mathematics numerical analysis was transformed by the computer from a former marginal sub-discipline into an important research field. Hereby only the computer as an enormously fast and programmable machine made it possible to process the many newly invented numerical methods for the solution of algebraic and differential equations and other mathematical problems. Furthermore a bunch of computer-based techniques arose in the following decades in various disciplines and transformed the researchers' work in fundamental ways. For example the well-known Monte Carlo Method was created in the context of war research in atomic physics, algorithmic approaches and scientific visualization in application fields. Among these new research technologies computer simulation became the probably most important tool, and in scientific communities the question appeared whether simulation is a third scientific method beyond experiment and theory. Moreover the scientists' eagerness for high performance computing devices had also a strong impact on the hardware development (supercomputers or parallel processing) and resulted in the setting of computer centers as service providers for scientific research in academic institutions all over the world. Moreover, in various disciplines forms of computational sciences emerged, such as computational astronomy, computational fluid dynamics and computational chemistry. While only few aspects of this eminent historical development have been explored so far—such as supercomputing at the large national research laboratories, the use of the computer in high-energy physics and in X-ray crystallography and the efforts to computerize bio-medical research—the field has been dominated by studies on computer simulation, mostly with a strong philosophical orientation. In general the emergence of computational sciences and the use of developments have not become a central topic for historians of science and technology so far and there are still large gaps in the knowledge on the history of computational sciences. This symposium aims at considering different developments of computerization and computer-assisted methods in various periods, nations, societies and cultures. These views support the interpretation of disunited paths of scientific disciplines to their computational continuations. The studies in this symposium will highlight relations between these scientific disciplines and aspects of politics, technology, and economics, which are part of the process that terminates in the computational turn. Finally, the symposium refers to the question whether the particular developments of disciplines are just parts of one unique process of “computationalisation”. Is the second half of the 20th century the beginning of an era of computational sciences or rather of a unified computational science?

Alberts, Gerard (University of Amsterdam)

Continuities and discontinuities in the rise of computational approaches

SUNDAY 16 SEPTEMBER, 14.00-15.30

The same historical phenomenon of growing use of computers in the sciences appears with strong continuities, when looked upon from the perspectives of computational methods developing and spreading, and appears with bumps and hiccups when observed from the side of the disciplines and their methods.

Perhaps the oldest right of birth of a scientific practice called computational, is held by CFD, Computational Fluid Dynamics, when it gradually superseded Aero- and Hydrodynamics; or in the German speaking world “Strömungslehre”. The practices, around the increasingly automated machinery show strong continuities. Certainly, fields like astronomy, or crystallography were at least as computer-intensive, but these did not bother to designate a branch as “computational”. By contrast a plethora of disciplines followed suit of CFD and developed computational niches, from computational chemistry and computational physics in the 1960s to computational management science in the 1980s. These niches were quite innovative, but in an incremental way, showing continuity. From the perspective of the receiving disciplines a different picture emerges, that of a methodological and epistemic revolution. For example, computational chemistry, like a cuckoo’s egg, developed from niche to dominant approach, marginalizing other approaches. By the turn of the millennium, the computational approach had become the predominant one in chemistry. It had become “only natural” to use computers and computational methods in every step of chemistry, from searching literature, to searching components with specific qualities, to reformulating basic equations, and to doing experiments in virtuality. Seen from the receiving end, becoming “computational” implied revolutionary discontinuities in methods and in ways of knowing. What was considered to be the “natural approach” had undergone drastic changes. Continuities and discontinuities make the historian acutely aware that it makes all the difference which perspective is chosen in rendering the “rise” of computational approaches.

Borelli, Arianna (Technische Universität, Berlin)

Beyond “artificial reality”: The many faces of Monte Carlo computations in early particle physics

The classical reference on the history of Monte Carlo computations is Peter Galison's (1997) study of their origin in nuclear weapon research and subsequent diffusion in scientific and engineering practices as an “artificial reality” in which experiments could be virtually performed. Casting doubts on some aspects of this picture, I will show how the view that Monte Carlo computations “simulate” reality was initially not so dominant as would be the case later on, and how the Monte Carlo method could be assimilated not only to experimental practices, but also to theoretical ones. Using examples taken mainly from early particles physics I will argue that, depending on the context, the “same” Monte Carlo computation could be seen as a simulation of physical processes, as a tool to numerically estimate analytical expressions or as a means to represent theoretical models of particle interactions. Only later on did the idea that Monte Carlos “simulate” reality became dominant, and it should not be more or less implicitly regarded as a “natural” consequence of technological developments in computer science, as often done today. My presentation addresses various issues at the core of the symposium, especially the question of whether processes of “computerization” in different areas of science and technology can be seen as mutually related, and how far, and for which time period, it may be historically plausible to speak of an overarching process of “computationalisation”.

Seising, Rudolf (Deutsches Museum, Munich)

Computational Statistics as a Fusion of Data Science and Artificial Intelligence

The cybernetic idea of constructing “devices out of logical elements with neuron-like properties” resulted in McCulloch and Pitts’s “logical calculus of the ideas immanent in nervous activity” (1943). In 1949 the neuropsychologist Hebb explained the concerted function of living neural “cell assemblies” as processing units and tried to explain “learning” and when the psychologist Rosenblatt established his theory of “perceptrons” as a class of brain models” (Rosenblatt 1958) he used a model of Hebbian learning. Another path to analyze learning

SUNDAY 16 SEPTEMBER, 14.00-15.30

behavior started with statistical work on biological classification (Belson 1959), verbal learning (Feigenbaum 1959) and concept learning as “experiments in induction” (Hunt, Martin, Stone 1966). Statisticians construed binary segmentation programs (Morgan and Sonquist, 1963) and algorithms for matching and prediction (Belson 1959) in data sets. These works resulted in the new field “data analysis” (Tukey, 1962). Some decades later the discipline of statistics stood at a crossroads (Friedman 1997). The different disciplinary backgrounds, statistics and machine learning, resulted in a dissimilar understanding of the mathematical tools to analyze data of random or complex processes. The data modeling approach is based on the assumption that a given stochastic model generates the data and that the statistician aims to estimate some probability distribution. Instead, members of the machine learning assumed that a complex but unknown “mechanism” generates present data. Using an algorithm, they tried to imitate (simulate) the observations, which remains an optimization problem (Breiman 2001).

I130 MATHEMATICS 2

Location: IoE – Room 736

Chair: Nocks, Lisa

Cerroni, Cinzia and Brigaglia, Aldo (Università di Palermo)

The “Circolo Matematico di Palermo” and the first world war: the crisis of scientific internationalism

The year 1914 for the “Circolo Matematico di Palermo” was a wonder-year, but also a very difficult one. It had achieved some prestigious goal: with almost 1.000 members, the Circolo was the more important mathematical association in the world (from a numerical point of view, at least); it had two thirds of members from abroad; the editorial board of its journal (the *Rendiconti*) was at its highest level (Hilbert, Klein, Borel, Picard, Fredholm, Moore, Volterra, Segre, Castelnuovo, Enriques, Bianchi, ...). But, on the contrary, many new difficulties had appeared: in the same year the founder and president of the Circolo, Giovan Battista Guccia, died and the first world war broke out, with the well-known consequences on the international relations among scholars. The new director of the *Rendiconti*, Michele De Franchis, had to face a very awkward situation. While he intended to be faithful to the ideals of scientific internationalism, some members of the editorial board (particularly Picard and de la Vallée Poussin) strongly demanded the exclusion of the German associates. Since 1914 to 1928 the Circolo was perhaps the only European scientific association with German (Hilbert, Landau, Courant) as well as French associates. During the '30s, the nationalist politics of the fascism and above all the racial laws will give a deadly blow to the Circolo as an international scientific association. We will use the rich correspondence in the Circolo's archives to shed some light on this.

Ciesielska, Danuta (Institute for the History of Science Polish Academy of Sciences, Warsaw)

Young Poles in Göttingen: A Difficult Struggle for the Unity

At the turn of the 20th century University in Göttingen was a “world Mecca” of the scientists. Students from all over the world were arriving to this university to study under the supervision of notable scientists: David Hilbert (1862–1943), Felix Klein (1849–1925), Constantin Carathéodory (1873–1950), Ludwig Prandtl (1875–1953), Hermann Minkowski (1864–1909) and others. At that time, international communication in science and international scientific collaboration started. Göttingen was one of the centres of the united world of scientists. Young people arriving there wanted to become a part of the “international scientific union”. Among those who came to Göttingen were young men and women united by Polish nationality and/or language. They formed quite a large group, so staying in Göttingen gave them an opportunity for discussions in their mother language. During these discussions, some of them were dreaming about “independent Poland” and “national science”. In November 1918 three parts of Polish lands, annexed in the end of the 18th century by Austria, Prussia and Russia, united into one independent country – Poland. Educated in Göttingen Polish mathematicians, physicists and astronomers were *crème de la crème* of Polish scholars. In the years after World War I they manage to combine two really different ideas, i.e. “national” and “international” science. In the talk I will present some results of research concerning this phenomenon.

Michel, Nicolas (University Paris-Diderot (Paris VII))

Escaping the gaze of the Gorgon: On the permanent reshaping of mathematical objects

A long-standing problem in the historiography of mathematics is that of reconciling the supposedly atemporal and universal character of mathematical truths and objects with the multiplicity of concrete practices, but also of conceptualisations of said objects. In this talk, we explore a case-study borrowed from the history of 19th century geometry, which brings this difficulty to the fore. In the wake of important discoveries by French geometer Michel Chasles, several mathematicians, anchored within radically different scientific communities, set out to

SUNDAY 16 SEPTEMBER, 14.00-15.30

expand on his results. Each used what they considered to be the adequate mathematical tools for modern geometrical practice. In so doing, not only did they end up with incompatible notions of an object as elementary as a conic, but also with a robust disagreement on the very veracity of one of Chasles' central claims. Our aim is to provide an historical account of this episode which explores the material techniques and resources used in the shaping of these incompatible notions of geometrical objects. We then compare these concrete practices with the normative discourses held by these actors on what constitutes a proper mathematical investigation. Exploring how mathematical objects are shaped and twisted through the displacements from one such "mathematical laboratory" to another, we claim, allows for an outlook that preserves the unity behind the intellectual dynamics at play, without subsuming the originality and peculiarity of each of these conceptualizations, as a reading informed by recent developments in algebraic geometry would necessarily do.

Besler, Gabriela (University of Silesia in Katowice, Poland)

Unity and Disunity between Gottlob Frege and Giuseppe Peano on the Basis of their Correspondence in the Years 1891-1903

Frege – Peano correspondence contains 12 documents and was started before 1891 by Peano, who sent Frege his papers. Definitely, there was a unity of their aims in mathematics: to improve it by logic. As Peano wrote, they had much to gain from the parallel between their systems: Peano's mathematical logic and Frege's conceptual notation. They compared their symbolisms: Peano's sign of deduction and Frege's conditional stroke; quantifications and its understanding. Peano translated a number of Frege's formulas into his mathematical logical symbolism. Frege praised Peano for introducing two kinds of propositions: general and singular. Both Frege and Peano distinguished universal and existential quantifiers. However, there was a disunity between them as well. For Peano logic was a tool to examine the principles of arithmetic and geometry (mathematical logic). For Frege arithmetical notions can be defined in terms of purely logical notions and arithmetical principles can be derived from the laws of logic alone (logicism). They did not agree how much their systems count primitive terms and which signs should be treated as primitive. Frege criticized Peano's definitions of equality and addition. They both did not agree as to what it means to create a good definition. Frege regarded his conceptual notation as better than Peano's in many respects. They used different signs to express quantification. There was much more unity than disunity between them. They well understood each other. However, there is a lot of constructive and serious mutual criticism in their letters. It is unity in diversity.

S18 THE CORRESPONDENCE OF JOHANNES HEVELIUS: BETWEEN SCIENCE AND SCIENCE POLICY. WORK-IN-PROGRESS REPORT

Location: IoE – Room 780

Chair: Halleux, Robert

Organisers: Włodarczyk, Jarosław, and Grell, Chantal

Johannes Hevelius (1611–87), the astronomer based in Danzig, published more than 20 scientific treatises which strongly resonated with the contemporary academic world. Moreover, he left a massive collection of correspondence, comprising more than 2000 letters and approximately 430 correspondents, scholars as well as people wielding political power at the local and continental scale. Presently the correspondence of Hevelius remains probably the largest understudied collection of letters written by the scholars from ‘the age of scientific revolution’. For the last several years, however, under the patronage of l’Union Academique Internationale and International Academy of the History of Science, we have been running an international project to prepare a critical edition of Hevelius’s letters. The project will significantly contribute to our understanding of the 17th century science, of the links among various scientific centres, the relations between scholars and their patrons, as well as of the historical, social and intellectual factors conditioning scientific research. The project renders also a cumulative picture of the fifty years of the evolution of the scientist figure in the early modern period. The symposium consists in the presentation of the newest findings as regards Hevelius’s correspondence.

Grell, Chantal (Université de Versailles)

The correspondence between Johannes Hevelius and Pierre des Noyers, as the mirror of scientific novelties

Pierre des Noyers (1608–93), a disciple of Gilles Personne de Roberval, is the most important correspondent of Johannes Hevelius. Their correspondence consists of 257 letters, in a corpus of 2700 letters, i.e. about 10% of the total. Pierre des Noyers came to Poland with the Queen Louise-Marie de Gonzague. During his travel he spent some time in Gdansk (dec. 1646) and met the astronomer who was a prominent member of the city elite, as one of the most important brewers. In this time, Hevelius was achieving his *Selenographia* (1647) and Pierre des Noyers was very helpful to enlarge to Europe a network that already included Marin Mersenne and Pierre Gassendi. The relations between the two scholars were very intense. After the death of the Queen (1667), des Noyers stayed in his friend’s house. The last letter is dated October 1686. Hevelius died in January 1687. Pierre des Noyers remained in Poland where he died in 1693. The contents of the letters are very diverse, especially about the new progresses in scientific actuality of which the present paper aims to give some samples.

Jasiński, Maciej (Polish Academy of Sciences)

Stanisław Lubieniecki and Johannes Hevelius: (Extra)ordinary “men of letters”

Stanisław Lubieniecki (1623–75) seems to be one of the most important correspondents of Johannes Hevelius. There are over ninety letters they wrote to each other in nine years’ time. Some of these letters are quite voluminous and contain lots of attachments dealing with various astronomical issues, mainly comets. Significantly enough, these letters constitute the third largest part of the corpus of Hevelius’ correspondence. The analysis of Lubieniecki’s book *Theatrum Cometicum* (3 vols., Amstelodami 1666–68), where he published his astronomical letters, shows that also in this case the letters to Hevelius were the third most numerous group. In my paper, basing on the manuscripts from the Paris Observatory Library, I will scrutinize the correspondence between Lubieniecki and Hevelius. Specifically, I intend to explain what these two participants of the Republic of Letters tried to accomplish with their letters, what methods they applied and why the correspondence between two men of so vastly different scientific

SUNDAY 16 SEPTEMBER, 14.00-15.30

standing could be so numerous and long-lasting. Furthermore, I will compare Hevelius' correspondence to other collections of letters in Lubieniecki's *Theatrum Cometicum*. This will serve to demonstrate both the ordinary and the unusual features of their correspondence.

Mallet, Damien (Université de Bordeaux-Montaigne)

Pierre des Noyers, a scholar and a courtier

Pierre des Noyers was a major personality at the court of Queen Louise-Marie. Officially her secretary and personal treasurer, he was also a man of science, a scholar interested in astronomy, astrology, and medicine, always curious about prodigies and miracles. Pierre des Noyers was an important courtier and middle-man for French and Polish relations. Through him materialized the French attempt to bring the prince of Condé on the Polish throne for instance. Long time correspondent of Johannes Hevelius and Ismaël Boulliau, he knew all but too well how critical patronage was for scientists of the time – he himself, was well cared of by no other than the Queen of Poland. Hampered by an empty treasury and a constant state of warfare, the king of Poland Jan Kazimierz could never provide Hevelius the protection he deserved. This paper focuses on des Noyers' efforts to promote the works of Hevelius in France, through his network of friends, fellow astrologers and powerful nobles.

Włodarczyk, Jarosław (Polish Academy of Sciences)

'Peripheral' astronomy in the correspondence of Johannes Hevelius: A case study of Maria Cunitia and Elias von Löwen

The letters of Johannes Hevelius reveal a very interesting map of the European astronomy of the 17th century. Significantly, Hevelius was not only a key agent in the transmission of scientific information among the main centres which, for example, made Gdańsk equally important as London and Paris for early modern uranography. Hevelius exchanged also letters with astronomers whose achievements are hardly ever discussed within the framework of the general history of astronomy. And yet the analysis of their activities allows for the complete reconstruction of the 17th century astronomy, including its diversification which stemmed from the tensions between tradition and modernity as well as from the specific research interests of minor scholars. One such case is Maria Cunitia (1610–64) and her husband, Elias von Löwen (Crätschmair; c. 1602–61) based in Silesia. Maria Cunitia is acknowledged for her *Urania Propitia* (1650), an innovative adaptation of the mathematical astronomy of Johannes Kepler's *Rudolphine Tables*. In turn von Löwen authored astronomical calendars and ephemerids. Their correspondence with Hevelius – 22 letters from the years 1648–1654 – constitutes an important source of knowledge about the astronomical 'background' which allowed them to complete their published works as well as about the activities of such astronomers from outside the major scientific centres. It is my intention to discuss the astronomical content of these letters.

SUNDAY 16 SEPTEMBER, 14.00-15.30

**S21/2 CONTINUITY AND DISCONTINUITY OF UNIVERSITY EDUCATION AND RESEARCH
ACTIVITIES OF CENTRAL EUROPEAN SCHOLARS DURING WORLD WAR II**

Location: IoE - Room 784

Chair: Jůnová Macková, Adéla

Organiser(s): Jůnová Macková, Adéla; Sekyrkova, Milada; and Kokowski, Michał

Commentator: Ash, Mitchell

World War II changed and challenged generations of European researchers, and impacted on the existence of research institutions. Several occupied countries had to close their higher education institutions in 1939 (Protectorate Bohemia and Moravia, Poland), scholars lost jobs and students opportunities. One solution that maintained a research career as a viable option for scholars consisted of teams in non-university research institutions. It was a way of survival that offered work, and sustenance, even though with limited teaching opportunities, and limited publication outlets. A generation of students had to leave the universities, and their younger followers did not have a perspective – army life and factory work was an imposed solution. An alternative applied in Austria, Hungary, and Germany itself was to embark on research projects and teaching plans deemed acceptable to the regime and to war conditions. Across Nazi-controlled Europe, racial laws, army conscriptions, and enforced exile exercised a considerable influence, next to a reorientation of research programmes to contributions to the war effort. Historiography mapping and interpreting a profound war impact in occupied regions concerns both institutional histories and individual, more biographically oriented aspects. Personal histories of Central European researchers on diverse sides of the conflict included also resistance to the Nazi regime. The symposium panel is concerned with a continuity and discontinuity of research institutions, disciplines, and research interests of Central European researchers during the war. Both institutional and individual aspects have been incorporated, mapping diverse strategies and outcomes. The individual perspective also includes everyday existence, and very personal aspects of habitus, with practices and representations set in highly complex situations, such as exile, resistance, war effort, or survival in a totalitarian regime.

Cain, Friedrich (Erfurt University)

Knowledge from the Underground. Polish Academia During the German Occupation, 1939–1945

During the German occupation of Poland, a rigid regime was installed. Though many governmental institutions were not closed and could even keep Polish staff due to the lack of German specialists, this only maintained the occupiers' structures. No official (diplomatic) German-Polish relations existed and Poles could only exist as low ranked individuals. Any collective effort was forbidden or mistrustfully supervised, cultural and social life could not carry on as before. Science was not spared either: Universities, research institutes, and the Academy in Cracow were closed and only few re-opened as German institutes. Nevertheless, Polish academic research and teaching did not cease to exist. After some time, former colleagues reconvened to organize seminars for their old (and also new) students. Such clandestine activities grew to respectable numbers: about 6.000 people studied at the so called Underground Universities that were organized in private flats, cellars, or under other cover. Many scholars also tried to re-/establish research activities. Devoid of laboratories and libraries they organized necessary equipment or thought about possible ways to replace parts of the apparatus or the apparatus as such. After the war a bulletin of the Cracow Academy listed not less than 626 works prepared and written between 1939 and 1945. The paper examines the effects the specific conditions on underground research and its results, covering theoretical and

SUNDAY 16 SEPTEMBER, 14.00-15.30

practical frameworks, techniques of the scientific self and the status of research in the Polish community. An outlook on post war careers and the legacy of the underground will be given.

Neuenschwander, Erwin (University of Zurich)

Three case studies of mathematicians in the Third Reich: Bessel-Hagen, Hausdorff, and van der Waerden

The mathematician Erich Bessel-Hagen (1898–1946) is perhaps best known for the many jokes that still circulate about him although having been an excellent and very decent mathematician. Hel Braun tells in her autobiography that Carl Siegel threw on a sea trip the only copy of Bessel-Hagen's habilitation thesis overboard – which he had to review – because this task hindered him in his own work. Another well-known joke goes back to Kerékjártó who referred in his book on topology to Bessel-Hagen by a topological diagram with oversized ears. Because of his shyness, Bessel-Hagen did not publish much. However, during World War II, he was on account of his physical handicap for a long time the only mathematician at Bonn University and helped among other things to preserve the papers of his Jewish colleagues for posterity. Bessel-Hagen's papers are an important source for mathematics under the Nazi regime. They contain besides his extensive correspondence great parts of the literary remains of Otto Toeplitz, who emigrated in 1939 to Palestine. Bessel-Hagen was one of the very few persons who held close contacts with Felix Hausdorff during these difficult years. It is therefore not surprising that I discovered around 1990 when I arranged the papers of Bessel-Hagen in the University Archive in Bonn Felix Hausdorff's farewell letter. Another important source for the Nazi period is the voluminous correspondence of B. L. van der Waerden on which I am presently working.

Franc, Martin (Masaryk Institute and Archives of Czech Academy of Sciences)

Wartime roots of research teams of the Czechoslovak Academy of Sciences

The closure of Czech universities during the WWII, in 1939, significantly disrupted the career path of many naturalists. After the Nazi occupation they had to seek new paths for scientific work. Many emerging found their way into industrial research on the territory of the Protectorate of Bohemia and Moravia, which was, of course, a considerable change for them from their previous experience in the academic world. The foundations of teamwork were created there, aimed at quite clearly stated objectives with practical outputs. Although traditional hierarchical networks were established in industrial research, this area still offered, somewhat paradoxically, greater opportunities for professionally and organizationally talented younger researchers than the very rigid academic environment, replete with a variety of personal ties and yet very narrow. Several important centres of scientific work were established, the breeding grounds for prominent scientists who played an important role in their fields after the WWII. These exceptionally talented experts began to build teams of collaborators that had a major impact on the staffing of several sites, especially in the Czechoslovak Academy of Sciences (CSAS). Probably the most prominent example of a CSAS site built around people grouped during the WWII was the prestigious Institute of Organic Chemistry and Biochemistry, headed by František Šorm, President of the Academy in 1962-1969; Šorm was an extremely capable scientist and organizer and had been very active in the Association for Chemical and Metallurgical Production during the times of the Protectorate.

Šoukal, Jiří (Masaryk Institute and Archives of the CAS, v. v. i.)

Czech professors from Medical Faculties and their career strategy during the World War II

Czech Professors from medical faculties and their career strategy during World War II The generation of natural scientists born in the 1880s and 1890s reached the top at Czech universities in the 1930s. Unfortunately, the occupation of Czechoslovakia interrupted their careers. On 17 November 1939 the Czech University and all other Czech institutions of higher learning were closed, a situation that lasted until the end of the war. The Professors were either transferred to other departments, reassigned to secondary schools, or sent on leave with waiting or into retirement. This paper deals with the question of what strategy the Professors

SUNDAY 16 SEPTEMBER, 14.00-15.30

chose. Some of them remained on leave or in retirement while others worked in research institutions. The difference between the strategy of heads of departments or institutions and younger lecturers or assistant professors is pointed out. Their approach was closely related to the position of the scientists, their habitus, family background and ambitions. One of the most important research institutions was the State Health Institute (today the National Institute of Public Health), which focused on the research of medications, especially vaccines. Some Professors continued researching there. Research in this Institute was an important contribution to the development of Czech hygiene, epidemiology and microbiology. Based on archival research and memories, it is possible to identify changes in the Professors' research and their standing in science.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S34/1 HISTORY BEHIND STATISTICS: UNITY AND DISUNITY BETWEEN SCIENTIFIC COMMUNITIES AND BUREAUCRACY

Location: IoE – Committee Room 1 **Chair:** Lanata Briones, Cecilia T.

Organiser(s): Lanata Briones, Cecilia T., and Daniel, Claudia

Commentator: Beaud, Jean-Pierre (Université du Québec à Montréal)

Statistics can be perceived as facts detached from producers and users that are unproblematic and certain, as ready-made science (Latour 1987). Since the nineteenth century, nation-states have produced and relied heavily on statistics, to the extent that governments' performance began to be evaluated by what numbers (do not) show. Economic and social statistics became the foundational backbone of modern government. The incorporation of numbers into public life aimed to depoliticise functions of public and private administration through rationalisation (Stapleford 2009). How were quantification tools constructed? Who developed them? How were public statistics and measurement tools used in different fields (science, politics, firms, etc.)? How have these instruments changed through time? This symposium examines the ways to produce statistical knowledge and the role played by statistical quantification tools throughout history. The panels bring together socio-historical approaches that enhance the social and political foundations that explain the transformations of quantification techniques, practices and languages. The unfolding of the history of statistics merged research categories that were born separately: one referring to the history of institutions and statistical systems and the other to mathematical statistics and probabilities. This convergence added complexity to the way we understand what statistics do and what we do with them. The encounter is linked to the fact that probabilities and macro-social descriptions of public statistics have been continuously intertwined, meeting and separating (Desrosières 2004). Therefore, the studies of its historical evolution should address both the academic and administrative dimensions of statistics, as they reciprocally shape each other (Porter 2000). Statistics is simultaneously a tool of constructing and proving scientific facts and a technical language used in the social debate with great capacity for persuasion (Desrosières 2008). This power lies on its double source of authority, of science and the state. The study of statistics has developed across a variety of fields, settings and actors, joining several histories. The history of economic facts and the trajectory of schools of thought were intertwined with the evolution of technical tools and statistical models used by economists. The production of sanitary statistics was connected with the social history of health and disease, the development of the medical profession, the public health movement, and of life insurance. Both the historic population moves and the development of demography were involved with the historical and political nature of censuses and the generation of vital statistics and statistical nomenclatures. Linking elements only distant in appearance, the history of statistics shows that the institutionalisation of concepts, practices and statistical tools does not follow linear trajectories. Quite the contrary, they are basting formulations made in national statistical agencies or academic spheres, discussions in statistical communities, applications in the practical world, and mobilisations of private interests or state support. These entangled histories sometimes portray tensions and controversies within scientific communities or between scientific societies and state bureaucrats. The inclination of statistical language towards universality intersects with specificities marked by national traditions. Lastly, private and public uses of statistical tools could

also be seen as factors of union and disunion.

Chazaro, Laura (Departamento de Investigaciones Educativas, Cinvestav-IPN)

A state searching for a national census: medics, statisticians and bureaucrats confronted regarding measurements of the Mexican population

Studies of the history and politics of population statistics show how population censuses are linked to the emergence of nation-states. These histories emphasise that the statistics produced within the administration of modern states are linked to science's spirit and practices of precision. The measurements linked to discourses and scientific practices created an enumerative spirit that administered society. Although in Mexico this trend is corroborated, the connections between the states' practices of population counting and those produced by scientists and scientific societies are disconnected from those produced by the national bureaucracy. The censuses produced by the Mexican bureaucracy faced technical, authority and political legitimacy problems. Enumerations, calculations and approximations made by scientists, doctors and educators, however, enjoyed greater credibility and authority. This paper examines what made it possible to produce censuses and enumerations of the population and how the administrative possibilities of measuring the population were created. Through the analysis of the quantification practices of bureaucrats and medics, this paper questions how a numerical description constitutes, constructs or intervenes on certain social configuration and what regulations create the public sphere. The aim is to examine how bureaucratic census production transformed medical measurements examining what is created or what is constructed when counting. The paper focuses on the practices that made the counting possible, on how the administrative possibilities to measure the population and account for its economic and health status were created.

Erdelyi, Matyas (Central European University)

You Are Not a Doctor: Medical Statistics in the Habsburg Monarchy

Statistical knowledge combines public discourse, disciplinary competition and statistical methods. Medical statistical tools' perceived universality is disrupted by disciplinary competition and credibility struggle. They involve a multi-dimensional analysis of knowledge production at the backdrop of increasing disciplinary competition, conflicting social values and habitus, and numerical interpretations. Hungarian statistician József Kőrösy advocated compulsory vaccination against smallpox using statistics. Kőrösy was questioned because "he is not a doctor", "he is not noble". The controversy exemplifies knowledge production: statistical tools' mathematical validity; competition between statistics, medicine and law; the scientists' background and political implications. My paper broadens this examining the production and application of medical statistics by people of different backgrounds. Abnormal lives in life insurance or the nomenclature and statistics of causes of death linked and confronted Eduard Buchheim, insurance physician in Prague, and Ernst Blaschke, mathematician at the Technische Hochschule in Vienna. The narrative exemplifies how the structure of the academic and semi-academic field in the Habsburg Monarchy was an outcome of the way people used it and how knowledge production happened on different semantic and social levels. It is the story of how differences and interpretations were constructed, and how agents contested and re-interpreted norms. They share "cultures of knowledge", but there is tension the old genteel society and the newcomers of de-feudalization, industrialization and democratization. These cases include power struggle over control of knowledge production, while agents must constantly negotiate and re-negotiate what counts as intellectually-established and culturally-legitimate.

Wallut, Quentin (Université du Québec)

Unity and disunity of contemporary censuses

Censuses are a form of governmental survey. "Traditionally" it is one of the most considerable peacetime government undertakings used to organize the polity. This enquiry has an impact on political questions and identity, being invested by interest groups and political actors. Despite

SUNDAY 16 SEPTEMBER, 14.00-15.30

certain evolutions, there is continuity in most censuses. This continuity is at risk to be disrupted by methodological change. Yet, there is a trend towards a new census model. In Europe, a growing proportion of national censuses are discarding exhaustive enumeration in favor of register-based operation, sometimes alongside representative surveys. The rationale of the reforms is diverse: cost, timeliness, burden of the respondents, privacy concerns, fears of polarization and politicization. Generally, these reforms did not induce controversy nor had meaningful public attention. Oppositions forbid change in the US and Canada. The 2010 Canadian Census Crisis related to a methodological modification decided by the government, a decision reversed by the next government. In the USA, tension arises and any reform faces political opposition. If there is a wealth of technical and methodological analysis of these changes, the phenomenon has not been documented through political science concepts. Yet the census is a very specific political issue. Could such a shift bring a “post census” era through a radical transformation of its definition and symbolic content? This paper explains that the modification of the census procedures could affect its political and philosophical understanding, showing that these technical and methodological transformations might affect national political equilibrium.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S43/5 WHEN SCIENCE DIPLOMACY DIVIDES

Location: IoE - Committee Room 2

Science and Diplomacy Group EGM

SUNDAY 16 SEPTEMBER, 14.00-15.30

S42/3 THE GREEN AND DARK SIDE OF ENVIRONMENTAL ISSUES IN CITIES (1850-1950)

Location: IoE - Room 709a

Chair: Simões, Ana

Organiser(s): Gomes, Inês; Miralles Buil, Celia; and Duarte Rodrigues, Ana

In 1984, the expert on French urban history, Bernard Le Petit, stated that “the city is neither a context nor an environment, but the expression of practices and social relations”. This symposium's ambition is to bring back “la part du milieu” (Braudel, 1949; Massard-Guilbault, 2002) into the cities, focusing on the question of hygiene. Hygienic issues in cities have been studied by different scholars, through different lenses. We argue for a change of perspective, connecting urban history of sciences and technology, garden history and urban environmental history. In particular, this symposium focuses on the role played by nature and/or environment (concepts that we want to clarify during discussion) in the healthy/unhealthy city. On the one hand, bringing “nature” (e.g. trees, plants or animals) and its natural elements (e.g. sun or air) into the city was considered a solution to solve some of its hygienic problems. On the other hand, the “nature” in the city was, periodically, considered as a source of danger for dwellers’ health. What kind of “nature” inhabitants, municipal authorities, doctors or other actors which addressed urban problems wanted in the city? Who were, in fact, the leading actors claiming for healthier cities - doctors, gardeners, engineers, or others? Did they agreed or disagreed about the necessity and effectiveness of the proposed measures? What policies were required to transform the city from dark to green? Are there similarities among those policies in different cities dispersed worldwide? How did, different actors, in their discourses and practices, try to unify or des-unify nature and city? These are the main questions addressed in this symposium. The diversity of case studies covered seeks a comparative analysis between cities – with different size, political importance or economic affluence - in Europe, America, Russia or India, highlighting the importance of experts’, ideas and models circulation, at a global scale. Furthermore, it also emphasizes the importance of local exchanges between different social groups in the construction of healthier cities, challenging the traditional center-periphery model. The variety presented in this symposium offers an overview of the significance of environmental urban history to our understanding of the history of science and technology in the city. This symposium is divided into three sessions, focused on animals and pathogenic organisms; cities and infrastructure; and gardens and green grounds arrangements. This symposium is divided into three sessions, focused on animals and pathogenic organisms; cities and infrastructure; and gardens and green grounds arrangements. Focusing on gardens and landscape through the lenses of the urban history of science and technology, the third part of this session shows how different contexts lie behind similar solutions in European cities. The disunity of causes between London and Holland or between Paris and Lisbon are opposite to a certain unity recognized in the renewal of urban green grounds.

Woudstra, Jan (University of Sheffield)

After the Great Stink; the creation parks, open spaces and thoroughfares during the transformation of London (1855-1889)

As many other cities in Great Britain and abroad the main conduit for disposal of waste was the river, in the case of London the Thames, providing a situation that was not just unhygienic, but also a dangerous source of disease and fumes. In the end it was the miasmatic theory which believed that diseases were transmitted through bad air rather than water that caused a change

SUNDAY 16 SEPTEMBER, 14.00-15.30

of policy. The cleansing of the London metropolis after the Great Stink of the mid-nineteenth century became the responsibility of the Metropolitan Board of Works (MBW), founded in 1855. It included a new sewage system, but also introduced additional infrastructure of roads and an underground system. The engineering achievements of this by Sir Joseph Bazalgette (1819-1891) have been justly celebrated, but other aspects have been overlooked as a result of continual criticism of corruption of the MBW and causing its demise in 1889, which has put the whole organisation and its contribution in bad light. However, the improvements included the creation of a greenspace network conceived not only as part of the improvement of general hygiene of the capital, but also to beautify the city in a way to rival the Hausmannian improvements of Paris. This paper investigates how physical and aesthetic considerations coincided with the engineering objectives of the MBW and how this contributed to and, by concentrating on the issue of parks, open spaces and thoroughfares, changed the general nature of the capital.

Fleischer, Alette (Independent Scholar)

Between Ideology and Idyll: Planning and Building Public Parks in 19th century cities in the Netherlands

From the mid 19th century onward, the appearance of Dutch cities gradually changed. Motivated by a growing industrial and colonial economy, cities expanded outside their 17th century bulwarks. The bulwarks and defense canals became the first type of public promenade parks with curvy lanes and water features as a green border between old and new urban neighborhoods. Health and ethical considerations, that German and English examples show, played equally in the Netherlands a role in the design of public parks in the new urban areas. However, when it came to actually building public parks this went together with economical and societal motivations in the young Dutch Kingdom. The idyll of a large public park, where one could enjoy beautiful environment, meet different layers of society, and get fresh air, proved to be more an ideology than a practice. This paper wants to contribute to the discussion of the awareness of health and hygiene in relation to urban history of science by looking on how two groups of actors. Those who propagated parks as a sound and healthy enterprise, a “green lung” for the entire community. And those who believed that parks were a waste of money, un-Dutch, or irrelevant. My argument helps to further understand how new inventions and novel ideas have to be molded and reshaped before it can be applied in a society. Dutch public parks, that today define the cities, have their present-day form and function (in part) because of the 19th century tensions within society.

Duarte Rodrigues, Ana (Universidade de Lisboa)

Lisbon's Lungs: integrating Landscape in the city

During the nineteenth-century, as cities grew, and the negative effects caused by the Industrial Revolution accentuated, many voices pleaded for the reintegration of natural elements into the urban landscape by creating green grounds that answered both demands of health and recreation. Many urbanists compared cities to organisms, and green spaces qua their lungs. This is the rationale behind the construction of many parks in European cities. However, I argue that the growth of Lisbon's lungs was projected for Campo Grande in the nineteenth-century, before Monsanto, and has different roots. The goal of Lisbon's City Council was to enhance the city as a great European capital, head of an Empire, and at the same time to provide healthy environment, comfort, honest recreation for the citizens, but above all to build a modern city, following the French standards. Pollution caused by industrialization was not the reason behind Frederico Ressano Garcia's utopic project for the enlargement of Lisbon to the north in the late nineteenth-century. Highly influenced by French urbanism and landscape architecture, Ressano Garcia projected Campo Grande as Lisbon's 'Bois de Bologne'. At the same time, the doctors and engineers claimed for the necessity of this large park. Therefore, I argue that Lisbon's lungs stand as an important case-study to discuss center-periphery because although appropriating models from the centers, different reasons lie behind greening the city in the nineteenth-

SUNDAY 16 SEPTEMBER, 14.00-15.30

century: Modernization rather than Industrialization.

Mexi, Alexandru (University of Bucharest)

Designing the first public garden in Bucharest. Context, reasons and decisions

Designed by the mid-19th century at the periphery of Bucharest, the Kiseleff garden is one of the oldest public gardens in Romania. It was built after the Russian general Pavel Kiseleff refused the honor of being erected a public monument and asked the local administration to use the funds allocated for his statue to create a space for public use. However, this was not the only reason and neither the most important that lead to the creation of this garden. Moreover, as there was no actual need for planted spaces in Bucharest, nor did the society demanded public gardens at that time, the project becomes even more unclear and debatable. To this end, this paper aims to analyze the history of the garden and the political, economic and cultural reasons that lead to the decision of creating the first public garden in Bucharest. The study will be based on a historical analysis of some recently discovered archival materials as well as on comparative analysis between the Kiseleff garden and other similar examples of public planted spaces in Romania and Europe.

SUNDAY 16 SEPTEMBER, 14.00-15.30

S39/3 CULTURES, STARS AND NUMBERS: INTERCULTURAL EXCHANGES IN EAST ASIAN MATHEMATICS AND ASTRONOMY

Location: IoE - Room 777

Chair: Cullen, Christopher

Organiser(s): Cullen, Christopher

Pre-modern East Asia was the home of distinctive traditions in both mathematics and astronomy. During the first millennium CE these traditions, first developed in China, became common to the whole region, including Korea and Japan. Within the broad theme of the conference, 'Unity and Disunity', the aim of this panel is to encourage discussion of relevant issues in a regional and global historical and cultural context. Despite their common roots, the theory and practice of mathematics and astronomy was by no means uniform across the whole East Asian land-mass. It is thus illuminating to trace the way that elements of these disciplines were appropriated, adapted and developed as they moved across regional and cultural boundaries. Moreover, pre-modern East Asia was highly permeable to the flow of ideas from the rest of the Eurasian continent - first from South Asia in the context of the coming of Buddhism in the first millennium CE, then from the Islamic world from the Yuan dynasty (1271-1368) onwards, and finally from early modern Europe with the arrival of Jesuit Christian missionaries in the later part of the 16th century. The complex interactions that followed from these contacts are revealing not only of the nature of the East Asian traditions in astronomy and mathematics, but also of the traditions that scholars in East Asia encountered afresh.

Yang, Hong-Jin (Korea Astronomy and Space Science Institute)

The transmission of astronomical culture in Korean peninsula since the prehistoric period

Korea has many astronomical heritage such as observational records, observatories, star maps, and so forth. Especially Korea has a long history of star maps, dating from the prehistoric period. Notable star maps in the prehistoric age are star-like cup-marks carved on cover stones of dolmens. Korea has the greatest amounts of dolmens in the world, and some of them have constellation-like cup-marks such as the Big Dipper, Sagittarius, Corona Borealis, Pleiades, etc. The patterns of constellation in dolmens are also appeared in the Goguryeo(高句麗, 37BC-AD668) tombs. Meanwhile, Chinese constellation system was firstly introduced and to be generally accepted by Goguryeo period. It means that aside from Chinese constellation system, Korean typical astronomical knowledge has been accumulated from preceding era. Recently a cobble stone, which was unearthed in distribution of typical Upper Paleolithic remains, was founded in Korean peninsula. The cobble has many tiny holes on the surface. As a hypothesis we identified the artificially pecked holes with stars and found constellations. The identified constellations were engraved in their relevant positions in the sky corresponding to those of ~40,000 years ago, based on the calculations of the proper motion and precession of stars. Although it needs more analyses, the holes can be supposed that the location of punctuation corresponds to astronomical chart.

In this talk, we would like to introduce the transmission of typical astronomical culture in Korea from the preceding era.

Yuan, Min

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Zhao, Jiwei (Northwest University, China) and Li, Gang

Some Notations on the Method of Double False Positions

SUNDAY 16 SEPTEMBER, 14.00-15.30

In medieval China and Arab, the method of double false positions is an effective tool in solving the linear problems of two variables. Fibonacci in his *Liber Abaci* (1202) develops this method into an iterated algorithm of multi-fold double false positions which can solve the system of n -variable equations, and this algorithm is simplified greatly by Clavius in his *Epitome Arithmeticae Practicae* (1583). However, the evidence of the adaption of this method to the approximate solution of nonlinear equation is fairly late except the popular conjecture that Fibonacci used this method when he solved accurately a famous cubic equation in his *Flos* (1225). We find that, Cardano uses this method in Chapter 30 of *Ars Magna* (1545) to evaluate a root of equations of higher degrees up to four. In fact, he develops this method in a different way into another algorithm which we now call the iterated method of linear interpolations. We check his four examples and find that there is an apparently reasonable result which is due to wrong calculations. In the end, based on the analysis of this defect as well as the extant reconstructions of Fibonacci's numerical solution of his cubic equation, we provide a new explanation of Fibonacci's solution.

Lee, Eun Hee (Yonsei University Observatory, Korea)

A study on the two astronomical tables in the Sultani zij: The oblique ascension and the parallax correction tables

The Sultani Zij is an astronomical treatise that was published by Ulugh Beg at Samarkand in 1438-1439. Particularly, this paper deals with the two astronomical tables listed in the Sultani Zij: The oblique ascension table for calculating the length of the day and night, and the parallax correction table for calculating the parallax to the prediction of solar eclipse. In this study, we examine the layouts and contents of these two tables and compare with those of other Islamic zijes compiled in 14th~15th century such as Tibetan Sanjufini Zij, Chinese Huihui-lifa and Korean Chiljeongsan-Oebyeon. As well, their features and relation are traced and discussed.

S35 UNIFYING PHENOMENA IN A DIVIDED WORLD: HISTORY OF CLIMATE AND METEOROLOGY IN EUROPE (17TH-19TH CENTURIES)

Location: IoE - Room 826

Chair: Omodeo, Pietro Daniel

Organiser(s): De Bianchi, Silvia and Miglietti, Sara

Among the most pressing scientific, political and financial questions that the world is facing today there are the implementation of International agreements and common measures to be taken against and to reduce the effects of climate change, as the recent Paris Agreement testifies. Our view of climate changed throughout centuries, but constituted a central question for scientists and natural philosophers already in early modern Europe. The purpose of this symposium is to explore the notion of climate in different Countries (England, Switzerland, Prussia and Spain) and periods, by taking into account the place that the study of climate had within meteorology, which kind of technology was employed for its implementation and which role the study of climate played at the Institutional and economic level in different contexts. Thus, by exploring tendencies of unity and disunity in employing different technologies in different political and economical contexts, the symposium will address in an original way the ESHS conference strand of unity and disunity in science, technology, and medicine within and across nations and will promote the discussion of the notion of climate from the historical perspective and beyond.

Miglietti, Sara (Johns Hopkins University)

An early-modern Anthropocene?

The idea of anthropogenic climate change in the early Royal Society While the term “Anthropocene” is of relatively recent coinage, the concept of human climatological agency that lies at its core has a long and complex history. The ancient Greek philosopher Theophrastus already identified a correlation between deforestation and changes in rainfall patterns, and the reactivation of his ideas during the Renaissance triggered a new generation of studies into how human activities on the land may alter local climates in more or less deliberate (and more or less desirable) ways (Grove 1996). This paper will explore the links between early-modern meteorology and the emergence of early ideas of anthropogenic climate change based on manuscript evidence from the archives of the Royal Society. While early Royal Society fellows and affiliates often tackled the question of human agency in and on nature from the perspective of contemporary ideologies of “improvement” (Slack 2015), the paper will show that this early-modern discourse of mastery and improvement was not blind to the possible side-effects of man’s environmental intervention. Beginning with the “hortulan” utopias of FRS John Beale and John Evelyn in the mid-seventeenth century (Leslie and Raylor 1992) to conclude with the climatological thought experiments of the Swiss natural historian and FRS Johann Jakob Scheuchzer in the early 1700s (Barton and Miglietti 2015), the paper will show that the environmental reflexivity of early-modern scientific networks was in fact much more complex, fraught, and self-scrutinizing than is usually acknowledged.

De Bianchi, Silvia (UAB)

In search of unifying patterns: meteorology, technology and power (1750-1795)

In this paper I shall analyse different approaches and technologies that scientists endorsed in the 18th century in discussing meteorology and the study of climate in particular. I shall clarify in which sense scientists talked about “climates” (plural) and in which sense they made several attempts to unify them under a notion of “climate” in the 1790s. In order to reach this goal, I shall consider the attempts at finding an equation to calculate the mean temperature at different latitudes and the like (e.g. Kirwan 1787) and the development introduced by Euler in geodesy at the Berlin Academy of Sciences in mid-1750s. In the second part of my contribution,

SUNDAY 16 SEPTEMBER, 14.00-15.30

I shall show how in the 1780s and early-1790s scientists started organizing joint campaigns in France, England, Prussia and Russia, by using instrument calibration and which kind of attitude was held by monarchs and research Institutions in their respective Countries with respect to their studies.

Jankovic, Vladimir (University of Manchester)

A British Fetish: 'National Climate' and the Victorians

The idea of a 'national' or 'hereditary' climate has a long genealogy. With the ascent of neo-Hippocratic medical practices, European physicians linked local climates to native bodies assuming a nervous sympathy that enabled external stimuli to move into the body's interior. Societies exposed to specific climates literally assimilated those climates. Not only did nations mimic their climates, they also owed their achievements to climatic stability that prevented migration and enabled sedentariness and civilization. Strangely, the British climate has never been a stable cultural entity. In this paper I analyse a sample of widely diverging Victorian claims about the British climate to establish how its uses naturalized social and racial values rather than refer to the trivialities of weather. The Victorian climate was in this process de-weathered and de-naturalized to the point of becoming a Victorian meme – and a fetish – that allowed the literary and otherwise 'climatosophes' to make mutually opposing argument about the British national achievement, or failure, depending on a reading they adopted about the country's climatic identity.

Pometti, Kevin (University of Aix-Marseille) and Alberola Romá, Armando (Universidad de Alicante)

Temperature oscillations, droughts and storms in the Spain of the 18th century: from the perception of people to the instrumental meteorological registers

The eighteenth century witnessed the last phase of the Little Ice Age. But the last part of this climatic instability was not reflected into an immediate moderation of temperature oscillations, as meteorological registers testify. Furthermore, the end of this climatic oscillation did not affect the stabilization of the meteorological instability. In Spain, the last years of Maunder minimum (upon 1715) and the last years of 'Maldá' anomaly (1760-1800) were characterized by the effects of extraordinary climatic events that had deleterious consequences over the agricultural production and over life conditions in general. This contribution highlights through detailed archival research the effects of this changing weather conditions from 1760s onward. The present research is based on meteorological data recovered from individual observers and scientific institutions and/or meteorological data extracted from newspapers. Our objective is to show the usefulness of these sources for the understanding of the impact and incidence of climatic oscillations over society. Moreover, we shall emphasize how the detailed analysis of extraordinary events can help to detect periods in which the environmental conditions changed and how these changes in the environment could have effects over the public health.

S11/2 HISTORICAL MOMENTS IN THE PUBLIC UNDERSTANDING OF SCIENCE (c.1600-1900)

Location: SciM – Lecture Theatre

Chair: Ampollini, Ilaria

Organiser(s): Ampollini, Ilaria; Gouyon, Jean-Baptiste; and Nielsen, Kristian H.

These two panels are intended to bring together studies of historical instances related to the construction of the public cultures of science. Taken together, the papers presented in these two panels highlight the variety of the aims, contexts, outcomes, and actors—audiences and producers—of an endeavour—the communication of scientific knowledge in public contexts—consubstantial to the development of modern science, which has remained a constant since the 17th century. As a whole, the papers presented in these two sessions intend to highlight the value of historical enquiry, and of an historical sensibility, for the development of current scholarship in and about science communication and the public understanding of science. The first panel lines up case studies from c. 1600 to 1900, the second panel concentrates on the 20th century. The title for these two panels is borrowed from the title of a rubric in the journal *Public Understanding of Science*. Since 2016, this rubric offers short essays on the history and the historiography of science communication on a regular basis.

De Ceglia, Francesco Paolo (University of Bari)

The origins of Italian scientific cinema (1908-1938)

The history of Italian non-fiction filmmaking is not well-known in Italy and almost completely overlooked abroad. Retracing the steps of its development could shed light on the way in which science was understood and represented by filmmakers, researchers and spectators. Italian documentary cinema was long identified with films which, disinclined to use narrative structures, relied on shots of small animals and natural phenomena, often reproduced in the laboratory. Paradigmatic from this point of view is the figure of Roberto Omegna, the most important Italian scientific filmmaker of the first half of the twentieth century. He worked before for the Ambrosio Film, in Turin, then for the Istituto Luce, which, in line with the Fascist political program, accompanied the usual laboratory reconstructions with innovative scenes of agrarian landscapes.

Casonato, Simona (Museo nazionale della Scienza e della Tecnologia Leonardo da Vinci), and Canadelli, Elena (Università di Padova)

A museum with a view: cinema, science and dissemination at the Museo Nazionale della Scienza e della Tecnica of Milan (1954-1964)

The Museo Nazionale della Scienza e della Tecnica (MNST) was founded in Milan in 1953 in the name of Leonardo da Vinci, celebrated as the symbol of the union between humanities, arts and science. In October 1954 the MNST opened a cinema theatre directly in its building, an unprecedented choice for an Italian museum. Cinema was a most popular entertainment in Italy in the 1950s, but the originality of the MNST project was stressed by the screenings programs, which included almost exclusively documentary and scientific cinema. Our paper will analyze the activity of the MNST cinema hall between the mid-1950s and mid-1960s. The recent reorganization of the MNST historical archives allowed to uncover the multiplicity of perspectives involved in it. The curators addressed the large debate that in the 1950s spread in the Italian universities about the educational and scientific role of cinema. At the MNST, films – even fictional movies – were regarded as tool of observation and discovery, implicitly reminding of the uses of cinema in the science laboratory. But the uses of cinema in the MNST were fostering also a different perspective on the culture of moving images of the time. We will enlighten how, throughout cinema, the MNST provided a fresh perspective in science dissemination, which not only wanted to overcome the traditional separation between

humanistic and scientific culture, but put also in discussion a strict separation between academic and popular scientific culture.

Boon, Timothy (Science Museum)

'What Manner of Men?' Meeting Scientists through Television

The Prizewinners (11 December 1962) was a key programme in the path-dependent development of televisual grammar for the representation of science in Britain. This was the first of a small flurry of interview programmes with scientists that, rather than seeking to convey the content of science instead placed the emphasis on the character, beliefs and personality of élite, male, scientists as a way of making science palatable to viewers. Although scientists had long appeared on television and in documentary films, this was the point at which personality became a self-conscious concern for television producers with, I will argue, significant results in subsequent televising of science and, indeed, in other media, including museum displays.

Gouyon, Jean-Baptiste (UCL)

From engaged citizen to lone hero. An investigation into the ecology of British television science

The presentation of Nobel laureates in the British television programme Horizon has evolved over the decades from politically engaged citizens to isolated Promethean figures. Of particular interest in this evolution is the narrative turn which the programme took in the late 1990s-early 2000s. Two kinds of primary material can help probe this narrative turn: the television programmes themselves, and oral history interviews with producers and editors of the series between the late 1960s and the mid-2000s. When contrasted, these two types of material tell a slightly different story. This paper examines this contrast, and reflects on the different value of TV programmes and oral history interviews, for understanding the history of science on television.

Nielsen, Kristian H. (Aarhus University)

'For the nation as a whole and for each individual in it': The Royal Society's public understanding of science report (1985) in historical context

The Royal Society's 1985 report on public understanding of science resulted from the work of an ad hoc group established in April 1983 under Walter F. Bodmer. The Society's interest in public understanding of science grew out of continuing concerns over low recruitment into the science and engineering sectors and over failing public and political support of basic research since the introduction of market-based approaches to scientific governance in the 1970's. The report argued that public understanding of science was fundamental to society. Better public understanding of science would boost national economy, improve the quality of public and private decision-making, and enrich the lives of individual citizens. Public understanding of science, Vice-President D.C. Smith concluded in the preface, is an issue 'that is important not only, or even mainly, for the scientific community but also for the nation as a whole and for each individual within it.' Based on published sources and archival material, this paper places the report's broad understanding of public understanding of science as well as its various recommendations to the scientific community, the educational system, the mass media, industry, museums, and government in a historical context. Key contextual elements to be addressed include prior changes to British science policy and the deliberations of the members of the ad hoc group as they forged the Royal Society's views on public understanding of science.

1107 MATERIAL CULTURE, DISCIPLINE FORMATION AND EDUCATION IN ENGINEERING

Location: SciM – Dana Studio

Chair: TBA

Eychenne, Bertrand (Université Paris Saclay)

The integration of the engineering school of Bogota to the *Universidad Nacional de Colombia* and their separation: the consequences on the training of Colombian engineers (1868-1880)

The government of the radicals, which intends to implement educational reforms and with them to transform the society, uses the university to prevent the breakup of the federal State threatened by the regional authorities' quest for autonomy. By focusing on the engineering school, we wish to show how the union of several institutions with the aim of creating the university thus allowing the training of Colombian civil engineers to develop, and how the civil war of 1876, caused by the educational reforms, led to the separation of the engineering school from the university and altered the way it operates by orienting it towards the training of scientific officers.

Our analysis will focus on the debates which sprung from the integration and then the separation of the engineering school and the university.

Wittje, Roland (Dept. of Humanities and Social Sciences, Indian Institute of Technology Madras)

Instruments of Development: Indo-German Scientific Collaboration and Engineering Practices at IIT Madras

This paper aims to explore Indo-German scientific and technological collaboration during the Cold War by looking at the history of the Indian Institute of Technology (IIT) Madras. IIT Madras was founded and set up between 1959 and 1974 with the assistance of the Federal Republic of (West) Germany during an evolving development discourse. The history of the Indian Institutes of Technology has so far been understood as the import of an MIT-type institution into post-independent Nehruvian India that facilitated outsourcing and the rise of the Indian IT industry. The history of IIT Madras, however, reveals a more complex story. As part of the Indo-German agreement, a number of German experts joined IIT Madras as professors for the initial years to set up laboratories and engineering curricula, to supervise students and research scholars, and to establish a corresponding research agenda. German ideas and practices of engineering education and research are manifested and materialised in laboratory setups and large amounts of German scientific equipment. How did the German professors think Indian engineers should be trained? How did German conceptions correspond to viewpoints and expectations of their Indian counterparts? How did Indian students, faculty and others experience the first decades of Indo-German collaboration? How did ideas and practices of engineering education and research unfold and transform in the Indian and local environment? I will trace the first generation of German experts, laboratory equipment and practices at IIT Madras and place them within concepts and practices of science and engineering education and research.

Valeriani, Simona (Victoria and Albert Museum)

Models as experiments? Methodological (dis)unity between engineering and architecture in the 19th century

This paper will take as its starting point the building of 'Albertopolis', the district in West London host to a number of cultural institutions, to look at the role played by experimentation within the engineering and architectural culture of the second half of the 19th century. A wealth of primary sources, including published articles and archival material, testifies to the importance placed on carrying out 'experiments' by the military engineers trusted with the design of a number of this iconic buildings, including the Royal Albert Hall and the South Kensington Museum (V&A), as a legacy of the Great Exhibition of 1851. In many cases the idea

of 'experiment' is closely linked with 3D models. These were a tool widely used by architects and –at least since the Renaissance– had been at the centre of a debate about usefulness and truthfulness. A commentator, in 1843 described modelling as 'an excellent handmaid to the philosophy of architecture' (*The Builder*, vol. 1, 1843) The paper will analyse the language and practice of experimentation on the building site, placing it in the context of other kinds of experiments military engineers regularly conducted in their practice, documented in professional journals and internal memos. Connecting this with the rich literature on the somewhat uneasy relationship between engineers and architects, who –in the period– were establishing themselves as a profession (e.g. founding of the Royal Institute of British Architects in 1837), the paper analyses methodological convergences and divergences between the two professional and scientific cultures.

Thébaud-Sorger, Marie (CNRS/Maison Française d'Oxford)

Fire-Fighting across Eighteenth-Century Europe. The Elaboration of collective Knowledge and shared Practices

During the seventeenth and eighteenth centuries, as demographic growth increased, making the urban environment a safer place became a matter of general concern. New approaches to fire fighting emerged, notably preventive methods to ward off the risk of fire by employing non-combustible materials or coatings. This involved popular know-how, an understanding of chemistry, and practical skills, all of which were put into use in different ways in different places, and with variations over the period. In the second half of the eighteenth century, many experiments were carried out in public in different cities, such as London, Paris, Brussels, Hamburg, Suhl, Vienna, St. Petersburg. The urban setting became the theatre of new scientific experiments and technical demonstrations during which the public was invited to contemplate houses which withstood the flames, thus reversing the dramatic and tragic association of large fires with the destruction of buildings. By retracing how this concern was addressed in different contexts, my aim is to underline the convergences observable within individual countries and operating within certain circles, such as municipal governments and academic societies. The knowledge shared by enlightened amateurs, apothecaries, physicians, and architects circulated through Europe with the support of learned bodies and societies (Royal Society, Society of arts, German ökonomische Gesellschaften, French provincial academies...), fostering discussions on the process of combustion, flammability, the role of air, and encouraging speculation on the properties of different materials, as well as contributing to debates over the composition of recipes and nature of substances used for fireproof coating.

Zakharchuk, Polina (S. I. Vavilov Institute for the History of Science and Technology of the Russian Academy of Sciences)

The Work of the Learned Mining Committee in Imperial Russia: 1825–1917

Mining and metallurgical industries have been the key sectors of the Russian state economy since the 17th century. This paper addresses cooperation and unity within the production sector and the scientific and engineering communities. In particular, this paper describes the foundation of the Learned Mining Committee, focuses on the results of its activities. Although Russia had already been training competent professionals for the mining and metallurgical enterprises, for many reasons, including the lack of the relevant professional periodicals, technological innovations sometimes took long to reach these enterprises. To address this problem, the LMC was set up in 1825 under the Mining Department (established in 1806) on the initiative of the Emperor Alexander I. The Committee combined renown scientists, practitioners, and managers of iron and steel enterprises. One of the Committee's core functions was scientific reviewing of the projects concerned with the developing mining and salt industries. The Committee also published *Journal of Mining* and facilitated the publication of technical works on the subject. The Committee members collected, processed and published statistical data and conducted studies on the history of metallurgy and mining. After the October 1917 Revolution, the Committee was dissolved, and the *Journal of Mining* first changed

SUNDAY 16 SEPTEMBER, 14.00-15.30

its name and then was temporarily discontinued. However, the experience of the Committee was taken into consideration in setting up the Soviet public administration bodies. The publication of the *Journal of Mining* was resumed. It is still being published in Russia.

SUNDAY 16 SEPTEMBER, 16.00-18.00

R31 NINETEENTH-CENTURY SCIENTIFIC CORRESPONDENCE NETWORKS

Location: IoE - Room 802

Chair: White, Paul (Darwin Correspondence Project)

Commentator: Neary, Francis (University of Cambridge)

Participants: Ferraz, Marcia H. M. (CESIMA-PUCSP/UCL)
Flannery, Maura C. (St. John's University, NY)
Gianquitto, Tina (Colorado School of Mines)
James, Frank A. J. L. (Royal Institution and UCL)
McCarthy, Gavan (The University of Melbourne)
Miknienė, Giedrė (Wroblewski Library of the Lithuanian Academy of Sciences)
Segala, Marco (Università dell'Aquila)
Weldon, Stephen (University of Oklahoma)
Pearn, Alison M. (University of Cambridge)
Brassington, Laura (University of Cambridge)

A consortium representing major correspondence corpora, among them the letters of Tyndall, Hooker, Faraday, and Darwin, is recreating the networks of scientific practitioners in the long nineteenth century. This session will be focussed around the first public release of Epsilon (www.darwinproject.ac.uk/Epsilon), a flexible technical framework that links letter-texts from multiple sources for cross-searching and analysis. It will explore the potential of recombined scientific correspondence from this period to prompt new directions in research, to reveal the contributions of women and other historically under-represented groups, to promote public engagement, and to provide data for present day scientific studies. The technical challenges will also be addressed. Epsilon, which was announced at the meeting of the History of Science Society in Toronto in November 2017, is being designed to promote and support the digital creation, delivery, and preservation of scientific correspondence, whether from existing editions or in small-scale research datasets, it will facilitate exploitation by the next generation of scholars and exploration by the widest possible public audience. The symposium will include a demonstration of the resource, together with roundtable presentations and open discussion. The roundtable will be organised around the major themes of: current approaches; technical challenges; research potential of linked 19th century scientific correspondence. Speakers will each give short presentations with ample time for open discussion. Topics include recovering informal exchanges; linking to other materials; the challenges and benefits of moving beyond the Anglo-American network; new perspectives on colonial/post-colonial science; links between letter writing, collecting and other practices; new ways of appraising participation, power and influence in the production of knowledge; reflections on the relationship and uses of digital and non-digital editions.

SUNDAY 16 SEPTEMBER, 16.00-18.00

S66 JAMES JOULE'S BICENTENARY: SCIENTIFIC AND PEDAGOGICAL ISSUES CONCERNING ENERGY CONSERVATION

Location: IoE - Room 804

Chair: Lopes Coelho, Ricardo

Organiser(s): Maurício, Paulo, and Lopes Coelho, Ricardo

With this symposium, proposed and organized by the Inter-Divisional Teaching Commission (IDTC) of the DHST/DLMPST, we intend to celebrate James Joule's bicentenary in 2018. His famous paddle wheel experiment with which he calculates the mechanical equivalent of heat is presented in every physics textbooks as a decisive if not crucial experiment in surpassing the caloric framework. The experiment is offered in the mentioned textbooks in a too much simplified form; in fact, he could not had performed it as he reported as recent replication of his experiment established. This symposium, has a threefold aim: a) celebrate James Joule achievement considering the most recent historiographic and epistemological work; b) discuss the scientific and pedagogical issues related to energy and energy conservation and how they are presented in textbooks and worked out in classroom, and, finally, c) discuss the present situation of teaching and learning science through the use of history of science both in K-12 and college level with an emphasis on energy and related concepts. J. Brian Pitts will discuss the implications of the development of the field theory to energy conservation and conclude that although the mathematical theory of the field theory is complicated, modest efforts could reduce students' misconception on energy conservation. Manuel Bächtold, will present a teaching strategy supported on the study and replication of Joule's paddle-wheel experiment. He will discuss the efficiency of this historical-based teaching strategy in students' outcomes. Ricardo L. Coelho will address how energy become understood as a substance through the time span between Clausius' 1850 paper and Lodge new concept of energy (1885) thus addressing a pressing issue in education that is the assignment of a substance-like ontology to energy by students and most teaches alike. Finnaly, Shaul Katzir argue that an incomplete notion of the principle of energy conservation was developed earlier than the historiography usually reports. Namely he will discuss the period between late 1810s to the 1840s where Fresnel, Ampère, Fr. Neumann, Roget, Faraday and Liebig employed incomplete notions of conservation to reach physical conclusion and laws in wave optics, electrodynamics and theory of batteries. From this he would suggest a diachronic view of its history, unlike the simultaneous discovery perspective.

Pitts, J. Brian (University of Cambridge)

Conservation of Energy: Missing Features in Its Nature and Justification and Why They Matter

The gap between what even many academics believe and what physicists know about energy conservation is striking. Justifications for energy conservation are partly empirical, such as Joule's paddle wheel experiment, and partly theoretical, such as Lagrange's statement in 1811 that living force (*vis viva*) is conserved if the potential energy does not depend on time. Noether synthesized and generalized such old results as Lagrange's and analogous results for momentum conservation and spatial homogeneity (due to Hamilton and Jacobi). She also proved a converse in 1918: symmetries imply conservation laws and vice versa. Conservation is thus not a categorical result, but (bi)conditional upon symmetries. The rise of field physics during the 1860s-1920s made a further difference: energy is in particular places, and conservation applies first not to the whole world, but to each place separately. The energy in any mathematical spatial box remains constant except insofar as energy flows through the walls; it cannot disappear in Paris and reappear in London, whether instantaneously or later. A

SUNDAY 16 SEPTEMBER, 16.00-18.00

global conservation law can be derived from adding up local conservation laws over the whole universe. This addition could fail to make mathematical sense, however, and probably doesn't for realistic cosmologies. Conceptions about conservation laws leads even academics to make poor arguments, such as has occurred for centuries about the mind-body problem. The mathematics of field theories and local conservation laws (partial derivatives) is too advanced for secondary school chemistry or physics. However, secondary education could reduce teaching misconceptions with modest effort.

Katzir, Shaul (Tel Aviv University)

The use of energy conservation before the formulation of the law

The historiography of the principle of energy conservation has concentrated on the formulation of the law by a few individual scientists. In this talk I will turn the analysis into the employments of the law before it was well formulated, and claim that these uses played an important role in the emergence of energy physics. From the late 1810s to the 1840s physicists like Fresnel, Ampère, Fr. Neumann, S. Carnot, Roget, Faraday and Liebig employed incomplete notions of conservation to reach physical conclusion and laws in wave optics, electrodynamics, thermodynamics and theory of batteries. Thereby they extended the validity of the law beyond non-frictional mechanical system, where the conservation of living forces (*vis-viva*) was accepted at the early 19th century. The examination of the uses of the principle would suggest a diachronic view of its history (unlike the simultaneous discovery perspective), and an understanding of its power in scientific inferences, and thus would suggest reasons for its development.

Lopes Coelho, Ricardo (Universidade de Lisboa)

How energy became a substance, 1850-1885

According to Joule, Rankine (1850) and Clausius (1850), heat is motion. In 1851, Thomson adhered to the dynamical theory of heat and introduced the concept of mechanical energy of a body. In 1852, Thomson divided the stores of mechanical energy available for men into two sets: the static and the dynamical. Rankine (1853) eliminates the adjective 'mechanical' in Thomson's 'mechanical energy' and characterises those two sets in potential and actual. Thomson (1854) uses Rankine's terminology in interpreting Joule's experiments. Rankine (1855) defines energy as the capacity of a body of doing work. In Maxwell's Theory of Heat, published several times in the 1870s, "the energy of a body may be defined as the capacity which it has of doing work". This definition was criticised by Lodge. He introduced then the concept of 'transference of energy' (1879). Thus, energy must be something that can be stored in a body and transferred from one body to another. In the cases, in which the bodies involved in transference of energy are not connected with each other, Lodge makes recourse to a linking element, the ether, through which energy could move (1885). Towards the end of the 19th century, some physicists raised objections to the concept of energy as a substance.

Bächtold, Manuel (University of Montpellier)

Introducing Joule's paddle wheel experiment in high school physics teaching: does it contribute to the learning of energy?

How to improve students' understanding of energy transformation and conservation remains a major challenge of energy teaching. To address this challenge, we developed a new teaching strategy suited to high school based on history and philosophy of science (HPS). This strategy was built and implemented in the frame of a collaborative and iterative work involving researchers and teachers. At the core of this strategy lies a sequence based on the study and replication of Joule's paddle-wheel experiment, which played a major role in the emergence of the idea of energy transformation, contributing thereby to the unification of physics in the middle of the 19th century. In this communication, we will investigate the following question: does such a teaching sequence built in the light of HPS and introducing some elements of HPS help high school students to better understand the concept of energy? We will first present the

SUNDAY 16 SEPTEMBER, 16.00-18.00

method for building, implementing and assessing the HPS-based strategy for teaching energy, before providing and discussing selected outcomes. The latter show that such a teaching strategy can indeed be efficient for many students with respect to their understanding of the notion of energy transformation and the principle of energy conservation.

S48 UNITY AND DISUNITY IN PSYCHOLOGICAL AND MEDICAL SCIENCE(S)

Location: IoE - Room 822

Chair: Borck, Cornelius

Organiser(s):

The disunity of science has often been, and still is, viewed by many researchers and professionals as threat and as a most salient problem among the human sciences. Sometimes this concern even led to the diagnosis of a state of crisis in the historical development of the discipline, such as it happened in the field of psychology and medicine in Germany in the 1920ies. Historical narratives of the first half of the 20th century aimed at counter-acting this trend, by pointing to discipline's common historical roots and constructing a coherent picture. Thereby, scientific criticisms, academic splits and heated debates about theory and practice were sometimes used justified some sub-division in scientific labor or disciplines while, other times, there were belittled, and even silenced. Thus, more research is needed to return to these problematic debates and tensions and to reflect critically on the role of historiography as powerful instrument to justify unity and disunity in sciences related to the human being, such as psychology, pedology (science of the child), pedagogy, neurology, general medicine and psychiatry.

In this panel we focus on the different rivaling approaches and techniques that emerged and were developed at a certain place and time, leading to debates about scientific expertise and professional boundaries. Questions such as the following will be explored: how did psychologists, pedologists, pedagogues and physicians deal with the diverse and contradictory views about mental 'abnormality', suicide and deafness? To what extent were some experts able to take control and homogenize approaches and techniques in these fields? How did the psychiatric establishment react to the multidisciplinary approach (Heilpädagogik) in the treatment of nervous diseases and the attempt to found neurology as autonomous discipline?

Mülberger, Annette (UAB)

Hygiene, Schooling, and Psychological Ruling: Detecting 'Mental Abnormality' in Spain

The paper deals with the different ways in which 'mental abnormality' was used as scientific category in psychological, pedagogical and medical texts in Spain during the first half of the 20th century. At that time, classifications of human beings into different psychological categories gained relevance. Clinical, psychological and pedagogical classifications were supposed to be based on 'objective' (scientific) criteria, imposing a 'rational' way of stratifying human society. Among them, also the category of (ab-)normality gained popularity and was subdivided into different types. I will first present some historical examples of social interventions aimed at detecting and selecting mentally abnormal schoolchildren. Such intervention took place in Spain during the first decade of the 20th century by means of intelligence testing. After that, I deal with the expansion of mental testing and its applications in schools in the following two decades. Finally, I show how the category of "mental abnormality" was used during the first period of the Franco regime. One striking characteristic of the uses of the category of mental abnormality is the lack of unity and consensus in definition and criteria. I argue that a progressive standardization of procedure returned the category of 'human abnormality' into an effective instrument of classification and segregation. Thus, the historical cases evidence the scientists' political and professional agenda. It reflects and expresses their different social reform projects and connect these to the discussions about disciplinary boundaries and scientific expertise between psychologists, physicians and pedagogues.

Byford, Andy (University of Durham)

The Unity and Disunity of Soviet Pedology, 1920s – early 1930s

SUNDAY 16 SEPTEMBER, 16.00-18.00

The paper considers the institutionalisation of child science or 'pedology' as a Soviet 'state science'. It deals with the institutional dynamics involved in incorporating the heterogeneous field of child science into the Soviet state apparatus across various (complex) state departments (the Commissariats of Education and Health). This involved a series of unpredictable institutional restructurings, yet which were seemingly irrevocably governed by the centrifugal drive of state centralisation, organisational rationalisation and ever-increasing administrative control. This process, however, also depended on the opposing, centripetal, dynamics of both administrative and scientific turf wars – ongoing divisions between government departments, as well as rivalries between research groups and disciplinary agendas. At the centre of the paper, however, is the analysis of how Soviet pedology was 'made', or more precisely, how its meanings as a 'Soviet science' evolved over the course of the 1920s-30s. In this context, the paper looks, first, how in the first half of the 1920s pedology formed a convenient 'bandwagon' formation that brought together a multiplicity of research programs and agendas around the study of the child and its development. Second, how soon after new leaders in the field, such as Blonsky, Vygotsky, Basov and Molozhavyi, sought to define pedology as a 'complex' discipline in its own right. Third, how, finally pedology was turned from a (pragmatic) 'bandwagon' and (wishful) 'synthesis' into a (political) 'program of takeover' of what was a highly amorphous and divided field.

Arnaud, Sabine (Centre Alexandre Koyré)

When deaf writers write back: the blind spots of psychological discourses

Starting in the 1880s, the importance of addressing a (supposedly) specific psychology of deaf people became a dominant trend in the conception of deafness held by French teachers, psychologists, and physicians, extending beyond conflicts about the limits of their fields. In fact, the focus gave psychological assumptions greater importance than the strict measure of an auditory imbalance in their understanding of deafness. This paper will examine the ways in which French deaf writers were aware of this curve from the start, and set themselves the task of denouncing such constructions. As early as 1882, and for over thirty years, Henri Gaillard questioned the use of the term abnormal, which, in the name of distinguishing a sensory difference, was soon equated with a mental difference, as well. In brochures, articles, and journals Gaillard either created, edited, or supported, he reviewed some of the most offensive publications, at times setting psychologists against teachers. Starting in 1886, the writers Limosin and Eugene Nee dedicated diatribes to highlighting how this psychological trend went hand in hand with pedagogical priorities that no longer fully allowed deaf pupils to develop their intellect. This paper will show how these deaf writers reactivated both unity and disunity across the sciences that were competing with each other to objectify them, thus defying the comfortable position of specialization.

Talavera Cabrejos, Gonzalo (University of Leeds)

Max Isserlin and the institutionalization of neurology in Munich 1914-1936 – a story of unity and disunity

At a time when a unification between psychiatry and neurology gains adherents, I consider of critical importance to understand the processes whereby they had been institutionally separated. While clinical neuropathology was a thriving specialism in late nineteenth century Germany, it was not yet an autonomous discipline. The First World War presented a unique opportunity for some doctors, psychiatrists and neuro-anatomists throughout Germany to secure institutional autonomy for neurology. This paper focuses on how the Munich-based psychiatrist Max Isserlin (1879-1941) and his colleagues fought for the autonomy of neurology by securing private funding and city support for the first neurology clinic in Munich in 1925. At the same time he promoting a multidisciplinary approach for treating nervous diseases, based on empirical psychology and special education (Heilpädagogik). This was accomplished despite the opposition of internists and psychiatrists holding university chairs, who argued that this development would be detrimental for medical progress and a waste of public funds. I argue

SUNDAY 16 SEPTEMBER, 16.00-18.00

that Isserlin's success resulted from his mobilization of clinical research. While Isserlin thus briefly defeated the medical establishment, the subsequent rise of National Socialism entailed that the autonomy of neurology was only finally achieved in Germany by the 1960s. To show that the institutional reforms of Isserlin were crucial for that end, I use (mostly unpublished) correspondence to be found in the Special Collections at the University of Leeds.

Serrano, Sara (UAB)

Suicide and the unity of neuropsychiatry in Spain (1900-1936)

The process of how suicide became a focus of medical concern in many countries during the 19th century has been already described by several historians. Under the influence of French alienism, this also happened in Spain. There, in the first third of the 20th century, and especially during the 1920s, suicide became one of the most salient topics in the professionalization and institutionalization of psychiatry. Firstly, most Spanish (neuro-) psychiatrists, when addressing suicide, distinguished on a methodological level, their clinical way from other, philosophical and statistical, approaches to suicide. Secondly, they justified the exclusive legitimacy and authority of their professional and theoretical approach to suicide, by remarking the homogeneity and unity of professional experiences of psychiatrists within the clinical context. Thirdly, they promoted prevention of suicide to be exclusively limited to the new institutional network of psychiatric services. Thus, this paper will show which theoretical and professional strategies were used by these psychiatrists to defend the unity of neuropsychiatry and how these constituted an essential part of the process of medical colonization of suicide in Spain during the first third of the 20th century.

S51 LITTLE SCIENCE

Location: IoE - Room 828

Chair: Martin, Joseph D.

Organiser(s): Roqué, Xavier

Compared to all that we know about Big Science, little is known about little science. The concept itself lacks a proper definition: what does “little” stand for? Inexpensive? Of scarce interest to the media? Little or slow? Little science risks being conceived of as the negative counterpart, the obsolete precursor, or the poor sister of Big Science, a scientific practice on its way to extinction. The symposium will challenge these meanings and explore ways to think about little science on its own. For the sake of clarity, little science will be provisionally defined as a contemporary knowledge-making practice performed by small teams of researchers that know each other and acknowledge that personal relations are central to research; as a practice that does not necessarily entail transnational cooperation and certainly does not depend on multi-million budgets; as a practice that may focus on what appears to be well-trodden paths with little promise... But crucially and paradoxically, too, as a practice that is disproportionately relevant and disruptive, and contributes to a great extent to produce new knowledge. The Superconductivity Group at the Universitat Autònoma de Barcelona provides an example. Consisting of seven members, combining theoretical and experimental physicists, and building prototypes from scratch in a tiny lab, its research on magnetic cloaks and wormholes was published in leading journals and featured in international news agencies. How does this fit with prevailing images of contemporary scientific practice? How does it relate to a broader argument about the long march of professionalization and the corresponding increase in size of the scientific enterprise? The symposium will therefore dwell on the theme of unity and disunity in the sciences, and the epistemic importance of little science, by looking at the relation between scale and relevance, broadly conceived.

Butrica, Andrew (Independent Scholar)

Planetary Radar Astronomy: Between Little Science and Big Science

Planetary radar astronomy, despite its origins in Big Science, quickly became and continued to remain Little Science. One can describe it accurately as a contemporary knowledge-making practice performed by small teams of researchers. It contributes dramatically to the production of new scientific knowledge, while existing on modest budgets, but relying nonetheless on Big Science primarily for instrumentation. Radar astronomy has always been conducted by small teams of researchers whose numbers literally have declined over time. They all know each other and have common institutional ties. Transnational cooperation existed only in the early days through collaboration with Jodrell Bank (UK). In contrast, radar astronomy has relied on access to large-scale, expensive equipment made available thanks to Big Science. Military spending provided the initial budgets, but funding later shifted to the civilian sector, specifically the National Science Foundation (NSF) and NASA. The actual budgets, though, always remained small. Despite its diminutive size, radar astronomy contributed fundamentally to astronomical science. On one hand, they provided raw data, for instance, for the compilation of the astronomical ephemerides used worldwide. On the other, their imaging abilities contributed in such areas as the topography of Venus and the shape and motions of asteroids. Thus, radar astronomy presents an example of a very successful program of scientific research carried out under Little Science conditions, although dependent on Big Science spending on equipment.

Martin, Joseph D. (University of Cambridge)

Before New Big Science

SUNDAY 16 SEPTEMBER, 16.00-18.00

The mass spectrometer found its first success as a means to determine the isotopic masses and constitutions of chemical elements. As the last known elements were analysed, its future in physics and chemistry laboratories was in doubt—and its inventor, Francis Aston, reportedly said so. From the 1940s to the 1960s, however, the mass spectrometer transformed from an instrument refined to answer a well-defined problem within a specific theoretical program into a flexible analytical tool that brought together researchers from disciplines across the natural sciences. This paper examines that transition through the cohort of young mass spectroscopists who was instrumental to finding new realms where their favoured tool could be applied and to building an interdisciplinary community around it. It argues that the reinvention of the mass spectrometer that the likes of Alfred Otto Carl Nier, Kenneth Bainbridge, and Edward Jordan helped effect prefigured a similar transition in accelerator laboratories, which Catherine Westfall and Robert P. Crease have called “new big science,” some decades later, suggesting that features of new big science reflect more general patterns of instrument use and the relationship between theory and experimental practice. This story further offers a useful perspective on unity and disunity in the history of science. In its first iteration, the mass spectrometer was strongly tied to unified theoretical programme. But it was principally by decoupling itself from that programme, and embracing a diverse but conceptually disunified set of applications, that it became the locus of a unified instrumental community.

Oliveira, Raiany (University of São Paulo)

Unity and Disunity within the Little Science done by the Physics Group of the FFCL-USP throughout the 1950s

This paper intends to discuss how the production of scientific knowledge was made in Brazil throughout the 1950s by means of the case study of the scientific work done by the Physics Group inside the Section of Science of the Faculty of Philosophy, Sciences, and Languages of the University of São Paulo, FFCL-USP. The Section of Science assembled the huge range of basic sciences, precisely Mathematics, Physics, Chemistry and Natural History. Their professors shared positions, teaching different subjects and promoting flow connections among different disciplines of knowledge. That community of scientists was based on mixed groups composed by both locals and European professionals who had been encouraged to come and be part of the University staff since its foundation in 1934. The creation of the Physics Department was marked by the presence of Gleb Wataghin, an Italian Professor that has introduced Experimental Physics by researching on quantum electrodynamics. After coming back to Italy, due to issues related with the Second World War, his pupils proceeded to researches on Experimental Particle Physics, as Marcelo Damy de Sousa Santos, the one who implemented the first particle accelerator in Brazil - the Betatron. At the same time, Oscar Sala struggled to start working on a Van de Graaf linear accelerator and during the whole 1950s, the researches made in the Physics Department were centered on experiments to improve the efficiency and precision of the electron accelerators using local technology and resources. This Little Science has contributed to developing a more accurate Nuclear Physics.

Roqué, Xavier (UAB)

Magnetic hoses, cloaks, and wormholes: a case-study in little science

In this paper I describe and analyse the work done by the Superconductivity Group at the Universitat Autònoma de Barcelona as a case-study in little science. This is a stable group of 5 to 10 researchers working within the Physics Department of the university. Combining theoretical and experimental skills in electromagnetism and materials science, the group builds working models displaying theoretically intriguing, potentially useful phenomena. They have devised and shown the first magnetic cloak (2012), a magnetic hose (2014), and a magnetic wormhole (2015). Even though this research has featured in leading journals, attracted funding, prompted international collaborations, been awarded, and drawn media attention, the group keeps working in relatively small premises with modest means. Rather than being a hindrance, the group's size appears to have worked to its advantage, stimulating creativity and favouring

SUNDAY 16 SEPTEMBER, 16.00-18.00

cooperation and cohesion amongst its members. I will build on this example to reflect on the current meanings and prospects of little science. Is this a useful category? If so, what would be its main features? How does it relate to other ways of categorising contemporary scientific practice?

1129 MATHEMATICS 1

Location: IoE - Committee Room 1

Chair: Stenhouse, Brigitte

Berenguer, Joaquim (Universitat Politècnica de Catalunya)

Tomàs Cerdà: Introducing Differential Calculus in Spain. The fluxion of the product and areas of curves

In the beginning of Differential Calculus, new concepts were employed in different approaches by eighteenth century European mathematicians. The teaching of the Differential Calculus in Eighteenth century Spain was introduced by several authors, such as Pedro Padilla (1724-1807?), Johannes Wendingen (1715-1790), Tomàs Cerdà (1715-1791) and Christian Rieger (1714-1780) influenced by mathematicians such as Christian Wolff (1679-1754), the Marquis of L'Hôpital (1661-1704), Colin Maclaurin (1698-1746) and Thomas Simpson (1710-1761), among others. Cerdà, a Catalan mathematician, published a treatise on Differential Calculus entitled *Tratado de Fluxiones*, which is an adaptation of Simpson's *The Doctrine and Application of Fluxions*. Our aim in this paper is to explain Cerdà's special contribution to the Newtonian theory of fluxions based on the definition of fluxion given by Simpson. Specifically, we seek to show that Cerdà on the one hand deduced the fluxion of the product of two variables and on the other hand the area under a curve. This mathematician arrived at these demonstrations by establishing the fluxion of a curvilinear surface, which was a different reasoning than that employed by other contemporaneous mathematicians and teachers in Spain. In his *Tratado de Fluxiones*, Cerdà basically follows Simpson's text, while also introducing certain Leibnizian elements, such as the notation of the Leibnizian differential, which provides a new perspective on the Newtonian conception. He also includes relevant reflections on Leibnizian orientation, which emphasise how much pedagogical factors prevail over the differences between the two visions of the Differential Calculus in the approach adopted by this Catalan mathematician.

Fiocca, Alessandra (University of Ferrara)

"A Masterly Though Neglected Work": Boscovich's Treatise on Conic Sections

The paper embraces the conference theme of 'Unity and Disunity' within and across diverse sciences, mathematics and natural philosophy, diverse nations, Italy and England, different periods, Eighteenth and Nineteenth centuries. In 1754, in the second edition of his *Elementa Universae Matheseos* Roger Joseph Boscovich (1711-1787) published the work *Sectionum Conicarum Elementa*. Boscovich started his treatise on conic sections by their definition in the plane, as the locus of points whose distances from a fixed straight line (directrix), and a fixed point (focus), are in constant ratio. Although this property was known to Pappus, it was Newton who brought it fully to light in his *Principia Mathematica*. As Newton, also Boscovich favoured the synthetic method to the analytical one, and through this definition he introduced a completely new tool, the so called "eccentric circle", by which he developed the whole theory of conics. The aim of this paper is to discuss the genesis of the *Sectionum Conicarum Elementa*, together with the motivations which led Boscovich to write this work, to illustrate the structure of this treatise, and to show how he developed the idea of the eccentric circle. Finally, we comment on the reception of his treatise especially in England, where Boscovich's influence was very strong because his ideas in natural philosophy become an integral part of the reigning Newtonian tradition and moreover, he was viewed as the great Continental ambassador of Newtonian ideas.

Jordi Taltavull, Marta (Johannes Gutenberg Universität Mainz - Institut für Mathematik)

On the boundary between physics and mathematics: Fresnel's wave surface and projective geometry

Geometrical optics is one of the most ancient parts of optics, which deals with the laws of light propagation. The basic laws of geometrical optics have survived for centuries over different

SUNDAY 16 SEPTEMBER, 16.00-18.00

conceptions of the nature of light and of vision, thus geometrical optics provides us with a fascinating object of study on the boundary between mathematical and physical approaches to optics to analyze the dynamic relationship between both domains. My idea is to analyze one specific mathematical-physical object of geometrical optics from this perspective, in particular the wave surface, proposed by Augustin Fresnel in 1821 to understand the propagation of light through anisotropic, biaxial crystals. Crystals had been a challenge in optics ever since the discovery of double refraction in the late 17th century, for light behavior depended on the direction of light propagation. Most interestingly, in few years after 1821 the ways to manipulate Fresnel's wave surface diversified, between physics and mathematics. For Fresnel had not published any derivation of the formula of the wave surface, other physicists after him, like James MacCullagh and William R. Hamilton, explored alternative methods to do so. In this context Fresnel's surface soon became the most prominent example of a quartic surface in the mathematical literature on projective algebraic geometry, a new branch of mathematics emerged in the 1830s. What is the relation between the origin of both Fresnel's surface and projective algebraic geometry? Until which extent does Fresnel's surface speak to a dynamics of differentiation or/and cross-fertilization between disunited fields of knowledge?

Ogawa, Tsukane (Yokkaichi University)

The Mathematical Philosophies of Seki Takakazu and Aida Yasuaki

Seki Takakazu (?-1708) is hailed as the founder of traditional mathematics of the Japanese Edo period (1603-1867). In those times, his Seki school was the main mathematical school. However, few of his contemporaries truly understood his mathematical philosophy due to his achievements begin widespread and his philosophy ahead of the times. In short, his main philosophy was one of generalization or abstraction. All his works, which deal with many different problems, aimed at this. For example, he tried to find the sum of p -th powers of the first n natural numbers and discovered the Bernoulli-Seki numbers. He was also the first mathematician who studied equations themselves as a subject. No one before him had thought about equations in general and finding all their solutions. Seki's pupil Takebe Katahiro (1664-1739) was one of the few mathematicians who reasonably understood Seki's mathematics and philosophy. For instance, he extended his master's acceleration method for calculating π to obtain a value of 42 digits in 1722. But it is impossible to say that even he inherited and developed his master's philosophy.

Aida Yasuaki (1747-1817) - who founded Saijo school against Seki - also tried to generalize problems, but he too didn't quite recognize Seki's philosophy. He wrote "Survey of Ancient and Modern Mathematics" in 1797 and criticized the work of Seki and Takebe. Considering his argument, I will compare Aida's mathematical philosophy with Seki's and clarify their characteristics.

I114 INSTRUMENTS AND MAPPING THE WORLD

Location: IoE - Room 736

Chair: Clifton, Gloria

Chen, Zhihui (Inner Mongolia Normal University, China)

Ancient or modern? -- Astronomical Instruments at the Ancient Observatory of Beijing in the Eyes of Europeans in the 1870s and 1880s

The Ancient Observatory of Beijing, which now is still perfectly preserved, can date back to the year 1279. For several hundred centuries, traditional Chinese astronomical instruments and afterwards Europeanized instrument established by Jesuits were installed on the terrace of the Observatory. As early as the 1870s, Europeans had been interested in the Observatory that was still used for observation at that time. In the International Congress of Orientalists 1876, British sinologist Alexander Wylie (1815-1887) read a paper entitled "The Mongol Astronomical Instruments in Peking". After Wylie, the Irish astronomer J. Dreyer and his friend S. M. Russell, who was an astronomical professor at the Tongwenguan (同文館, College of Foreign Languages). Dreyer's paper had drawn the Amiral Mouchez (1821-1892), who was the director of the Observatory of Paris. In 1887, Mouchez requested some photographs of the instruments the astronomical museum established by him at the Paris. These photographs were not only presented in the scientific magazine *La Nature*, but also exhibited at the Paris World Exposition afterwards in 1889. Through the introduction and promotion by these European scholars, Astronomical Instruments at the Ancient Observatory of Beijing had been presented before the European people with an image of high level scientific instruments and exquisite arts in the history of science. Different from the sinologists' concentration on the tradition of the instrument in ancient China, the Exposition focused on the Europeanized instruments constructed by the help of Jesuits, in order to show the achievement of the European modern science in the Eastern world.

Yang, Wei-Ting (Institute of History, National Tsing-Hua University, Hsinchu, Taiwan)

An Analysis of Genealogy of Japanese Buddhist World Maps

We study the relationships between Buddhist world maps made in Japan from the 14th to 19th century. The maps of the same area sometimes look different because they show different cartographic styles and represent various knowledge and concepts of different periods. To reconstruct the relationships between the maps, this paper attempts to discuss the applicability of the methodology of "textual analysis" for the study of cartography. The 18 maps are divided into three groups: "Go Tenjiku zu" 五天竺圖, "Nansenbushu bankoku shoka no zu" 南瞻部洲萬國掌葉之圖 and "Nan'enbudai shokoku shuuran no zu" 南閩浮提諸國集覽之圖 according to their style and background. We designed two methods: one is an analysis of the directions and distances of several points on the maps conducted in order to identify their specific features; the other is a computer-aided method that we designed on the basis of phylogenetic method developed in biology to build a genealogical tree of maps. We will compare the results of these two methods to analyze their effectiveness, discuss the relationships between the maps in each group and draw a genealogical tree for all the maps of the three groups.

Zhang, Jiuchen (Institute for the History of Natural Science, Chinese Academy of Sciences)

How Modern Geology Was Published: A Case Study of Chinese Geological Journals, 1919 to 1948

Modern geology was introduced into China in the early twentieth century. This subject was accepted by Chinese people after the processes of introduction, acceptance and growth. As academic periodicals were the main information carriers, and were also the medium of communication for scientific research achievements, this paper examines the creation and development of the geological journals which were published in China from 1919 to 1949. This

SUNDAY 16 SEPTEMBER, 16.00-18.00

research reflects the transmission of modern geology into China from the research on the development of the types and an increase in quantity of geological journals; unifying terminology and using of scientific language, changing of the author group, and social impacts such as the Second Sino-Japanese War. The study draws the conclusion that the process of scientific transmission includes introduction, reconstruction, and output. Its goal is to become international.

Ivanov, Konstantin (Institute for the History of Science and Technology, Moscow)

Astronomers and Surveyors in the Struggle for the “Upper Oxus State”: A Few More Episodes in the Great Game of Middle Asia

The territory of the Central Asia, occupied by Imperial Russia between 1865–1878, was mainly desert land that contained just a few small, densely populated oases. Why was it necessary to gain control of it? It did not serve any military purpose, because the better protection of the southern frontier of the Empire were the notorious deserts and dry steppes. Economically, it was also a questionable venture. The advance of Great Britain into the same region from the opposite side reflected the same trend. Paradoxically, the only rational reason to move into the region was a scientific one. At that time, the Central Asia was still a blank spot on the European maps and it was the only region on Earth in which the great empires had not yet confronted each other. The frontier lines of both empires were bound to move in on each other, even if unfavorable for each of them. In my talk, I am going to show how the war for the territory eventually turned into a war against the territory. The main agents of that war were the British and Russian military geodesists and surveyors, who used their skills to advance their careers. Rather than a hostile confrontation, to them, their collaboration during the demarcation between the Russian Empire and Great Britain in 1885, brought the pleasure of sharing topographical and geographical information. As a result, this region was surveyed and explained not only in terms of geography, but also economically, ethnically, and historically.

Godinho, Carlos (University of Lisbon)

[The Armillary Sphere and the Virtue of Hope]

Present across material cultures in media such as books, paintings and sculptures, the armillary sphere is arguably one of the most commonly depicted scientific instruments from Antiquity to the Renaissance. Nevertheless, the significance of this geocentric model of the universe as a way to understand the cultures of science has not been fully assessed. While it has been discussed in the historiography, the key role of the model as an object in which astronomy and theology intersect in the Renaissance has not been considered. The lack of a standard terminology between the Middle Ages and the Renaissance makes it hard to identify all the possible references to the armillary sphere in textual sources. A deeper reading of those sources, and, especially, a careful analysis of its visual representations are both required to disclose the cultural meaning of the model during this period. I will try to relate theoretical worldviews with contextualized material cultures by exploring the association of the armillary sphere with the theological virtue of Hope. I claim that this virtue, which worked as one’s desire and expectation of union with God, was believed to be potentiated through the visualization of the armillary sphere. Relying on a number of visual and textual evidence, I propose that the model was seen as a godlike archetype. Built on a Christian Neoplatonic tradition embedded in Portugal’s 16th century astronomical and theological culture, the sphere represented an ambiguous relationship of unity and disunity between the Creator and the Cosmos.

I136 HUMAN SCIENCES

Location: IoE - Room 780

Chair: Morton, Alan

Dadaian, Anna (UCL - CMII (Health Humanities))

Jung on the Unity and Disunity of Science and the Role of Psychology

In this paper, I outline Carl Gustav Jung's position regarding the notions of 'unity' and 'disunity' in psychology, as well as in science in general, based on his writings in 'Psychological Types' originally published in 1921. The aim of this paper is twofold. In the first part, I illustrate that at the heart of Jung's theory of psychological types is a plea for disunity in psychology. In particular, I show that Jung's typology provides a basis for a pluralistic methodology in psychology. In 'Psychological Types', Jung argues that 'the assumption that only one psychology exists or only one fundamental psychological principle is an intolerable tyranny, a pseudo-scientific prejudice of the common man' (Jung, 1971, p. 41). In the second part of this paper, on the other hand, I show that Jung conceptualised his typology as a way of overcoming the bias, or 'subjectivity', of the scientist and moving towards 'objectivity' and unity. From this perspective, psychology is conceived of as the 'unifying language' of science. I explore why Jung thinks this is the case by looking at how he conceptualised his theory of psychological types—its philosophical basis. I argue that Jung follows William James in his contention that 'the history of philosophy is, to a great extent, that of a certain clash of temperaments' (James cited in *ibid.*, p. 300). Jung's typology, then, and, by extension, psychology, can be understood as a meta-epistemology—an analytical framework, or a language, allowing us to acknowledge our epistemological biases and engage in fruitful discussions.

Pannese, Alessia (University of Oxford)

One Self: the autonomic nervous system and the (dis)unity of consciousness

Aristotle distinguished between intellectual and moral virtues, holding that the former result from instruction whilst the latter from habit. Nineteenth-century empirical evidence confirmed that much of everyday action consists of habits: by the end of the century, William James estimated that 'ninety-nine hundredths or, possibly, nine hundred and ninety-nine thousandths of our activity is purely automatic and habitual.' The pervasiveness of habit in human behaviour mirrors the centrality of automaticity in human physiology. Physiological accounts of automaticity made great strides in the second half of the nineteenth century, thanks to discoveries made by Claude Bernard (1813-1878), Walter H Gaskell (1847-1914), Walter Bradford Cannon (1871-1945), and John Newport Langley (1852-1925), who, in 1898, introduced the term "autonomic nervous system". Based on the experimental evidence accrued from these and other investigators' physiological studies, it became clear that the autonomic nervous system fulfils an essential role for the organism's integrity and survival because it maintains homeostasis, i.e. internal unity and balance in the face of variability in the external environment. Drawing on the 19th-century physiological literature, I will suggest that this realisation problematised the understanding of the self (as defined by conscious control) and of its relation to self-regulation (as dominated by automaticity). I will present my case by examining ways in which the discovery and characterisation of the autonomic nervous system as major player in self-regulation led to a novel understanding of human conscious experience of the self as uncoupled (dis-united) from self-regulation, and of self-regulation as coupled (united) with automaticity.

Tanghe, Koen (Ghent University)

On the non-Existence of a Science of Man: A View from the Past

The project of a science of man is older than both the idea of a science dedicated to the study of the Earth ('geology') and the concept of a science of life ('biology'). And yet, anno 2018, a young student can aspire to become a biologist, specialized in molecular genetics, or a geologist, specialized in volcanology but she can still not embark on a study of what might be called

SUNDAY 16 SEPTEMBER, 16.00-18.00

andropology and subsequently specialize in bio-anthropology, economics or medieval archaeology. Why was the creation of geology and biology through the integration of, respectively, eighteenth-century Earth sciences and nineteenth-century life sciences successful whereas scarce attempts to integrate the sciences that study our species have failed? The common denominator of the former two integrations offers the beginning of an answer to that question: they were facilitated by the discovery and study of the deep history of Earth and life. Nothing makes sense in geology or biology, except in the light of that history. The main reason why the deep, binary or bio-cultural history of man has not, likewise, acted as a catalyst for an integration of the human sciences must be sought in the ancient conflict between the study of life and the study of man. The main, counter-intuitive thesis of this presentation is that biology is the chief culprit of this chronic friction and, ipso facto, of the lingering lack of an integration of the human sciences, based on the bio-cultural history of our species.

Tarbuck, Derya (Bahcesehir University)

Religious, Scientific and Philosophical Accounts of Melancholia in the Eighteenth Century

The relationship between a study of Moral Philosophy, eighteenth-century Medicine and the changing understanding of Melancholia is not such straightforward one. It is already established that the Enlightenment study of mind and emotions was a branch of moral philosophy. Especially when one considers that the main purpose of the Scottish thinkers in the eighteenth century was a study of Man. This study includes an assessment of the self as a man with feelings, sociable instincts etc. When one considers feelings as expressions of mind, this opens up a new territory for an understanding of Melancholy. The questions I would like to ask in this respect are how did the eighteenth-century theorists of Reason and Emotion think about Religious Morality? How were the scientific categories and philosophical conclusions about the conception of Morality in the eighteenth century negotiated with the Religious approach to Ethics? How did the evolution of Moral Philosophy in the eighteenth century have an effect on the ways in which Religion moderated the Moral Behaviour? The aim of this paper is to elaborate these points of view within the general framework of the secularization of Melancholy, by examining religious, philosophical and medicine related treatises that dealt with the subject in the eighteenth century.

Limeira Da Silva, Victor Rafael (UFBA/UEFS)

Between uniformity and human diversity: a proposal of an ethnography of the Uaupes Indigenous in Wallace's scientific travel on the Amazon

In spite of the fact that historians have paid more attention to the travels of Alfred Russel Wallace on the Brazilian Amazon (1848-1852), the historiography has focused on his practice as a neophyte scientific collector, and no research has engaged in studying his ethnographic work on the Amazonian indigenous people. The labeling of imperial reports reinforced the homogenization of upper Amazon indigenous as "savages" through comparative categories with well-known groups, such as the Tupi-guarani, the so-called "civilized". Initially under this logic, Wallace dedicated his two last trips to the Uaupes river to collect and register ornaments, instruments, moralities, racial constitutions, musicalities and languages of the natives with whom he came into contact. This communication is an effort to contribute to the history of the ethnographic dimension of Wallace's travel to the Amazon and of his interaction with the emerging Human Sciences. It intends to reflect upon Wallace's contributions to the Amazonian indigenous ethnology. It also concentrates on analyzing the classificatory schemes applied by Wallace, in order to question the extent to which it corroborates the idea of "uniformity", derived from the indigenous tutelage system lexicon, or "diversity", a notion that emerged with the growing interest in the humankind history by early Ethnology and Anthropology. This communication also aims at addressing possible reverberations of this study to the historiography of Wallace's fieldwork and scientific production, still massively interested only in the entomological and zoological aspects of the Amazonian incursion of the young British naturalist.

SUNDAY 16 SEPTEMBER, 16.00-18.00

**S21/3 CONTINUITY AND DISCONTINUITY OF UNIVERSITY EDUCATION AND RESEARCH
ACTIVITIES OF CENTRAL EUROPEAN SCHOLARS DURING WORLD WAR II**

Location: IoE - Room 784

Chair: Svobodný, Petr

Organiser(s): Jůnová Macková, Adéla; Sekyrkova, Milada; and Kokowski, Michał

Commentator: Ash, Mitchell

World War II changed and challenged generations of European researchers, and impacted on the existence of research institutions. Several occupied countries had to close their higher education institutions in 1939 (Protectorate Bohemia and Moravia, Poland), scholars lost jobs and students opportunities. One solution that maintained a research career as a viable option for scholars consisted of teams in non-university research institutions. It was a way of survival that offered work, and sustenance, even though with limited teaching opportunities, and limited publication outlets. A generation of students had to leave the universities, and their younger followers did not have a perspective – army life and factory work was an imposed solution. An alternative applied in Austria, Hungary, and Germany itself was to embark on research projects and teaching plans deemed acceptable to the regime and to war conditions. Across Nazi-controlled Europe, racial laws, army conscriptions, and enforced exile exercised a considerable influence, next to a reorientation of research programmes to contributions to the war effort. Historiography mapping and interpreting a profound war impact in occupied regions concerns both institutional histories and individual, more biographically oriented aspects. Personal histories of Central European researchers on diverse sides of the conflict included also resistance to the Nazi regime. The symposium panel is concerned with a continuity and discontinuity of research institutions, disciplines, and research interests of Central European researchers during the war. Both institutional and individual aspects have been incorporated, mapping diverse strategies and outcomes. The individual perspective also includes everyday existence, and very personal aspects of habitus, with practices and representations set in highly complex situations, such as exile, resistance, war effort, or survival in a totalitarian regime.

Kokowski, Michał (Polish Academy of Sciences)

Higher education and research activities in Poland and in exile during World War II (a review of main issues)

The paper discusses the state of higher education and research in Poland during World War II in the areas occupied both by the Third Reich (until 22 June 1941, only the western part of Poland, including Poznań, Warsaw and Kraków; short after this date – all territory of Poland) and by the Soviet Union (until 22 June 1941, the eastern part of Poland, including: Vilnius and Lviv). It considers, among others, the imprisonment and murder of Polish scholars by the invaders (e.g. Sonderaktion Krakau, starting on 6 November 1939 in Kraków and ending with the deportation of Polish scholars to the Sachsenhausen concentration camp; the murder of Lviv scholars by the Nazis in June 1941; the murder of Polish scholars by the Soviets in 1939–1941); the closure of Polish universities; the looting of scientific goods, both material and intellectual, belonging to Polish academic institutions or scholars; the devastation of academic buildings; the Nazification and the Sovietization of higher education and research activities in the areas of Poland occupied by the Third Reich and the Soviet Union respectively; the foundation of new scientific institutions; the public and secret academic activity of Polish scholars; the clandestine higher education in Poland; the emigration of many Polish scholars abroad; the Polish institutions of higher education and research in exile; the very difficult and complex issue of historical axiology, i.e. patriotism and collaboration with the occupants.

Wójcik, Wiesław (Jan Długosz University in Częstochowa)

The creation of new research centers in the West by Polish mathematicians emigrating during the Second World War

In the paper I demonstrate the creation of new research centers in the West by Polish mathematicians emigrating during the Second World War. The rapid development of the Polish School of Mathematics was interrupted by the outbreak of World War II. During the war, scientific activity in the occupied Polish lands almost completely froze. Some mathematicians emigrated (mainly to the United States), where some of them have created significant research centers. The examples of such mathematicians are: Antoni Zygmund, Samuel Eilenberg, Alfred Tarski, Jerzy Sława-Neyman, Mark Kac. These centre can be treated as a continuation of the Polish Mathematical School (I will try to justify it in the article). I will focus on the most important mathematical centers created by Polish mathematicians. I will outline their significance for the development of mathematics, and on selected examples, I will also show the specific scientific achievements of these centers.

Vogt, Annette B. (MPI Berlin)

Scientists and their resistance against the Nazi regime

During the long-durée investigation of female scientists at the Kaiser Wilhelm Institutes and at the Berlin University, we found out only very few male and female scientists who were strictly against the Nazi regime, from the very beginning, or later (Vogt (2007), pp. 383-411). Eight out of 710 female doctoral students at the Berlin University and very few scientists in the Kaiser Wilhelm Society were involved in resistance activities. First, I'll sketch out the situation for German scientists under the Nazi regime, and the circumstances becoming either an active Nazi, or being opportunistically and building one's career, or following their mind and heart and becoming one of the very few people to resist. Second, I'll describe the different activities of resistance, the various resistance groups and their actions. Third, I'll illustrate some examples of these resistance activities of male and female scientists who were working in some Kaiser Wilhelm Institutes, at the Berlin University, and in other research units in Berlin and other towns. These scientists had in common their great courage, they maintained severe discipline, they were ingenious to help persecuted people, and to help each other. After the unconditional surrender of the Nazi regime most of them didn't talked about their resistance activities, they kept their secret resistance fights silent. Although they belonged to a very small minority, it should be the duty to investigate and to remember their activities.

Sekyrková, Milada (Charles University, Prague)

Life Unity and Work Disunity of Czechoslovak Historian Otakar Odložilík during WWII

The WWII changed the fate of most people who experienced it. Its impact was, of course, as a rule negative. Paradoxically, there are people who have moved on in their working career strongly in a way they have not dared before, or war period gave them the possibility of living freer, more naturally of their nature and of their founding. The paper focuses on the research and the private trips and contacts of historian Otakar Odložilík (1899-1973), professor of Czechoslovak history at the Charles University in Prague, until the outbreak of the WWII and during it. Paper explains the continuity of Odložilík's travels during the war in time of his first emigration in the U.S.A. and later in the U.K. where he worked for the Czechoslovak exiled government. In addition, it speaks about his achieved research results, and shows how the war has changed or didn't changed his research goals and his private life. He returned to Prague for three years after the war, but in 1948 he finally emigrated and died abroad. Paper is based on Odložilík's diaries, correspondence and his personal archive funds from Czech archives.

SUNDAY 16 SEPTEMBER, 16.00-18.00

S47/2 MEANINGFUL COLOUR: EPISTEMOLOGY OF COLOUR IN THE SCIENCES (EARLY MODERNITY TO TODAY)

2. THE REPRESENTATIONAL MATTER OF COLOUR: ITS EPISTEMIC WEIGHT

Location: IoE - Room 790

Chair: Berry, Dominic

Organiser(s): Bock von Wülfingen, Bettina

From amazingly colourful antique relics to the attempts to standardise colours in biomedical imaging – colour is gaining in relevance in the sciences. Yet the epistemic role of colour, its long-standing neglect due to historic symbolic, in part gendered, ascriptions, and the function of colour in visualizations for internal scientific use have not received much attention in the sciences and humanities to date. This is especially the case for non-mimetic colour use. With the term non-mimetic we refer to colours that are not applied to mimic colours of nature (such as the sky blue, urine, or plant colours) but are of (sometimes hidden and unintended) semiotic relevance. The internal use of colour in the sciences raises different epistemological questions to those that arise with images for external communication. The choice and symbolism of colour in the latter case is guided to a greater degree by a need for simplification and considerations as to the expectations of a broader public. Coloured images for internal scientific use emerge during the research process itself (as a medium for self-reflection) or are produced in appliances and used for intersubjective communication and to obtain feedback from the scientific community. Digital publishing has enhanced the use of colour in scientific images, in contrast to the costly use of colour in print media, whilst the globalisation of the scientific community challenges the idea of universal colour symbolism. Meanwhile standardisation of colour applications in scientific images seldom occurred and occurs, leaving a broad diversity of colour symbolism within fields. All this raises the need for colour awareness. The history of the ontology of colour has already gained some attention in history of science. It is of course not to disentangle from its meaningful use or non-use. Still, the session rather focuses on the meaningful application of colour and its interpretation by the sciences – and the history of such theorising. It explores the colour conventions and strategies in scientific images that predominate today as well as in historical perspective and across disciplines. This encompasses the issue of the neglect of colour as an object of scientific self-reflection and as an object of the humanities' research on the sciences. In brief: in this session we investigate the epistemic dimensions of colour in the sciences, across disciplines and across history.

Txapartegi, Ekai (University of the Basque Country)

Color images as not-so-confusing representations

“Why does Descartes seem to place such epistemic weight on picturing?” asked Baigrie (1996: 86) echoing the perplexity that always produces to find so many pictorial illustrations in the scientific works of this rationalist philosopher. Given the material falsity that Descartes famously attributed to colour sensations as obscure and confused ideas for (not) being able to represent the mechanical nature of the real physical colours (AT VIII A 34; AT VII 44; AT VII 233-5), one is tempted to conclude that his advice to scientists would be: “Never use colour images to describe the world. Represent always mathematically!”. However, Descartes never abandoned the use of arbitrary (or partially arbitrary) conventional signs as words or illustrations to describe the world through ‘visualization’. The main idea that I will argue for is that, according to Descartes, colour sensations (or colour images, for that matter) are perfectly representational (De Rosa 2007), intellectually necessary even, and that Descartes did not question their representational value for certain cognitive functions. The epistemic role of

SUNDAY 16 SEPTEMBER, 16.00-18.00

colour sensations (or colour images, for that matter) to intellectually grasp the natural world might not be, according to Descartes, as avoidable after all.

Kleinwächter, Tanja C. (Technical University, Berlin)

Colour samples for creating natural history - Ignaz Schiffermüller (1727-1806)

An increasing number of publications on colour in the second half of the 18th c. shows a growing interest in colour and in colour order. Contributions to the systematisation of colours were delivered out of Arts, Sciences, and Economy. Natural history played an important role for the systematisation of colours. The obviously urgent need for an order of colours led to a significant number of contributions on the nomenclature, the reference, and the order of colours. In my proposal I address the question for the internal use of colours in 18th c. natural history. In my opinion, unpublished samples, scales, and reference tables were much more important for scientific research and education than published ones. It is difficult to proof my assumption with quantities of examples, because just a few of these work-in-progress colour samples and scales survived and are available for examination. Instead I'd like to show the internal use of colour during the research process at the example of Ignaz Schiffermüller. Schiffermüller was a Jesuit priest and natural researcher in Austria. Well known for his classification of the Viennese butterflies he published a system of colours as well.

Gerontas, Apostolos K. (University of Applied Sciences, Coburg)

The early history of chromatography: bringing back the colours in chemical analysis

The chromatographic cluster of techniques has been revolutionary in the history of chemical analytics twice: once in its pre-mechanised version in the 1930s and, once again, through the introduction of chromatographic apparatuses from mid-1950s on. While it is so successful today, it is often forgotten that chromatography entered the theatre of history with a major failure. In its first introduction by its founder Mikhail Tswett at the beginnings of the 20th century, it has met the almost unanimous rejection of the chemical community. Introduced as an experimental/analytical solution to the then current problem of chlorophyll, chromatography was making a then radical claim: separate molecules may be definitely recognized, and considered isolated, only by their notable physical properties, in the case of the three chlorophylls, their colour. This claim came in conflict with the norms of contemporary chemistry –a fact that led to the shelving of chromatography for the next two decades. This paper offers a narrative of the first steps of chromatography and the controversy that surrounded it, while suggesting the potential explanations for both the initial rejection of chromatography, as well as its reintroduction and eventual canonization in the 1930s.

Cobbold, Carolyn (University of Cambridge)

From palette to palate: the invisibility and elusiveness of chemical colours in nineteenth-century food

From the 1850s chemists created hundreds of new synthetic dyes that transformed the colour and consumption of material goods, revolutionising the textile industry and initially delighting consumers. However, these novel substances, created at the cutting edge of chemical science, also came to permeate food and drink products invisibly across the western world, passing through a complex international supply chain from chemical factory to wholesale and retail chemists to the food industry, with their physical and chemical origins becoming more and more obscured. Despite their brilliant colours and ubiquitous presence in nineteenth-century food, their existence was hard to detect and, moreover, continues to be invisible historically. I will examine how chemists from different cultural and institutional backgrounds sought to understand, detect and assess the new colourings being used in food. Chemists had used colour as an analytical tool in assessing substances and mixtures since the sixteenth century, but no standard method of measuring colour or detecting dyes was established. The new chemical colours proved to be elusive boundary objects, moving from being epistemic laboratory-based substances to becoming commercial commodities and objects of political, public and scientific

SUNDAY 16 SEPTEMBER, 16.00-18.00

inquiry, understood in different ways across a range of communities.

S38/6 SPACES OF CIRCULATION AND COLONIAL / IMPERIAL LANDSCAPES: CRITICISMS AND CHALLENGES

Location: IoE - Room 731

Chair: Gesteira, Heloisa

Organiser(s): Silva, Matheus Alves Duarte

Discussion of processes that cross political, geographical, or cultural boundaries has increased among historians of science in the past years. Following this “global turn”, the problematic of intercultural interaction has been mobilized to make sense of the construction of different forms of knowledge — geographical, natural historical, linguistic, ethnic to name but a few. According to this conception, knowledge thus circulates within circumscribed spaces that are always the result of encounters and negotiations. The rising deployment of the problematic in the past decade notwithstanding, many scholars continue to conceive the term as a synonym for diffusion, transfer, transmission, mobility, or simply fluidity, and are perplexed by its implied concession of agency to all participants in contexts of colonial or other asymmetrical power relations between social or ethnic groups. By bringing together scholars who have used the framework of circulation in their work as well as those who have reservations as to its relevance, we would like in this symposium to develop the problematic through a dialogue between these different positions in order to establish a better understanding of the prospects and methodological nature of the idea of circulation. Moreover, the intention of the symposium is to explore the implied conception of ‘spaces of circulation’ within which bodies of knowledge, know-hows, practices, and norms are constructed and shared, and beyond which they need again to be negotiated in order to move. Finally, the question of unity and disunity is strongly tied to all such concerns, as circulation – or, for its critics, at least movement and mobility – is in itself a main cause of all manner of mergers and splits. Participants are invited to explore the possibilities and the methodological and theoretical challenges inherent to this approach, to probe its limits, and to engage in conversation with skeptics. Albeit empires and colonial settings themselves constitute a multiplicity of deeply diverse historical entities, the symposium includes contributions which focus on the production of knowledge in this kind of political formation, both European and non-European, from circa 1500 to 1945.

Kury, Lorelai (Casa de Oswaldo Cruz)

Brazilian woods and plains: Auguste de Saint-Hilaire’s global biogeography

This paper analyses the theoretical and practical botanical work accomplished by the traveler-naturalist Auguste de Saint-Hilaire (1779-1853). My focus here is to understand how he incorporated local knowledge about Brazilian vegetation and, at the same time, accumulated data aiming to develop means for acting at a distance. He chose the Brazilian region of Minas Gerais as a case study. He distinguished various types of primitive and altered woods and plains, using words extracted from the traditional knowledge he learned during his trip. A central part of his analysis of the vegetation of Minas Gerais was based on his interaction with Brazilian inhabitants, during fieldwork. Nevertheless, once in France, he tried to follow the model of the Scottish naturalist Robert Brown, who studied the flora of Australia. Brown and Saint-Hilaire used analytical descriptions of species, classifying methods and a comparative perspective to organize plants originated from non-European areas. They endeavoured to find patterns of plant distribution on Earth. The confluence of biogeography and the so called “natural method” increased the possibilities of “action at a distance”. Their work created expectations concerning science and its possibilities. Botany could be a powerful tool for predicting which kind of plant could exist in a given region or for determining which kind of

SUNDAY 16 SEPTEMBER, 16.00-18.00

virtue one could expect to find in a recently discovered plant. Acting at a distance could open access to plants while avoiding contact with local people.

Hossain, Purba (University of Leeds)

Crossing the Kala Pani: Indentured Networks and the Calcutta Public in the Long 1830s

Contractual labour migration was a longstanding phenomenon in the nineteenth-century; one that became the theme of debates around labour rights, mobility, and imperial responsibility towards citizens of the Empire. With the emigration of indentured labourers from India to Mauritius in 1834 and British Guiana in 1836, the indentured system gained ground and soon emerged as a systematised network of overseas migration to colonial sugar plantations. As the site of embarkation and disembarkation, the colonial capital of Calcutta occupied a unique position in global indentured networks—one where local personages and periodicals participated and contributed to global discussions around migrant labour and servitude. This paper explores the linkages across Empire through the lens of indenture, and seeks to locate Calcutta within these networks.

Chamelot, Fabienne (University of Portsmouth)

Transferring archival science to the colonies: the making of French colonial archives in French West Africa and Indochina, 1911-1958

Academic debates on colonial archives have mostly focused on archives as documents or sources and have little engaged with archival science and its definition of archives: a set of fonds respecting the principle of provenance. Yet, this approach allows the opening of a new field of reflection with regards to the relationship between archives and power. The French colonial administration offers relevant case studies to investigate this question. For instance, an archives office was created both in French West Africa (AOF) and Indochina approximately at the same time. The two archivists appointed head of each archives came from the Ecole des chartes: Claude Faure in AOF and Paul Boudet in Indochina. Therefore, these archives should have been similar. But the administration in Indochina found itself with one of the most efficient classification system France has ever known while the administration in AOF had hardly any organised archives. As archivists coming from the metropole and trained in a school aimed at a national setting, Faure and Boudet had to reinvent themselves and find innovative ways to transfer their knowledge and skills to a colonial setting. They each did that according to the specific social and political context they faced, resulting in contrasted outcomes. This paper will show that colonial archives were a political tool in the repertoire of power of the French administration which could be used to reinforce the administration and contribute to its persistence in order to dominate a population or to exercise control over its own administrators.

Korge, Lisa (University of Konstanz)

From pragmatic to professional, from local to international? The emergence of a specific road construction knowledge for the tropics in the Dutch East Indies

The proposed contribution examines the emergence of a specific body of expertise concerning the construction of modern and trafficable roads for the tropics. Dutch administrators and engineers already had several decades of experience in the construction of paths and roads under the geographically and climatically conditions of their archipelagic colony. However, with the introduction of the first motorcars, the requirements regarding overland routes changed drastically. This subsequently led to two different developments in the way the road construction knowledge in the colony was produced and disseminated. The first is the transition from a rather pragmatic to a more professional, and even scientific, approach. At the beginning of the century, the main task was to teach colonial officials without much technical experience how to plan and build roads. The required knowledge was laid down in manuals that were compiled by experienced engineers. As road requirements became technically more complex and maintenance more expensive, the pragmatic know-how ceased to suffice. This led

SUNDAY 16 SEPTEMBER, 16.00-18.00

to the establishment of a test laboratory for construction materials fit for the tropics. This shift to the second development: as Dutch engineers and researchers reached the limits of their expertise, they soon began to look for technical solutions and best practice beyond their colony. The paper intends to tackle the problematic of circulation by carefully examining the media in which the road construction knowledge was accumulated, namely manuals, professional publications and conference reports. This approach promises also to check if their results subsequently were adopted in (inter)national contexts.

Haines, Elizabeth (Royal Holloway, University of London)

Harnessing political influence around the Zambezi, 1880-1920: Circulating referees

The maps of Zambezi that passed between the BSA Co. and the British Colonial Office have largely been read with one of two approaches. Through this first lens, maps are part of the legitimization of territorial claims within the rhetoric of European statecraft. Recently more attention has been paid to the same maps as evidence of African political systems that predetermined the shape of colonial territorial demarcations. On the ground, emergent colonial states were also realised through a series of fiefdoms of white colonialists, which are recognised metaphorically. This paper, however, takes that metaphor seriously, and reconsiders governmental cartography of the middle-Zambezi to trace the generation of two such fiefdoms. First of these is Val Gielgud, first BSA officer, then labour agent. Second, William Harding, soldier and personal secretary to Cecil Rhodes. Rather than reading the maps generated by these officers as part of the prehistory of an emergent modern political territory with a centralised government, I will expose them as a record of mobility. I propose that Gielgud and Harding offer us documentation of a moment in which the complexity of power and knowledge was institutionalised into a system of political governance under indirect rule. In this process, controlling information, and in some cases retaining it locally, created a "centrifugal" system of colonial authority. The nature of flows within that system continued to depass the bounds of territory yet gradually became hidden within the dominant representational forms of an apparently 'modern' government.

1126 GEOGRAPHY

Location: IoE - Committee Room 2

Chair: Martin, Rebecca

Hopkins, Andrew (LSE)

Conspicuously Cumulative? Aspects of 'Progress' in the History of Geology

Geology is predominantly an historical science which seeks to uncover the Earth's history by making inferences from field-based observations in the present about events and processes that operated in the deep past. Although there is also an experimental aspect to geology which mainly takes the form of numerical and physical modelling, this is secondary to its historical dimension. So while some explanations in geology are causal and nomothetic, there is a clear disposition towards narrative forms of explanation that are appropriate to its historical nature. Another characteristic of geology is that new discoveries or ideas tend to clarify or modify existing theories rather than overturn them completely. Hence geological knowledge generally proceeds by absorbing new evidence into existing theoretical frameworks: in Martin Rudwick's words, geology is "conspicuously cumulative". Even the acceptance of the theory of plate tectonics in the 1960s, probably the most profound transformation in thinking in the history of geology, is widely viewed as a non-Kuhnian event that drew heavily on existing ideas. This paper uses cases from the history of geology to explore the possible connections between these distinctive aspects – historical, field-based, narrative and cumulative – that we find in the way geologists have, over time, explained and re-explained the Earth's history. It is in addition, a significant question whether these characteristics are critical to the distinction between historical and experimental sciences generally – a fundamental aspect of disunity - as emphasised in recent years by Carol Cleland.

Lund Jacobsen, Lif (The Danish National Archives); Lajus, Julia (Department of History, National Research University Higher School of Economics, Petersburg); Fedorova, Irina

The exchange of seismic technology and knowhow between USA and the Soviet Union, 1961-1965

Originally developed in the 1880s to record seismic waves emitted from earthquakes, seismographs of various designs were placed in stations across the globe. However, in the 1950s it became clear that global seismic monitoring was the most reliable method to detect underground nuclear tests and a key technology to uphold an international nuclear test ban. In September 1961, Professor Maurice Ewing of Columbia University was contacted by Professor Eugene Savarensky of the Institute of Physics of the Earth, the Academy of Science in Moscow, who suggested that the two institutions could exchange seismographs on a scientific basis. The underlying interest was to gain access to the counterparty's technology to increase verification possibilities, a goal that could not be achieved through the usual diplomatic channels. Over the next four years, the two regularly keeping in contact (but never met) and, guided by their political and military hinterland, expanded the initial scope of the exchanges to include visits of scientists and experts. At times of high tension, like under the Cuba Missile Crisis, both parties used third-parties' like scientists from Denmark or Finland, or international organisations like UNESCO, to further depoliticize the situation or act as a go-between. Based on original archival material from USA, Denmark and Russia, relating to the above described exchange of technology and knowhow, this study will exam, how science and scientists was used as diplomatic tools to facilitate nuclear negotiations in a seemingly neutral setting and discuss the findings in the wider context of science diplomacy.

Nizovtsev, Viacheslav (Lomonosov Moscow State University)

Dualism of views in the formation of anthropogenic landscape science

At the turn of the XIX-XX centuries in Russia the works of V.V. Dokuchaev, L.S. Berg, A.A. Borzov and other scientists have established the classic landscape science, where the issues of

SUNDAY 16 SEPTEMBER, 16.00-18.00

anthropogenic transformation of landscapes were closely examined. In the 1930s, L.S. Berg called landscapes, transformed by human activity, cultural, and A.A. Gozhev and B.N. Gorodkov called them anthropogenic. Later, this discrepancy led to a different interpretation of such landscapes, resulting in heated debates and discussions in the scientific literature and geographical conferences. A new dualism of views on anthropogenic landscapes appeared in the second half of the XX century with the formation of a new scientific direction in landscape science - anthropogenic. Its founder F.N. Milkov believed that anthropogenic landscapes are complexes where on all or the most part of their area any of the components of the landscape is subject to a fundamental change further to a man influence and that a separate discipline should study them. F.N. Milkov believed that a landscape is a natural and socio-historical unity. According to his main opponent A.G. Isachenko, the landscape is an exclusively natural formation. It should be noted that this discussion has remained unfinished. For example, V.S. Preobrazhensky (1997) argued that landscape science will not survive if it is considered a mere physical and geographical study rather than general geographical science. Contrary to that, I.I. Mamai (2006) believed that "Anthropogenic landscape science has fulfilled its task and begins to impede the development of all landscape studies".

Nordlund, Christer (Umeå University)

Understanding Field Science Institutions: On Opportunities and Conflicts

From the oceans to the mountains and the vast in-between scientists have created institutions for scientific work in the field. Long-lived or temporary, more or less institutionally authoritative, magnificent or humble in scale, these spaces and infrastructures in the landscape and seascape have provided an organizational domestication of migratory science and facilitated scientific work on nature beyond urban centers of learning. As such they have played a significant role in the history of knowledge production, yet not always in ways predicted by their founders. Opening a field research station, for example, can be an attempt to unite center and periphery, to counter potential land use conflicts, or to gather scientists from different disciplines in order to foster exchange of ideas and multidisciplinary collaboration. But it might as well result in severe conflicts between scientists, amateurs and locals as well as between scientists with different goals and interests. Furthermore, a permanent institution in the field might facilitate long-term measurement of environmental change and become a site of scientific authority, but it might also be trapped in its own tradition and eventually prevent scientific renewal and advancement. This paper draws on and presents the forthcoming book *Understanding Field Science Institutions*, eds. Helena Ekerholm, Karl Grandin, Christer Nordlund & Patience Schell [to be published by Science History Publications/USA in the spring of 2018], which analyses both similarities and differences within the complex history of field science institutions and their relation to other types of academic institutions, from the seventeenth century onwards.

Wess, Jane (Independent Scholar)

Maths and Maps: Investigating unity and disunity between theory and practice at the Royal Geographical Society in the long 19th century

The paper explores the relationship between the mathematical theory of projections, contour lines, and the four-colour theory with the cartographic practice evident at the Royal Geographical Society in the long 19th century. It argues that there was disunity between theory and practice to the extent of a lack of knowledge of theory among prominent members of the Society. It will also argue that the development of contour lines, unlike that of other isolines such as isotherms or magnetic charts, was held back by the skilled nature of hachuring, so that disunity was set up between a mathematical approach to map making and an artistic one. Britain appears to have lagged behind other parts of Europe in producing new representations of the globe, and in representing heights by isolines. It appears to have lagged behind the United States in producing maps compliant with the four colour theorem. The paper presents surveys of the collections and discussions at the Royal Geographical Society, together with material

SUNDAY 16 SEPTEMBER, 16.00-18.00

from contemporary textbooks, and images from a wide range of sources, to formulate the arguments. It can be considered in the light of the 'Unexpected Effectiveness of Mathematics' debate first promulgated by Eugene Wigner in 1960 and still very much alive today. As for the case of longitude in the 19th century it will be argued that mathematics actually had little effectiveness on practice.

1128 EARLY MODERN MATHEMATICS

Location: IoE - Room 709a

Chair: TBA

Chikurel, Idit (Tel Aviv University)

Manifold in Unity: Influences of Greek Geometrical Analysis on Maimon's Notions of Analysis

It is often claimed that analysis, defined in the most general sense as "manifold in unity", is grounded on the principle of contradiction alone. Synthesis, however, defined as "unity in manifold", is grounded not only on the principle of contradiction but on pure intuition as well. This distinction is inaccurate. In my talk, I discuss the notion of analysis as something that can be grounded on sensibility as well. For this purpose, I present practices of Greek geometrical analysis and discuss how they shaped philosophical and mathematical notions of analysis that are broader than merely logical analysis. I present the case of the philosopher Salomon Maimon (1753-1800) and his work on the different notions of analysis. Maimon's work on analysis is entwined with his work on invention. When writing the outlines of a theory of invention, he turns to Euclidean geometry and practices of Greek geometrical analysis as his main source of influence. This influence is extended not only to his formation of methods of invention but also to his notions of analysis and invention. He presents several notions of analysis, philosophical and mathematical, that are grounded not only on the principle of contradiction but on intuition as well. My discussion of such influences will be accompanied by examples taken from Euclid's *Elements* and *Data*. This study of the different forms of analysis is meant to shed light on the less known aspects of the practice of manifold in unity.

Dobre, Mihnea (ICUB, University of Bucharest)

The role of mathematics in Samuel Clarke's annotations to Jacques Rohault's *Traité de physique*

One of the most curious receptions of a physics treatise in the early modern period is provided by the history of the publication of Jacques Rohault's *Traité de physique* (1671). The book had a tremendous success; it was quickly translated into Latin and published in numerous places around Europe. In England, the *Traité* had an intricate history, especially in the form of the various editions prepared by Samuel Clarke, from 1697 to 1723, when the first English version of the treatise was printed. As other scholars have noted, Clarke's Rohault is peculiar because it contains Newtonian annotations. My paper will explore the development of these annotations in the various editions prepared by Clarke. By building on the excellent work by Michael Hoskin and Volkmar Schüller on the annotations, I plan to examine the changes in Clarke's notes from a different angle. More specific, I intend to explore the use of mathematics and how mathematics was employed in the annotated text. In doing so, I take into account changes in each edition issued by Clarke and examine how mathematical reasoning was presented as solving some of the problems indicated by Rohault's text. I further corroborate the findings with the independent publication of the English version of Rohault's *A Treatise of Mechanicks* (1716, translated by Thomas Watts, with a preface by William Whiston). Due to such joint approach, the paper aims to provide a more comprehensive picture for the interaction between Cartesianism and Newtonianism in the early eighteenth century.

Meyns, Chris (University of Pittsburgh and Utrecht University)

Data (Long) Before Big Data

Was there a concept of data before the data revolution? Scarcely any work has been dedicated to the philosophical (pre-)history of the concept of data. Rosenberg (2013) has argued that the concept develops in the early modern period, naturalizing in the mid-eighteenth century as a "rhetorical concept", signifying whatever in a given dialogical context is agreed beyond argument. In this paper I challenge this picture on two fronts: (1) I argue that relevant philosophical use of the concept of data can already be found earlier than Rosenberg suggests,

SUNDAY 16 SEPTEMBER, 16.00-18.00

namely in the seventeenth century; and (2) the concept of 'data' in these early modern debates is no more (merely) 'rhetorical' than any of the other core concepts in its vicinity, such as 'fact', 'probability' or 'objectivity'.

Vida, Grigore (University of Bucharest)

Abstraction and Mixed/Practical Mathematics in the Early Descartes

If we think about the mathematization of physics in terms of the relation which results between the two disciplines, we see that mathematics and physics can remain independent or become one and the same thing. In the first case we encounter the language of "applying" mathematics to physics, "imposing" a formalism on physical reality, "approximating" the natural etc. The second case is more radical: physics just is mathematics. Descartes belongs to this camp and it's hard to find among his contemporaries someone else who held such a conception. It cannot be ascribed to Galileo, for instance, in spite of his alleged Platonism (though to speak about Platonism here can be misleading). How did Descartes arrive at this singular view? Since its main elements can be identified in the *Regulae*, my focus will be on the period until 1628. First, I analyze the different levels of abstraction in the *Regulae* and show how after the abstraction of sensible qualities from bodies, the remaining bare geometrical figures are again abstracted, so as to arrive at magnitudes in general. At this this higher level, however, Descartes describes the abstraction in a quite Aristotelian fashion, with numbers and shapes as being properties; it's just that the objects of which they are properties are objects formed in the imagination. Next, I argue that the use of this theory of abstraction in mixed and practical mathematics (in which the early Descartes was engaged) can result in a conception in which bodies are "geometrical objects made real".

Malet, Antoni (Universitat Pompeu Fabra)

Sixteenth-Century Tracts on Ratio and Proportionality

From Luca Pacioli's "Sermo" of 1508, to Oronce Fine's *De arithmetica practica* (1532), to Maurolico's "Sermo de proportione" (1554) and "Compendium" of Book V (1567), to Cardano's *Opus novum de proportionibus* (1570), to Guidobaldo del Monte "Commentarius" (c. 1600), to mention just the famous names, a number of commentaries and criticisms of Book V of the *Elements* were written (and most of them printed) throughout the 16th century. My talk will address a few general questions about these tracts. In what measure are they sharing a common perspective in their critical views on Euclid's definitions of ratio and proportionality? Did those authors' criticisms derive from practical concerns? What alternative definitions were they setting forth? How were the new definitions received? Were the alternative definitions similar to each other in important features? Finally, how do sixteenth-century critiques relate to the substantial, theoretical 17th-century criticisms of Borelli, Tacquet, and Wallis?

I133 MEDICINE 3

Location: IoE Room 777

Chair: Maerker, Anna

Samuelsson, Jonatan (Department of Historical, Philosophical and Religious Studies at Umeå University, Sweden)

Battery-Mouths and Mercury-Breathers: Oral Galvanism and the Onset of Late Modern Swedish Dental Amalgam Controversy

Understanding the nature and role of uncertainty is vital to studying processes at the border of science, policy and public life in the risk society. Shackley and Wynne (1996) describe representations of uncertainty as boundary-ordering devices, which structure and uphold modes of science-policy interaction. This paper studies oral galvanism and the origins of the “Third Amalgam War” in Sweden in the late 20th century, highlighting such uses of uncertainty. During the 1980s and 1990s, the issue of potential poisoning from dental amalgam – a widely used, mercury-containing dental filling material – provoked public controversy in many countries. In Sweden, this controversy led to extensive care programs and research efforts, as well as parliamentary and expert panel investigations. At the onset, however, mercury was not the main issue; oral galvanism was. Oral galvanism is an electrochemical phenomenon that occurs when metallic dentures and saliva come together to form a so-called galvanic element - a battery in the mouth. It was this phenomenon that became associated with a variety of symptoms, attracting a growing interest from science, politics and the media during the late 1970s. Poisoning from dental mercury entered the scene in the early 1980s, proposed as the main explanation for discomfort from oral galvanism. This paper details how oral galvanism was established and perceived as an important scientific, social and political problem in Sweden, by examining its international intellectual history prior to the controversy, as well as its mediated, scientific and political life in Sweden until the early 1980s.

Sugden, Nicola (CHSTM, University of Manchester)

‘Habeus Cerebrum’: Donald Winnicott and the Physical Therapy Controversies in the British Medical Press

The opposition of psychoanalyst and paediatrician Donald Woods Winnicott (1896-1971) to ‘shock treatment’ and psychosurgery - as against contemporary enthusiasts such as William Sargant - is regarded as being in alignment with the principles of his life and work, and has in some quarters been understood as a position representing the insights of psychoanalysis in contrast to the errors of hospital psychiatry. The dichotomy employed in such narratives belies the variety and nuance of medical opinion on the physical therapies in mid-Twentieth Century Britain. Detailed examination of a series of controversies in the correspondence pages of the *British Medical Journal* and the *Lancet* between 1943 and 1956 allows these differences to come to the fore. Medical opinion differed not only by disciplinary allegiance or by increments along a scale of enthusiasm, but according to different conceptions of scientificity, ethics, and the nature of mental disease; different priorities in the treatment of patients; and different hopes and fears for the future of scientific psychology. This paper discusses these themes alongside an exposition of the development of Winnicott’s views on physical treatments for mental illness.

Varino, Sofia (Humboldt Universität zu Berlin)

“Material (Dis)Unities: historicizing celiac disease as a disorder of malabsorption in Willem Dicke's Experimental Studies 1948-49”

From Samuel Gee to Sidney Haas and Willem Dicke, and even presently, a large number of scientific articles published on celiac disease research either appear in pediatrics journals, or are written by pediatricians or researchers working in pediatrics departments. Although today celiac disease may appear to be “all grown up,” classified as an autoimmune genetic disorder that can be studied through sophisticated laboratory techniques and understood via elaborate biomedical models, in this talk I want to emphasize the unities between its rudimentary past as

SUNDAY 16 SEPTEMBER, 16.00-18.00

a malabsorptive condition and contemporary celiac clinical practices. I turn to Dicke's foundational experimental study of celiac children between 1948-49 in the Netherlands to show how its simple design and accuracy, measuring malabsorption as fecal fat coefficient, continues to be applicable for an understanding of celiac beyond visible signs of damage to the intestinal mucosa. Unable to visualize the atrophied villi that would, after the introduction of the jejunal biopsy, become crucial for a conclusive celiac diagnostic, Dicke developed a way to effectively study the signs of malabsorption due to wheat ingestion that were causing malnutrition and failure to thrive in celiac children. I argue that it is this same logic of disease mechanisms that is applicable today for studying, diagnosing and treating celiac beyond its visible intestinal damage, by finding unities and disunities in its long history and status as a disorder of malabsorption and malnutrition.

Wulff, Enrique (Instituto de Ciencias Marinas de Andalucía (CSIC))

Cancer Diagnostic: Findings of Allfrey and Mirsky at the Roots of a Probe Coming from Ochoa's School in the US

The sorts of interactions between the research programs described in this contribution, those of Severo Ochoa and Vincent G Allfrey, help to understand the diagnostic probe invented at Manuel Perucho's laboratory to screen for mutant ras genes and detect single point mutations in mammalian genes. A unified theory for the development of cancer involving genetic and epigenetic changes supported the consideration of an original mutation event as the initial trigger of cancer and the concept of genetic instability as critical in its development. Cancer results from the malfunctioning of the expression of an "invisible college" of viral proteins in the cell nucleus that is essential to its survival. Allfrey and Mirsky showed in 1959, that the activity in these nuclear systems requires the presence of a polyacidic matrix whose specificity is clearly defined. Their findings introduced the possibility that more subtle mechanisms may exist which permit both inhibition and reactivation of RNA production at different loci along the chromosome. Given the physiological relevance of the polymerase that synthesizes DNA and RNA, scanning methods for the detection of point mutations frequently needed in the field of cancer and molecular genetics are closely related with this shock strategy. These methods for the detection of single base substitutions in eukaryotic genes played a major role in making possible the 1985 PCR revolution. It is expected to explain here that this useful approach was of very general applicability and why it was presented by Severo Ochoa to the US National Academy of Sciences.

Olechnovičienė, Jadvyga (The Lithuanian Academy of Sciences)

The Development of Allergology Science in Lithuania in 1926–1990

The presentation deals with the development of allergology science in Lithuania from its very beginning in 1926 to the re-establishment of Lithuania – in 1990. Two main fields in allergology science in Lithuania – experimental and clinical – have been established. Rudiments of this division are observed during the initial period of the development of allergology science, and they revealed themselves most clearly during the late soviet period. Having analysed the material collected it has been established that 32 authors published 270 scientific publications in the field of allergology during the period between 1926 and 1990. Almost half of the publications (48%) cover the field of experimental allergology. The development of allergology science in Lithuania was divided into three periods: the initial period of allergology (1926–1944), the early soviet period (1945–1963) and the late soviet period (1964–1990). The most characteristic features of every period have been analysed. The development of allergology science in Lithuania is related to the activity of Vladas Lašas. He made a great contribution to the investigations into allergology science and laid foundations for the school of experimental allergology of Lithuania. The sources of literature and archives that have been analysed showed that allergology science in Lithuania from 1926 to 1990 was developed and research was carried out at Kaunas Institute of Medicine, Vilnius University and the Institute of Experimental Medicine, however, at that time the most intensive studies were conducted at Kaunas Institute

SUNDAY 16 SEPTEMBER, 16.00-18.00

of Medicine.

S61 CRAFT HUMANISM IN THE EARLY MODERN WORLD

Location: IoE - Room 826

Chair: Avxentevskaya, Maria

Organiser(s): Avxentevskaya, Maria

The panel session aims to explore the category of craft humanism understood as the phenomenon of employing classical legacy and learned discourse for the development of the early modern competences of practical knowledge, such as botanical expertise, alchemy, medicine, lapidary arts, and map-making, in their social, epistemic and technical aspects. The panel participants will focus on the role of humanist strategies, such as verbal and visual rhetoric, *loci communes*, and the performativity of speech, in ensuring the social credibility, political authority, and intellectual persuasiveness of epistemic patterns and actions within the early modern history of specific crafts. In this view, the session will examine the humanist regularities of effective collaboration for the purposes of knowledge-making, in the form of correspondence and knowledge-sharing, the humanist approaches to building codes of practices and procedures necessary to ensure the social and economic acceptance of practical knowledge, as well as the translation of humanist values of ingenuity between specific crafts and aspirations concerning the liberalization of knowledge practices within censored and emerging crafts, in the context their related scientific occupations. The panel will address a range of specific questions aiming to clarify more broadly but concretely the role of humanist learning in the development of practical knowledge, such as: how the discourse and methodologies of practical arts were influenced by the supposedly liberating involvement of humanist culture; how the social credibility function of humanism affected the knowledge-making of craft practices; how the classificatory features of humanism (e.g. Ramism and anti-Ramism) could influence the procedures and routines of specific practical arts; and how did humanist legacy in the development of natural history facilitate a strife for tracing the applicability of specific substances through the local geography of their origins. The panel participants will also examine the genres of textual, visual, and material culture, which provided possibilities for displaying early modern craft humanism, such as *alba amicorum*, emblematic botanical illustrations, manuals on lapidary arts, tacit narratives on alchemy, and the framings of early modern maps. We will contribute to discussing the main theme of the conference - the unity and disunity of knowledge - by considering the far-reaching legacy of humanism as a factor in verbally defining and publicly presenting the identity of specific crafts, in organising their internal operational classifications, and in arranging their relationships among themselves, with more formal scientific practices, as well as with institutions of knowledge and the bureaucracies of the state.

Avxentevskaya, Maria (MPI, Berlin)

Craft Humanism in the Artisanal *Alba Amicorum*

The manuscript genre of *album amicorum*, also known as “traveling friendship book” became popular in mid-sixteenth century in the Protestant circles, where a *manu propria* entry by Luther or Melancthon could serve as a collectable rarity and a letter of recommendation. The genre implemented represented a collective variety of *loci communes*, which produced rich and diverse volumes of autographs, drawings, and prints, often protected by embossed leather bindings and cases. *Alba amicorum* participated in the economy of knowledge networking, as many of them were kept by scholars, physicians and educated artisans peregrinating between learned communities within the reformed part of Europe, across the continent, and beyond. Most of the *alba* entries contained verbal and visual reflections on professional issues, and displayed relations of trust within and between intellectual groups. But entries in the artisanal

SUNDAY 16 SEPTEMBER, 16.00-18.00

alba amicorum also more specifically displayed the epistemic tensions between and within specific areas of craft knowledge. For instance, the learned apothecary from Augsburg, David Wirsung (1554-1592) collected reflections on the unity and specificities of medical occupations in delivering treatment for body and soul. The alba amicorum which belonged to goldsmiths (another numerous category) reflected more on the social and economic turns of the craft fortune. The genre also encouraged an exchange between artisanal, scientific, theological, and legal values. My paper will examine the humanist techniques of reflections on the practices of specific crafts in the genre of craftsmen's alba amicorum - a display of early modern craft humanism.

Bycroft, Michael (University of Warwick)

Humanism and Writings on the Lapidary Arts in Louis XIV's Paris

Writings on the lapidary arts flourished in Paris in latter decades of the seventeenth century. Lapidaries, goldsmiths and jewellers were responsible for a range of published texts that described how to cut and polish precious stones, how to distinguish one variety of stone from another, and how to profit from the local or global trade in these valuable commodities. These texts are notable for their precocity and variety. They predated the Encyclopédie of Diderot and d'Alembert by nearly a century, and they emerged from a range of literary and institutional contexts, including travel narratives, guild regulations, and state-based commercial administration. Missing from this list is the Paris Academy of Sciences: the codification of the lapidary arts was the work of artisans and administrators rather than naturalists and philosophers. These writings therefore show the vitality and autonomy of extra-scientific literature on the crafts. My paper will reflect on the identity of lapidary craft practices in early modern France, and will explore the humanist features of narratives depicting lapidary arts, to outline the role of humanist techniques in developing the functions of authority and credibility in knowledge-making.

Benison, Liam (Freie Universitaet Berlin)

Humanist Knowledge Practices in the Cartography of Terra Australis Incognita

Jonathan Swift's famous satirical remark, 'So Geographers in Afric-maps/ With Savage-Pictures fill their Gaps' is often credited as encapsulating the notion that much of the rich repertoire of illustrations on early modern maps and globes can be explained by cartographers' horror vacui. But it was not only savage-pictures that filled the gaps on maps; in particular, the framing of maps contained information intended to ensure the credibility and authority of knowledge presented in visual form. Cartouches with elaborate classical frames contained elaborate poetic dedications to the contemporary political leaders, and explanations of the classical authorities in natural history, on which the cartographer had relied for the geographical knowledge represented on the map. For instance, Gerard Mercator used such authorities to support his description of the extensive coastline and toponyms of his theoretical Terra Australis Incognita. In this paper, I will reflect on the theme of universality and discrepancies in the early modern geographical representations by discussing some less-known examples of such "framings of authority" on a selection of maps representing Terra Australis Incognita. I will argue that these frames employed the techniques of humanist visual rhetoric and the legacy of classical learning to serve the rhetorical purpose of persuasion and performative engagement of the viewer - a point which is crucial for understanding the methods of ensuring credibility and authority in the framework of early modern cartographic practices.

SUNDAY 16 SEPTEMBER, 16.00-18.00

R70/2 BSHS OEC PROVOCATION 2: HISTORY OF STEM AND POLITICAL ACTIVISM

Location: SciM – Hans Rausing Lecture Theatre **Chair:** McAlpine, Katherine

Organiser(s): BSHS Outreach and Education Committee

Participants: Armstrong, Eleanor (IoE, UCL)
Arness, Damian (Queerseum)
Damodaran, Vinita (Centre for World Environmental History, University of Sussex)
Mounsey, Chris (University of Winchester)

Academic scholarship in the history of science provides a long view on scientific and technological developments that had (and in some cases still have) profound ethical and political impacts for society. But how does that long view affect contemporary debates? How and when might history of science become activism? In this session, historians of science from around Europe, and at all stages of their careers, will discuss instances where activism and history of science collide.

This 'provocation' session complements the official conference programme, and is organised by the British Society for the History of Science Outreach and Education Committee (<http://www.bsbs.org.uk/outreach-and-education>).

I102 FOCUS ON OBJECTS IN THE HISTORY OF SCIENCE AND TECHNOLOGY

Location: SciM - Dana Study

Chair: Elliott, Francesca

Forschner, Dirk (Technische Universität Berlin)

Standardization of the Motive Power and the Rolling Stock of the Schantung Eisenbahn Gesellschaft / China, 1899-1935

After occupied the Jiaozhou area and built the Qingdao Colony, Germany started - as an essential plan of the occupation - the building of the Schantung Eisenbahn Gesellschaft ("SE") from Jinan West to Qingdao. As an isolated railroad, the SE started its operation in 1904 in Shandong province. When the SE was connected to the Tientsin - Pukow Rly ("TPR"), the German standards for air brakes, coupling systems and other locomotive equipment were not in line with the Chinese standards applied to the TPR and other railways. Therefore, step by step, the SE had to make adjustments in the above-mentioned aspects mainly by creating the Henricot coupling system and using Westinghouse air brakes. By 1930s, all relevant - not usable - German standards were annulled, by which SE started to become aligned with the standards of other Chinese railways.

Reininger, Alice (University of Applied Arts Vienna)

Handprinting Device for blind Maria Theresia von Paradis: A device developed by Wolfgang von Kempelen in 1779 for the blind artist and pianist which enabled her to communicate in writing

Despite all her talent, Maria Theresia von Paradis was still unable to write by the time she was twenty years old, nor had she mastered the alphabet. Wolfgang von Kempelen helped her to do this. The Pressburger Zeitung reported on 6th July 1779, how Kempelen proceeded to teach the blind artist how to read and write: "He gave her preliminary instructions in how to spell, and then let her put the words together herself using Latin letters cut out of cardboard". When she was completely familiar with this method, he constructed a printing device for her, with which she could "print her letters properly instead of writing them". The article closed with the sentence: "The rarity of such an invention, together with the value of this humane attempt, deserves to be known the world over." A few years before, the physician, hypnotist and magnetist Franz Anton Mesmer (1734-1815), who, in Vienna, was excited by his proclaimed animal magnetism, tried to heal the blind girl, but this was a complete failure. Only an order of the sovereign Maria Theresia in 1777 put an end to this fraud. Mesmer had to leave the city. The young woman, however, remained blind. In 1784 von Paradis set out on a so-called "art trip". In Paris she met with Valentin Haüy, the founder of the first blind school in Paris. Valentin Haüy presented his "manière d'élever les aveugles" to the French Academy of Sciences. The essay precisely described Kempelen's method and the small printing device.

Ritchie, Tom (Science Museum/University of Kent)

Child's Play: Meccano as the nuts and bolts of British engineering

Meccano was developed as a child's construction toy in 1901 by Frank Hornby, who intended for it to be both a toy and an educational device. Thirty-three years later, Douglas Hartree used Meccano to build Britain's first differential analyser at the University of Manchester. What remains of the Hartree Differential Analyser now sits in the Science Museum, representing a unity of play, creativity, autodidacticism: essential components in the science of engineering. Through exploring the language of the original Meccano patents, this paper demonstrates Hornby's desire for his invention to fill a 'long felt want' in society: a toy that could inspire young minds with practical engineering principles. It further analyses different articles from the Meccano Magazine, highlighting how language was used to render the toy a legitimate scientific and engineering instrument. Finally it will discuss the Hartree Differential Analyser in the period leading up to the Second World War, demonstrating how the Meccano used to construct the machine represented more than simply a child's toy; it also served as the 'nuts

and bolts' of British engineering, collapsing the boundaries between work and play.

Sumner, James (University of Manchester)

Computers and national identity: the strange and exceptional roots of the 'Brexit phone'

"The big flagship phones are made by American, Korean, Japanese and Chinese names. There isn't much option for British people to get behind the national flag and show off a British name! We want to change this." So states the announcement of the Acorn Micro Phone C5, launched as a crowdfunding opportunity in 2018. The device is, as bemused industry commentators pointed out, essentially a rebranded version of the existing Leagoo S8, and will be made in China. This paper explores the rhetoric and realities of the British IT industry as a case study in national technological culture. Technological divergences are often subtle but powerful markers of national identity at both the practical and symbolic levels: consider incompatible power plugs, or analogue television systems. Computers present a somewhat more complex case. Though they can be made highly distinct in form, their central defining quality – programmability – means that they can often be cajoled to imitate each other's most seemingly idiosyncratic features. In the marketers' arsenal of rhetorical devices, boasts of a nationally specific culture of excellence co-exist happily with the reassuring appeal to global interoperability. Beginning with the earliest promotion of commercial computers in the 1950s, I will consider the rising appeal of global standards (an approach often described at the time as 'Americanisation') and the reaction that coalesced in a highly distinct national culture around the microcomputer boom of the 1980s – a culture whose legacy encompasses both inclusive educational initiatives, and the bombastic challenge of the 'Brexit phone'.

Pilkington, Helen-Frances (Birkbeck, University of London)

Sealed and certain? Unity and disunity in railway company seal designs in the nineteenth century

As a key signifier guaranteeing the legality of the share, railway company seals were a critical site of unity with suitably respectable institutions and differentiation to attract investors to this scheme rather than another. Despite being united by form, these seal designs nevertheless show a remarkable ingenuity of different designs including the promotion of industry, showcasing the latest locomotive, arguments using intricate allegorical motifs and championing civic harmony. Drawing on an unstudied archive of 763 railway seals held in the National Railway Museum in York, this paper will chart the major trends of railway company seals during the nineteenth and early twentieth centuries before focussing on seals from the first half of the nineteenth century as it was these seals which started many of the railway tropes and narratives today. The paper will conclude by reviewing the railway seal designs in the context of railway share certificates and will show that both the early nineteenth-century railway share seals and certificates were highly derivative from eighteenth-century bank note and coin designs. Due to their linkages to such financial instruments, disunity from crashes or business failures was never far away.

I139 ASIAN AND GREEK MATHEMATICS AND ASTRONOMY

Location: SciM - Dana Study

Chair: Wittje, Roland

Guevara-Casanova, Iolanda (Universitat Autònoma de Barcelona)

The geometry of the Sulbasutras, the Nine chapters and the Elements. Unity and Disunity in the squaring of polygonal figures and in the use of the Pythagorean theorem

Pythagorean Theorem, procedure of the base and height ... there are different names for this theorem that appears in various places and at different times in the history of mathematics. A problem that uses this result is the transformation of polygonal figures, in particular a rectangle, into a square in the same area. Many cultures have made geometric constructions to transform polygonal figures into squares of the same area. In this communication some constructions of the Vedic geometry are analysed (800 BC - 200 BC), and some of the propositions of the Elements of Euclid (around 300 BC). In both, the result of the Pythagorean theorem is used directly. The transformation of figures that conserve areas also underlies the demonstration of the Pythagorean theorem, both in the Elements and in the Nine chapters on mathematical art (Jiuzhang Suanshu) compiled, it seems, between the 2nd and 1st centuries BC. What unites and breaks these geometric constructions is what will be discussed in this communication. In a certain way, it reflects the concern of mathematics teachers who bring to their classes the idea of mathematics as a science in continuous evolution, related to contexts and situations in which mathematical knowledge does not appear spontaneously but based on the one constructed by different people that one place or another thought and worked on the same problems.

Kvasz, Ladislav (Charles University in Prague)

On the cognitive unity of Thales' mathematics

There is a gap of more than 500 years between the times of Thales and of the reports by Diogenes Laertes and Proclus of his mathematical achievements. This led some scholars (Dicks 1959) to question the authenticity of these reports and to doubt whether Thales produced any mathematics et all. In the paper I will characterize the cognitive unity of the six mathematical results ascribed by the tradition to Thales. I will argue that they (1) lacked generality, (2) lacked compositional synthesis, (3) lacked deductive synthesis, (4) were based on the principle of equality. So several theorems ascribed to Thales are special cases of more general theorems that can be found in Euclid. They lack compositional synthesis in the sense that they concern usually one single isolated object (in contrast to complex configuration which Euclid constructs by means of ruler and compass constructions, which are the tool of Euclid's compositional synthesis). The theorems ascribed to Thales can be proven by recognizing a symmetry of the single isolated object, thus the proof does not contain a sequence of deductive steps (the deductive synthesis of the Euclidean proofs). And finally almost all theorems ascribed to Thales are about equality of two single objects (as opposed to similarity or proportionality). The main argument for the authenticity of Thales' mathematics is that for the authors living in an era when mathematics has successfully overcome these cognitive limitations it would be very difficult to find six mathematical results with such a high cognitive coherence.

Mousavi, Razieh-Sadat (MPIWG, Berlin)

Al-Farghānī's Elements of Astronomy, an innovative presentation of Ptolemaic astronomy?

The astronomical treatise of al-Farghānī (ca. 805-870 A.D) mostly known as the *Elements of Astronomy* (or Kitāb fī al-Ḥarakāt al-Samāwīya wa- Jawāmi' 'ilm al-Nujūm) was composed after the death of Ma'mūn ('Abbāsīd Caliph) in 833 but before 857 A.D. This book was quite popular in Arabic, as testified in part by the numerous surviving manuscript copies. Al-Farghānī's *Elements of Astronomy* gives a comprehensive account of Ptolemaic astronomy in an entirely descriptive and non-mathematical method. These features, together with clarity and conciseness, might have been responsible for the enormous popularity of this book both in

Islamic and European history of scholarship. It is a short introductory presentation of astronomy based on Ptolemy's *Almagest*, comprising thirty chapters. On one hand, the *Elements of Astronomy* remained within the framework of the astronomical models proposed by Ptolemy in *Almagest* regardless of some updates in parameters. As a result, al-Farghānī's compendium was often characterized as a compilation of selected parts, or in one sense, a summary of Ptolemaic astronomy. On the other hand, special features of describing astronomical notions including intentional selections of Ptolemaic astronomy, support the idea of making *Elements of Astronomy* more in line with what we know as the hay'ah tradition. This trace of innovation despite the loyalty to the principles in writing *Elements of Astronomy* will be briefly discussed in this paper. Accordingly, the stability and deviations of *Almagest* will be explored in al-Farghānī's *Elements of Astronomy* through methods of presentation and classification of Ptolemaic astronomy.

Thomann, Johannes (University of Zurich)

Two Ancient Values for the Solar Apogee Ascribed to Persian Astronomers: Observations or Borrowings from Indian Astronomical Works?

Finding the solar apogee was a difficult task in premodern astronomy. Ptolemy's value had an error of $5^{\circ}37'$. Ibn Yūnus devoted a chapter in his *Zīj* to the solar apogee and its motion. Besides his own measurement ($86^{\circ}10'$ in 1003 CE) and that of Ptolemy ($65^{\circ}30'$ in 139/140 CE), he mentions three more measurements in order to reinforce his opinion that the solar apogee moves with a constant velocity, which he believed to be identical with the precession of the equinoxes. For that purpose, he gives approximate timespans between the three intermediate measurements. Two of them are said to have been made by Persian astronomers ($77^{\circ}55'$ and 80°) with a time interval of "approximately 160 years". The third measurement mentioned is well-known, made by the astronomers of the Caliph al-Ma'mūn ($82^{\circ}40'$ in 829 CE). Its time-distance from the later Persian measurement is given as "approximately 200 years". According to that, the Persian measurements would have been made in about 470 CE and 630 CE. Far reaching conclusions about Persian astronomy coming prior to Indian astronomy have been drawn from this information by some historians, but were rejected by others, and the case remained controversial. A fresh look at the relevant sources shows that the matter is more complex than it has been assumed. The conversion methods between tropical and sidereal coordinate systems are key to understanding the different values for the solar apogee within a comparatively short period in time (5th/6th century CE).

Hosking, Rosalie (Seki Kowa Institute for Mathematics)

Not Just Geometry: Broadening the definition of Sangaku

During the isolation of the Japanese Edo Period (1603-1868 CE), wooden tablets containing mathematics were dedicated to Shinto Shrines and Buddhist Temples. These tablets were known as *sangaku*. While most *sangaku* contained geometrical problems and theorems, a smaller percentage dealt with calculating the heights of mountains and distances between towns and Shrines. To date, no investigation of *sangaku* dealing with land surveying has ever been conducted, and academics have largely ignored this area. Subsequently published academic works refer to *sangaku* as mathematical tablets dealing with problems in geometry. This I argue, has created an undeserved disunity in the tradition, separating it into *sangaku* proper – tablets containing geometrical problems - and *sangaku* minor - 'landscape sangaku'. In this paper I closely examine the contents, purpose, and design of these 'landscape sangaku'. I argue that they should be treated not simply as a subtype of *sangaku*, but as part of the main tradition along with geometrical tablets. I promote a changing of the definition of *sangaku* to include investigations in cartography and land surveying as well as geometrical puzzles, such that the term *sangaku* does not automatically infer tablets containing geometrical problems.

SUNDAY 16 SEPTEMBER, 16.00-18.00

S24 THE PLACE OF EUROPE IN THE HISTORY OF GENOMICS

Location: SciM - Dana Study

Chair: Bud, Robert

Organiser(s): Lowe, James

In this symposium, we will show that European transnational collaboration played a crucial role in the history of genomic science. We will question the unitary narrative that both scientists and commentators still convey, which equates genomics with human genomics, and in particular the Human Genome Project. In this narrative, the history of the Human Genome Project has often reflected the role of the so-called G5, five large-scale sequencing centres that contributed a significant share of the draft human genome sequence announced in 2000 and published in 2001. Of the G5 sequencing centres, four are based in the USA, and one in the UK. As a result of this, the European contribution to the emergence and development of genomics has remained obscure. We will focus on the key contributions of the European Commission in fostering international collaboration during the early history of yeast, human and pig genomics: 1. The yeast genome sequencing project (1989-1996), directed by the Commission's Directorate-General XII (DGXII) for Science, Research, and Development, involved more than 80 institutions across Europe. Drawing this massive European effort together with yeast genome sequencing projects in North America and Japan generated a single reference sequence able to unite a global yeast genomics community. 2. The Human Genome Analysis Programme (1990-1992) was also supported by DGXII and originally immersed into a broader initiative on predictive medicine within the BIOMED-1 programme. A specific genomics programme enabled human and medical geneticists to pool their results, mainly through the funding of chromosome mapping workshops in Europe. 3. For the pig, the genome mapping initiatives were organised and funded by the Commission's BRIDGE and BIOTECH programmes (PiGMap, 1991-1996). There were a number of successor projects to further improve the genomic resources available to researchers, and the Commission eventually funded parts of the project to fully sequence the pig genome (2003-2009). As well as tracing the history of genomics in Europe, we will present a number of quantitative techniques that considerably help towards this goal. One of us has been developing methods in bibliometrics and Social Network Analysis (SNA) that enable us to visualise how European institutions collaborated between them and with other continents in the sequencing of the yeast, human and pig genomes. The aim of the symposium will be to situate the different genomic initiatives within the strategies of the European Commission. These strategies involved building collaboration between hundreds of European institutions that would pool their mapping and sequencing results and, eventually, complete the genome of those organisms. The European strategy stood in stark contrast with that of the G5, that involved the sequencing of the human genome by a selected club of factory-style laboratories. Our symposium will, thus, question the unity of the history of genomics by retrieving the horizontal, cooperative and largely forgotten strategies that proliferated in Europe during the early-to-mid 1990s. We will also reflect on how these strategies may be useful in current attempts at improving the medical translation of genomic data.

Wong, Mark (University of Glasgow) and Leng, Rhodri

Mapping Institutional Collaboration in Genomics: Data Linkage and Social Network Analysis

The significance of the Human Genome Project has led to a widespread view of genomics as a science practiced by a small number of factory-style sequencing centres. However, not all

MONDAY 17 SEPTEMBER, 09.00-10.30

genomic initiatives reflect this pattern and the strategies of sequencing were subjected to significant transformation over time. In this paper, I will show how bibliometrics and Social Network Analysis offer a broader and more nuanced image of genomics, especially in considering the early collaborative efforts in European countries. I illustrate the findings of a large-scale quantitative study that analyses collaborations among international institutions in the sequencing of the human, pig and yeast genomes (c.1980-2015). I also outline an innovative method of mapping institutional networks by linking data from the European Nucleotide Archive, Europe PubMed Central and SCOPUS. This method helps to identify the different organisational strategies within and across each sequencing initiative, their evolution, and how the quantity, nature and association of the European institutions had changed. The changing roles and centrality of European institutions in the global genomics network will be discussed. I will argue that the European actors are characterised by decentralised efforts and involved diverse laboratories from various disciplines. Through this approach, one can identify several less-prominent and under-researched institutions that were involved in human, pig, and yeast genomics in Europe. I analyse their network positions and influence before and after the rise of the large-scale sequencing centres known as the 'G5', and suggest how and why they were involved in genomic sequencing.

Garcia-Sancho, Miguel (University of Edinburgh), and Albayrak, Gulsah

The Human Genome Analysis Programme: Europe's attempt to govern genomics from below

My paper will explore the involvement of the European Commission in the early history of human genomics. I will focus on the Human Genome Analysis Programme (HGAP), launched in 1990 with the aim of topping-up national funding and fostering coordination between European States in the mapping and sequencing of human genes. The HGAP promoted a horizontal approach to human genomics that stood in marked contrast with other continents – namely the US – seeking to create new, factory-style genome mapping and sequencing centres. Instead, the European Commission opted for creating networks and pooling the results of existing European laboratories. Toward the mid-1990s, five powerful institutions from the US and Britain – the so-called genomic G5 – proposed a concerted effort in which the human genome would be systematically completed by a selective club of large-scale centres. Their strategy clashed with the more collectivist and gradualist approach of the European Commission, and was backed by the Wellcome Trust and US National Institutes of Health. The G5 finally implemented its vision, which has been retrospectively identified with an international, unified and successful Human Genome Project. By exploring forgotten approaches such as the one pursued by the European Commission, scholars may question the unity of the history of genomics. The very expression “Human Genome Project” evokes a coherent effort that never existed as a single administrative entity. Instead, the 1990s witnessed a proliferation of national and transnational human genome initiatives, some of which were chosen and others discarded due to highly contingent reasons.

Szymanski, Erika (University of Edinburgh) (in absentia)

The yeast genome sequencing project: Creating unity amongst diversity

Saccharomyces cerevisiae, baker's yeast and a common experimental organism, was the first eukaryote to have a complete sequenced genome with a first full draft released in 1996. Despite the historic centre of yeast genome mapping activity being in the USA, the centre of yeast genome sequencing activity became the European Community (EC) through the initiative of André Goffeau, a Belgian biologist civil servant. Between 1989 and 1996, over 80 European public and private laboratories had contributed sequence data, together with twelve institutions from North America and Japan. The resulting single “reference sequence,” was praised for its high quality and became – and remains – a powerful resource for a global yeast genomics community. I argue that the ability of the yeast genome sequencing project to unite diverse European laboratories in a landmark scientific effort was enabled by the peculiar

MONDAY 17 SEPTEMBER, 09.00-10.30

material affordances of yeast: the prior development of a single reference laboratory yeast strain, the culture of freely sharing materials, and the ease of sharing a single-celled organism. The development of a yeast genomics community and reference strain are inextricably co-dependent. Yeast community resources enabled EC cooperation, shaping the nature of the genome sequence generated by that community, its perceived ownership, and its perceived utility. The ethos of sharing engendered within the yeast community and the ethos of cooperation being developed with the EC colluded to produce unity out of diversity in the form of a single shared resource that could not be claimed by just a few genomics powerhouses.

Lowe, James (University of Edinburgh)

European collaboration and the forging of genomics in a livestock genetics community

The European Commission-funded Pig Genome Mapping Project (PiGMAP; 1991-1996) was the first systematic effort to map the genome of the pig. The consortium was based on collaborations in the mid-1980s to investigate the genetics of a condition called malignant hyperthermia, as well as research concerning the Swine Leucocyte Antigen region associated with immune response. PiGMAP was an example of two main developments in European Commission scientific research policy: the formation of European-scale collaborative biological projects to produce fundamental resources for the development of a field of research, which would not be feasible for individual laboratories to produce; 2. The European Laboratory Without Walls, in which additional collaborators could share data and materials, in turn having access to the databases and findings of other participants. Through this, more peripheral groups in Europe and those outside Europe were able to participate. PiGMAP played two key roles in the development of an international community of pig genetics researchers. It provided a platform for the cooperation of actors across Europe and then the world to work towards the common objective of producing maps of genetic markers. Further collaborations developed from this work, and were enabled by the production of maps, the development of statistical and molecular methods and advancements in informatics that were the outcomes of PiGMAP and allied research. It also ensured that some institutions involved, who at this time were experiencing a decline in the amount and security of their research income, were able to continue their research into livestock genetics.

I142 MEASUREMENT, ESPECIALLY TIME

Location: SciM - Dana Study

Chair: Keene, Melanie

Holmberg, Gustav (University of Gothenburg, Sweden)

The production and distribution of synchronized time in Sweden, 1860-1930

This paper studies the production and distribution of time in Sweden. Following the unification of a diversity of local times into a single national time ("Svensk normaltid") in 1879, as well as because of the needs of navigation and expanding railway and telegraph systems, methods for making and disseminating time increasingly became an issue that involved technological and astronomical expertise. It entailed collaboration between private, commercial, and state interests. The spread of unified and synchronized time had both practical and cultural values. Produced at central standard-bearing institutions such as astronomical observatories and state-run navigational schools, it was distributed through a network of telegraph wires, publically visible clocks in urban settings and railway stations, and time balls close to harbours.

Pan, Yue (Shanghai Jiao Tong University)

How Did Chinese Scholars Discover the Hijrah Epoch of Islamic Calendar?

The Chinese-Islamic calendar, namely Huihui Lifa, had made a misunderstanding on the Islamic epoch at first. Instead of the correct epoch A.D.622, it took A.D.599 as its epoch. This misunderstanding was caused by the confusion on the lunar and solar calendar. Newly found materials prove that this misunderstanding occurred not long after the translation of Huihui Lifa at the early period of Ming Dynasty. The calendar Weidu Taiyang Tongjing, which was compiled by Yuan Tong, shows the influence of the misunderstanding on the calculation of Chinese astronomers. During the late period of Ming Dynasty, Chinese scholars had also been aware of the problem on the epoch, and they used an algorithm called jiaci fa to make some kind of correction. In Qing Dynasty, the problem on the epoch of Huihui Lifa was reinterpreted by Chinese scholars including Mei Wending and Li Rui, who said there were two different epochs for Islamic calendar. This study shows that how Chinese scholars discovered the epoch of Huihui Lifa from the misunderstanding.

Wu, Yan (Institute for History of Science and Technology, Inner Mongolia Normal University)

Shift of Traditional Festival during Calendric Reform in early half of 20th century: Focusing on Confucius's Birthday

During Republic of China in early 20th century, the rite of Confucius's birthday gradually replaced the bianual sacrifices to Confucius, and was eventually established as an official commemorative day. At the time, the determination of the definite date of Confucius's birthday both in the Chinese lunisolar calendar and in the Gregorian calendar, as an academic question, was still unsolved. The questions which needed to deal with included how to determine the correct ancient records, how to reckon the date of Confucius's birthday in the Chinese lunisolar calendar and how to transform this date from the Chinese lunisolar calendar to the Gregorian calendar. In terms of these questions, there were several approaches at the time. All of them illustrated some different concept of periodic commemorative day. As a typical case, shift of the date of Confucius's birthday and modification of commemorative ritual related to Confucius illustrated how the government reconstructed social order through reconstructing the order of time.

S04/2 INTERPRETING ANCIENT EGYPT: THE ONE AND THE MANY

Location: SciM - Dana Studio

Chair: Gertzen, Thomas

Organiser(s): Navratilova, Hana; Bednarski, Andrew; Dodson, Aidan; and Lewis, Clare

The study of ancient Egypt embraces a wide range of academic disciplines, from archaeology and historical scholarship, through a multiplicity of 'scientific' approaches, from anthropology to zoology, straddling the humanities and sciences divide. As with other humanities and scientific disciplines, modern social and political attitudes and opinions have impacted on Egyptology, affecting how ancient Egypt has been interpreted over time. In recognition of the resulting fluctuations in the theoretical principles underlying the practice of the discipline, there has been a growing trend in international Egyptology to reflect more rigorously on its own history, which has exposed both continuities as well as discontinuities of practice. The historiography of Egyptology is thus a multifaceted endeavour, embracing research paradigms concerned with an ancient civilization, and their subsequent application of knowledge in modern contexts. Egyptology has addressed its own conceptualization and practices since at least the beginning of the twentieth century, including reflection – or the lack thereof – on sociological and political perspectives. Studies have both diversified and intensified over the past two decades, with a more conscious appreciation of Egyptology as fundamentally interdisciplinary endeavour, with established geographical, chronological, and cultural boundaries. The time-boundaries embrace the period from pre-history to the Islamic conquest, the geographical ones the Nile-valley and surrounding areas. Cultural boundaries are set wide, encapsulating all those which have impinged on this chronological-geographical area, but in particular on users of the ancient Egyptian language, both in its hieroglyphic form, and in its final Coptic incarnation. Egyptological historiography benefits from histories of other disciplines; vice versa, it complements other disciplinary historiographies, as well as broader intellectual and cultural history. For example, colonial and postcolonial studies have highlighted aspects of Western (or European) interest in the ancient and modern history of the colonised regions that were a result, as well as a tool, of national competition and control, which extended into the realms of local memory and history. The productive element of thinking along these lines is obvious: a widening of the scope of the history of science induces a research reflexivity that sensitises practitioners of archaeology and Oriental studies to the context of their activities, and the formation of their practices. However, the approach may be also be developed in a reductionist mode, explaining the production of knowledge predominantly in terms of politics, power and control, offering a rather selective intellectual history. In a mostly sensible attempt to de-mythologise the history of Egyptology, complexities, constraints, as well as individual agency of researchers may be lost, and new 'myths' created by over-application of theoretical approaches. A diversified methodology might be more productive, including the adoption of a global concept of the history of science that emphasizes a hybrid production of knowledge. The symposium intends to address the position of Egyptology among histories of humanities and sciences, and the diversity of approaches to Egyptological historiography. Fundamentally, the panel seeks to probe the permanence and disruption of interpretive frameworks and their social and political situatedness, to develop and inform a wider understanding of Egyptological historiography.

Rocha da Silva, Thais (University of Oxford)

MONDAY 17 SEPTEMBER, 11.00-13.00

Brazilian Egyptology: Reassessing colonialism and exploring limits

Studies about ancient Egypt have significantly developed in Brazil since the last decade. This does not mean, however, that Egyptology is an established field in the reality of the Brazilian academy. This recent development has been accompanied by the expansion of Ancient History departments around the country and investments in archaeological research within Egyptian collections in Brazil. The absence of good libraries, 'proper training' as Egyptologists, the long distances to primary research centres in a continental country, and funding are among the difficulties faced by Brazilian students interested in ancient Egypt. Thus, whereas internationally, Egyptology has started reflecting on its own conceptualization and professional formation, Brazilian scholars are challenged to accommodate the traditional ways of doing Egyptology to the Brazilian academic reality. This leads to other challenges: how does a former colony take part in a colonial discipline while challenging colonial frameworks? Questions related to geographical distance, cultural differences, and varied backgrounds seem to justify the absence of an understandable reason why Brazilians could (or should) be interested in ancient Egypt. In this paper, I discuss Brazilian insertion into a global Egyptology, while examining the limits of this idea in Brazil. Moreover, I will discuss how interest in ancient Egypt and its relationship with the ancient world have been (re)shaped in recent Brazilian history.

Dodson, Aidan (University of Bristol)

Egyptology: a British model?

In contrast to the state-based 'top-down' processes through which Egyptology first developed in much of Europe, in the UK a much more 'bottom-up' situation has existed since earliest days of the, with minimal interest, let alone funding from central authorities. Indeed, Sir Gardner Wilkinson received his knighthood in part because he had achieved so much without state support. This paper will thus survey the history of Egyptology in the UK during the 19th century in contrast with that in other European states, with case-studies leading up to the foundation of the first UK chair in the subject – by private initiative, and some decades after the subject had become established in some other states.

Kóthay, Katalin (Museum of Fine Arts, Budapest)

Early Hungarian Egyptology in the context of patriotism and European identity

In Hungary, formal scholarly interest in ancient Egypt started in the last third of the nineteenth century. The road to institutionalization at the beginning of the twentieth century was a long one, and was preceded and accompanied by systematic collecting of Egyptian antiquities, education of the general public (organised travels and publications of translated foreign and Hungarian books in the field), casual courses on ancient Egypt offered at the Royal Hungarian University of Budapest, as well as by the first Hungarian archaeological mission in Egypt. This multifaceted process took place in a particular ideological and socio-cultural setting, which was characterized by a dispute on the primacy of national or European values. Addressing issues such as musealization and institutionalization, governmental support, ideological motives, and individual initiatives, the paper explores how, for the educated Hungarian, ancient Egypt represented European (not only universal) values, and how the new discipline of Egyptology was used to enhance both patriotism and European identity, or took a back seat behind national cultural issues.

Ketchley, Sarah (University of Washington, USA/Independent Scholar)

Nile Travel and Excavation in the Valley of the Kings 1889-1913: The Diaries of Mrs. Emma B. Andrews

"I now close this little record of the winter's travel, feeling assured that the pleasure of future reference to it, will more than atone for all the time I have given to it." Mrs. Emma B. Andrews, 'A Journal on the Bedawin', May 16th 1890. In penning these words, Mrs. Andrews could not have anticipated that her journals would become a significant resource for the history of archaeology and Egyptology during the so-called 'Golden Age' at the end of the nineteenth and

MONDAY 17 SEPTEMBER, 11.00-13.00

beginning of the twentieth centuries. For over two decades between 1889 and 1913, Andrews traveled along the Nile with millionaire lawyer turned archaeologist, Theodore M. Davis, and was present when he discovered 18 of the 42 tombs now known in the Valley of the Kings. Her as yet unpublished eyewitness account is often more accurate than some of the official archaeological reports. The diaries are also a detailed yet under-explored commentary on the social and political history of Egypt at the time. Davis and Andrews became a nexus for turn-of-the-century society in Egypt, including scholars and archaeologists, politicians, landed gentry, industrialists, bankers, authors and artists. This paper will explore the valuable cultural, social and archaeological perspectives Emma's diaries add to this period of modern Egyptian history. It will also describe ongoing digital humanities work to create new textual and graphical versions of diary content, based on an extensive database of contemporary biographies, correspondence, journals and photographs.

Navratilova, Hana (University of Reading)

Limits of hermeneutics of suspicion - Egyptologists in the Cold War

A biography, or life writing, focused on the individual, has been a so-called maverick genre in history writing (in particular regarding British historiography). As a part of history of science and humanities it has been increasingly superseded by social constructionist approaches, mobilizing social structures and formative paradigms, as well as social identities, as driving forces. This approach, mapping social and political context, is also known as the 'hermeneutics of suspicion', aimed at dispelling an idea of 'value-free' research. Yet there is a call for bringing the individual back into the narrative, or, at the very least, recognising them as having a part in the formation of, as well as a resistance to, the agendas that influenced individual researchers' lives and works. Survival strategies in difficult political regimes should, for example, not necessarily be taken at face value as representing seamless integrations of researchers into a political climate or into power structures. Case studies of two Egyptologists sharing similar aspects of their background, but operating on either side of the Cold War divide - Jaroslav Černý and Zbyněk Žába – will be used to illustrate examples of an individual agency in complex political and social structures.

1115 HISTORIOGRAPHY OF SCIENCE

Location: SciM - Dana Studio

Chair: James, Frank

Hayes, Emily (Oxford Brookes University)

'it's the time, it's the space, it's the motion': the chiasmus in historical geography

In his 'Scope and Methods of Geography' lantern-slide lecture of 1887 Halford Mackinder (1861-1947) conjured up the image of a 'new' geography whose purpose was the resolution of the malaises of modern times. Mackinder declared that 'One of the greatest of all gaps lies between the natural sciences and the study of humanity. It is the duty of the geographer to build one bridge over an abyss which in the opinion of many is upsetting the equilibrium of our culture.' (Mackinder, 1887, 148). In physiology the term chiasmus comprises the optical nerve in which images produced by each human eye, meet and fuse, thereby producing multidimensional images. In the twentieth century the concept was harnessed by philosophers, anthropologists, semioticians and historians of science (Merleau-Ponty 1968; Derrida 1981; Beer 1996; Baldwin 2004; Strecker & Tyler 2012; Wiseman & Paul 2014). As a rhetorical figure of speech, the chiasmus has been scaled up to become a symbol for structuring patterns of thought in a number of Levi-Strauss's works (Wiseman 2001; 2009). In addition to the aforementioned works, this paper draws on scholarship on rhetoric, visual media and geographies of science. Via a discussion of the significance of magic lantern practices of the Royal Geographical Society in the founding, professionalization and popularization of geography in the 1880s and 1890s, and the changing rhetoric, imagery and conception of the subject by Halford Mackinder and others, this paper considers the unit of the chiasmus in geography and assesses its utility to historical geographers.

Tsai, Jia Chun (Institute of History, National Tsing Hua University)

Making up Galileo

In 1609, Galileo Galilei made his first telescope and used it to provide a strong argument for validity of Copernicus' system of universe. Since then, the telescope became a "symbol" of Galileo. Numerous portraits of Galileo Galilei show the brilliant scientist with his telescope or his model of universe, or both of them. However, the instrument was not the only characteristic feature of the portraits of the Italian scientist. The paintings devoted to him fall into several categories, some of which are especially well known: Galileo demonstrating telescope to the Doge of Venice; Galileo interrogated by Inquisition; Galileo under home arrest; Galileo stating "And yet it (i.e., the Earth) moves". Large number of these paintings was produced in the 19th century, when Galileo became one of "heroes" of the Scientific Revolution. The image of Galileo thus changed dramatically: a scientist became a hero. When this process of transformation started? How exactly this image of "hero" was constructed? What were the motives of the artists who represented Galileo in this way? What were their sources of information? In my paper I will analyze literary sources and portraits of Galileo in order to answer these questions using.

Alberti, Sam (National Museums Scotland and University of Stirling) and Inglis, James (University of St Andrews) and Volkmer, Laura (University of Edinburgh)

Historians of science and material culture: The immaterial turn?

Studies of things in the history of science are blossoming; and many of these things can be found in museums. Examples of collection use at National Museums Scotland include our own projects involving scientific acquisitions and typewriters. This paper will detail how we use artefacts in two of these endeavours: James Inglis' study of typewriters and commerce in Scotland c. 1900, which engages with the rich collections of writing machines and auxiliary devices in Edinburgh and Glasgow to construct an experiential history of the typewriter; and how Laura Volkmer uses collections given by the University of Edinburgh to the Museum to understand ownership and intellectual property rights. We will outline the extent to which these projects illustrate a unity between curators and (other) scholars. Are we unusual,

MONDAY 17 SEPTEMBER, 11.00-13.00

however? Our presentation will go on to reveal the results of a survey of the presence/absence of objects in the published outputs of history of science and technology (following J J Corn's 1996 study of the journal *Technology & Culture*). Among the many fine publications about material culture, how many historians use material culture? We consider whether the results indicate a broader disunity between museums and universities. Does this matter?

Loiodice, Eleonora (Università degli Studi di Bari "Aldo Moro")

Culture: unity of knowledge. Giorgio De Santillana's credit in history of science debate

Focusing on the theme 'Unity and Disunity', Giorgio De Santillana (1902-1974), a complex and eclectic scholar, studied the history of science and its origins from a particular point of view. This paper aims to show and underline Santillana's credit in 20th century Italian cultural debate. Humanistic and scientific subjects were separated after Gentile's reform of the Italian educational system in 1923. This dichotomy even affected the University model, in which philosophy was restricted to the Faculty of Letters, destroying Federigo Enriques's idea of a single faculty, of a united vision about knowledge. One of Santillana's teachers, he contributed within Italian cultural debate. Strong supporter of the idea of a unified and not divided culture, Santillana continued, in *Origine del Pensiero Scientifico* and other latest books, studying the history and origins of scientific thought, focusing on the primitive cosmology and analyzing myth existing all over the world. In ancient mythologies he found the same unity, in which the apparent difference between myths is seen as a puzzle that actually converges towards a unifying figure. The mythological language, talking about stars, constellations and movements of the sky is actually the first scientific language, because unifies mythology, astrology and astronomy in what today is considered science. In addition, in ancient times even mankind perceived itself in harmony and unity with the universe and nature, differently from now. The sources are books, press articles and original documents from archives as Harvard and MIT (Institute archives & special collections).