ESHS Bologna 2020

9th Conference of the
European Society for the History of Science

Visual, Material and Sensory Cultures of Science

Bologna (Italy), 31 August - 3 September 2020

Program & Book of Abstracts

Centro Internazionale Storia delle università e della scienza
International Centre History of universities and science

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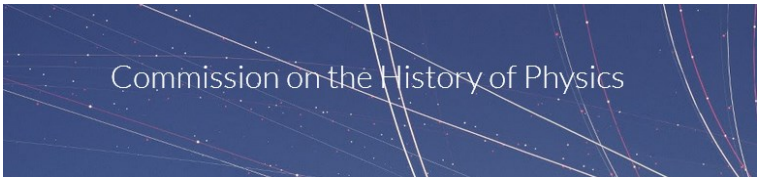

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Welcome to ESHS 2020 Bologna Conference !

It is a pleasure to welcome you all to the 9th ESHS Conference on the "Visual, Material and Sensory Cultures of Science" jointly organized by the ESHS and SISS, the Italian Society for the History of Science.

The preparation of the 9th ESHS Conference in Bologna began in 2018, and was discussed extensively with all parties involved during 2019 and the early months of 2020. No one could predict then that the ESHS, SISS and the Bologna Local Organizing Committee (LOC) would face the incredible challenge to organize the first big virtual conference in our field. When Italy was dramatically ravaged by the COVID-19 pandemics, the courage, professionalism and stamina of SISS and the LOC, managed to prepare a virtual meeting involving almost 600 participants from 40 countries and 11 parallel sessions.

The ESHS Conferences are special forums to affirm the ESHS vision of a plural history of science in its various dimensions (geographic, career- and gender-wise, thematic and methodological). They do so by meeting the needs of an ever more diverse and multi-continental ESHS constituency, in an open dialogue with other historians of science. This conference program and participation offers a vibrant example of such plurality.

I thank Ezio Vaccari, and Maria Conforti, respectively President and Vice-President of SISS, and all members of the Organizing Committee, and most especially Marco Beretta, Elena Canadelli, Sandra Linguerri and Paolo Savoia, involved in the challenging task of organizing such a ground breaking conference in Bologna, the first virtual conference of its dimension in our discipline. I am sure this Conference will stand as a striking example of the adaptive creativity of our community in facing the challenges posed by the virtual world of conferences, and the honour for this goes to them.

Ana Simões

President ESHS, 2018-2020

ESHS Bologna 2020: *Visual, Material and Sensory Cultures of Science*

The theme of the ESHS 2020 meeting is a very broad and inclusive topic. A scientific program with 90 symposia and 30 Thematic Sessions will address in different ways the history of the sensory approaches to scientific objects, their material culture, as well as the building of scientific practices based on the use of the senses (vision, hearing, touch and smell), with particular attention to the history of the relationship between the visual arts and the sciences across nations, periods, and historiographies; visual epistemologies and the cultural practice of thinking scientifically with images; the relationship between different media (print, photography, digital imaging, etc.) and scientific disciplines in various social, political, and economic contexts. Given the developments of the discipline in the past twenty years, this theme is particularly topical and capable of generating broad historical questions at the same time.

This theme will also provide ample opportunity to take stock and reflect on "sensory cultures" and on the "visual turn", to assess their strengths and weaknesses, as well as to explore their relationship with competing or overlapping historiographical trends such as the material and global history of science, medicine and technology.

As you know, because of the current pandemic, the 9th Conference of the European Society for the History of Science will be the first major meeting in history of science entirely organized on-line, with the aim to turn this new mode of scholarly exchange into an exciting a stimulating one.

The Conference, hosted by the Centre for the History of Universities and Science at the University of Bologna (CIS) and by the Italian Society for the History of Science (SISS), will now take place only virtually in Bologna, one of the major centers for the study of the history of science in Italy, with a distinguished tradition which goes back a long time. Since the later Middle Ages Bologna has been at the core of significant developments in European medicine, natural philosophy, mathematics, astronomy and a wide spectrum of other emerging scientific disciplines. Over the centuries, the city and its university have collected and preserved a vast amount of documentation that traces the practice and evolution of these disciplines within a variety of institutional and civic contexts. As a result, Bologna can praise itself for hosting some of the richest archives for the history of science and medicine in Europe. The anatomical teaching of Mondino de' Liuzzi in the 14th century, the birth of one of the first proper scientific museums through the legacy of Ulisse Aldrovandi, and the development of mechanical philosophy around Marcello Malpighi are only three of the many scientific achievements associated with the city and its university that have attracted international scholars. By the late 19th century, Bologna hosted the first chairs in the history of medicine and mathematics, and immediately after the process of Italian unification it became one of the leading universities where different traditions in the historiography of science first developed in Italy. These traditions, now open to global influences, have continued to flourish to this day.

The Scientific and Organizing Committees are delighted to welcome you at the ESHS 2020 Bologna Conference !

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GENERAL INFORMATION

During each Symposium (S) and Thematic Session (T) the chairpersons will be assisted by 'technical chairs' provided by the Organizing Committee in order to facilitate the running of sessions and offer technical support/advice should problems arise.

Each talk in Symposia and Thematic Sessions, including commentators, will be allowed max. 20 minutes; speakers present one after another; questions and general discussion will follow at the end of each session.

Access to Microsoft Teams virtual room opens 15 minutes before starting time in order to allow speakers and chairperson to check their connection.

The tutorial for taking part to the conference with Microsoft Teams and the links to all the virtual rooms are available in the Conference website.

Plenary events that exceed the capacity of the virtual rooms (250 people) will be live streamed on youtube and the link will be posted in the Conference website.

Please note that all times refer to Central European Summer Time (CEST)

Scientific Program

Monday 31 August

9.00 - 12.00 - ESHS Scientific Board Meeting

12.00 - 13.00 - Centaurus Mentoring Program (led by Koen Vermeir)

pause

14.00 - 15.00 - Conference Welcome and Program Presentation

15.00 - 15.20 - Neuenschwander Prize Lecture

Chair: Erwin Neuenschwander

Kostas Gavroglu (University of Athens)

The Sisyphean fate of historians of science

The Sisyphean tale is often thought of as a kind of punishment which expresses the perpetuity of pointlessness: Sisyphus cannot place the boulder on the hill, since every time it reaches its destination, it tumbles back, and Sisyphus is there to push it uphill again. This part of Sisyphus is known to almost everyone. What, however, is not known is what caused the outrage of the gods to give him such a punishment. Sisyphus, having gone to the underworld, managed to trick death twice, and this allowed him to return to our world. He thus gained fame for his trickery and intelligence; Homer referred to him as the "most cunning of men." But the gods thought otherwise and punished him. History of science in its hundred-years long history also managed to trick death twice. For many decades, almost all scholarship was intended for an audience of scientists. Decades of amazing scholarship were met by benign neglect on the part of the scientists. It was not an insignificant part of the community of historians of science that raised time and again the questions – whom are we writing for, who is listening to us, what effect do our findings have on the education of scientists? The answers to these questions were depressingly clear; however, history of science has managed to trick death by slowly and painstakingly creating its own audience. The second time history of science managed to trick death was when social constructivism came into being through a series of brilliant yet scathing criticisms against every single issue history of science had traditionally stood for. But history of science was able to raise from its deathbed, without succumbing to social constructivism's aggressive agenda. The discipline cunningly exchanged one of its constitutive characteristics with another

chance to enjoy the blessings of this world of ours. After the protracted fight with constructivism and the niceties exchanged, there is no more serious internalist scholarship to be found anymore. Internalism as a specific way of doing history of science, and its practitioners, who shared an articulate set of beliefs and methodological preferences, is an exponentially waning part of history of science. The blotting out and extinction of internalism from contemporary history of science is, perhaps, one of the momentous transformations of our discipline. However, even though historians of science have proved themselves to be incredibly adaptive with respect to serious challenges to their discipline, presently they face the most dangerous of all the challenges so far: the almost forceful instrumentalization of the humanities and the social sciences from the European funding bodies, and especially the HORIZON program. Will history of science be able to trick death yet again?

15.20 - 15.40 - Plenary Lecture ESHS President

Chair: Ana Simões

Theodore Arabatzis (University of Athens)

History of Science and its Interlocutors in the Humanities

From the very first stages of its professionalization, in the aftermath of the 2nd World War, the history of science has been seen as a bridge between the natural sciences and the humanities. However, only one part of this triadic complex, the relations between the history of science and the natural sciences, has been extensively discussed. The other part, the relations between the history of science and the humanities, has been less commented upon. In this talk I will make a small step towards redressing this imbalance, by discussing the relationship between the history of science and two other humanistic disciplines that have been historically and institutionally associated with it: the philosophy of science and general history. I will argue that both of these relationships show the characteristics of an unrequited friendship: on the one hand, historians of science have, for the most part, ignored calls of collaboration from their colleagues, the philosophers; and, on the other hand, historians practicing other branches of history have, again for the most part, been rather indifferent to the efforts of historians of science to understand science as a historical phenomenon. I will attempt to offer a diagnosis of this regrettable situation and some suggestions for overcoming it.

pause

16.00 - 16.30 - Early Career Scholar Lecture 1

Chair: Ezio Vaccari

Clara Florensa (University Autonoma of Barcelona)

Agnotology, epistemologies of ignorance, and invisibilisation studies in the history of science

In her illuminating work "The Speculum of Ignorance" (2006) Nancy Tuana challenged the history and sociology of science community: "If we are to enrich our understanding of the production of knowledge in a particular field, then we must also examine the ways in which not knowing is sustained and sometimes even constructed." Two years later, in his introduction to “Agnotology” (2008), the term proposed by Robert

Proctor for these studies in the early 90s, he complained that scholarship attention given to epistemology (the study of how we know) was terribly unbalanced in relation to the attention given to how or why we do not know. Since then, the studies of this field of inquiry have analysed a variety of illuminating concepts such as the “undone science”, "privileged knowledge", "selective ignorance", "acknowledged ignorance" and the "epistemologies of ignorance" of resistance movements. Many have demonstrated that invisibility, doubt or ignorance are not natural states of the population, simple absences of information or knowledge, but the outcome of active and effortful cultural and political processes. Most of these works have focused on the study of the construction of gender, race or social inequalities and environmental hazards, while unravelling processes of construction of power relations in different contexts and times. The social, cultural, political and scientific mechanisms at play to render some things/people invisible or ignorant that the works on agnotology reveal can help unveiling silenced voices, actors and narratives in the history of science, thus potentially challenging current historiographies. Going beyond the application of the agnotological approach to environmental, health or social exclusion risk cases, I will show two examples of challenges to already established historiographies this approach can provide, such as the study of science under dictatorships or the traditional histories of Neo-Darwinism.

16.30 - 17.00 - Early Career Scholar Lecture 2

Paolo Savoia (University of Bologna)

Chair: Toni Malet

Checking the Surface: Vernacular Science, Everyday Knowledge, and Observation in Early Modern Europe

In the past decades, historians of early modern science and medicine have examined the influence of artisanal practice, embodied skills, and vernacular know-how on the rise of modern science. Fostered by ideas on “artisanal epistemology” and “vernacular science,” this trend has its roots firmly planted in the work of twentieth-century historians like Edgar Zilsel, who in the 1940s argued that the scientific method had been created within the artisans’ workshops. This “artisanal turn” is in dialogue with ideas on the key importance of “everyday knowledge” and the domestic scientific activities of previously marginalized groups, first of all women, but also illiterate artisans. This lecture both draws a state-of-the-art of historiographical trends focused on artisanal knowledge, the history of knowledge, and gendered practices, and tries to move forward by attracting attention on several different practices of observation, manipulation, and experimentation with the surface of natural things. I argue that by looking at the embodied skills of “vernacular scientists” one is able to link the observational and empiricist ethos of the seventeenth century with barbers observing the veins crossing the human body, metallurgists looking for ores in their mountain hikes, gardeners finding ways to graft plants, merchants praising the colours and peel of their citrus fruits, and butchers skinning their animals. The surfaces of natural things invite observation, manipulation, measurement, and re-configuration, with the promise to unveil the knowledge of depths. Practical knowledge about the surface of things and bodies led to the concept of nature and matter as composed of layers, corpuscles, and artificially reproducible solid parts. Such changes contributed to the demise of traditional Galenic and Aristotelian views on nature. This plenary explores issues of production of knowledge, and studies the ways in which material knowledge-making practices contributed to the mental habits of observing and experimenting with nature.

17.00 - 17.30 - Early Career Scholar Lecture 3

Chair: Elena Canadelli

Sietske Fransen (Biblioteca Hertziana)

Media Changes and Early Modern Visual Cultures of Science

It is only in the past twenty years that historians of science have come to a full appreciation of the significance of the visual in early modern science. As a result, the field has started to develop the intellectual toolkit needed to do justice to the importance of illustrations, diagrams, graphs, and tables within the context of a broader understanding of how science was practised. This paper discusses the work done so far by art historians and historians of science, and the way in which we can advance the field of visual cultures of science. Historians of art have made significant progress in recent times in developing a general understanding of the early modern visual culture in a scientific context by systematically analysing images in light of their form and function. Questions asked include how these images were understood, how they were used at the time, who made them, and how? And, from a more historiographical perspective, questions have been posed about the appropriate methods with which to study such images. Within the history of science, advancing research into epistemic uses of visual material in the various "fields of science" makes it now possible to compare various traditions of scientific visual cultures, instead of looking separately at, for example, the history of mathematics and anatomy. Combining such unifying insights, I argue that we are at a point in which we can start to ask a set of new questions about the role of the visual in the wider context of early modern scientific communication, media changes, and the history of knowledge. As one example, we can ask how visual representations of science were impacted by their media? And did causation operate in the opposite direction? To what degree did media technologies respond to the challenges posed by contemporaneous visualizations of knowledge?

17.30 - 18.30 - Early Career Network Working Group (led by Matthieu Husson)

Tuesday 1 September, 9.00 - 11.00

Room 1: **T4 - Museums and Collections**

Chair: **Elena Canadelli** (University of Padua, Italy)

1 - **Daria D. Novgorodova** (Russian Academy of Sciences, Russia)

Pietra Dura Mosaic as a Mineralogical Object in the 18th century Russian Collections

My paper is devoted to the history of pieces of art inside mineralogical collections, specifically of some samples of pietra dura mosaics that entered the Mineral cabinet of the Kunstkamera in the 18th century and are kept in the Fersman mineralogical museum. The foundation of the first Russian mineralogical museum was the Mineral cabinet of the Kunstkamera of Peter the Great. From 1725 the Kunstkamera became an academic museum and belonged to the Petersburg Academy of sciences. In 1836 the Mineral cabinet of the Kunstkamera was separated as a mineralogical museum of the Petersburg Academy of sciences (1836) and now this is the Fersman mineralogical museum of the Russian academy of sciences, the well-known research institution. The 18th century collection catalogues give an opportunity to reconstruct not only the composition and structure of the 18th century collection of minerals, but to clarify specific meanings of collectible items. As a rule, those meanings are unlike contemporary ones. Tracing changes of those meanings in time give an opportunity to see the history of mineralogical knowledge in a special way, from the perspective of collectible items. Following by their descriptions in the catalogues I found that in the 18th century the Florentine mosaics had “mineralogical’ meanings in the collection and were described as figured stones (or *lusus Naturae*, sports of Nature). Figured stones were included in almost any collection of minerals in the 18th century and in many systems of mineralogy as a special class. Change in their position in the collection of the mineral cabinet can be traced through catalogues and academic printed sources of the 18th century. The concept of figured stones disappeared by the 19 century with the birth of paleontology (petrified items in the 1930s got the special title of pseudomorphs, literally false forms). By that time, figured stones were excluded from catalogues but not from the collection. Works of art from natural stones are counted as a sort of traditional decoration of the mineralogical collection. Study catalogues from the 18th century clearly show that initially these samples carried scientific mineralogical meanings in the collection. Today the figured stones and mosaics remain in the collection, playing an important role in the museum exhibition, attracting visitors’ interest even more than 'scientific' systematic part of the exposition. However, they are mute and do not tell much about mineralogy and its history.

2 - **Galina Krivosheina** (Russian Academy of Sciences, Russia)

Popularization of Science Through Visual Patterns: The 19th Century Moscow Scientific Exhibitions

The first public museum in Russia (Kunstkamera) was established by Peter I in St. Petersburg in 1719. At first the principal idea of the museum, as Peter put it, was to make people of all social standing “look and learn”, so the visits and guided excursions were free of charge and to attract more people the museum even offered visitors free meals and tea. But in the course of time access to the museum was

considerably limited and at the beginning of the 19th century the museum was hardly available for lower classes. In Moscow, Russia's "second capital", the situation was even worse. Several attempts to establish public museums in the city were not a success. In 1856, when the young zoologist Anatolii Bogdanov, after passing the Master's examination at Moscow University, went abroad to complete his thesis, he was most impressed by European museums and by the abundance of shops selling herbaria, mineral and zoological collections. All this was uncommon for Russia, where the general public seemed to show little interest in natural history and scientific museums were very few in number. It was during this journey that Bogdanov realized the role of public museums in the dissemination of scientific knowledge and developed his plan of popularization of science in Russia. This plan included organization of scientific exhibitions as visual representations of scientific objects and scientific ideas and establishment of new public museums. The paper will focus on the three of his exhibitions (Ethnographical, 1867: Polytechnical, 1872; and Anthropological, 1879), the visual methods Bogdanov used to illustrate scientific ideas, his feats and defeats in developing them, and the ways how politics and ideology interfered into his plans.

3 - **Miriam Focaccia** (Historical Museum of Physics, Center Enrico Fermi, Italy)

The new Museum of Physics dedicated to Enrico Fermi and the role of place in engagement with science

The Museo Storico della Fisica e Centro Studi e Ricerche 'Enrico Fermi' (CREF) at the end of 2018 moved to its new location, the historical building in Via Panisperna in Rome. Here, starting from 1881, flourished the Institute of Physics: a truly 'creative environment' where Enrico Fermi, who took the chair of Theoretical Physics in 1926, organized and prepared the conditions that would lead to the birth of the group of young scholars who became famous as "i ragazzi di via Panisperna". Here, within an exceptional season for Italian science, the first experiments on the phenomenon of neutron-induced radioactivity began; their success was crowned in 1938 with the award of the Nobel Prize to Fermi. Because of its 'double soul', research institute and museum, CREF's mission is to create cutting-edge research activities of an interdisciplinary nature, as well as disseminate and promote scientific culture. The permanent exhibition 'The scientific legacy of Enrico Fermi' tells his life, his discoveries and his exceptional legacy through a dozen significant "steps" of his life and discoveries. A path has been defined and enriched with modern technologies (touch-screens, graphic views, interactive panels and holographic screens), in order to engage and thrill the visitor. The building itself is the protagonist of the museum journey as a place where a scientific discovery has been made or where 'science happens'. A number of innovative projects are related with the Museum: from the VIEWLAB laboratory, where physical research is applied to Cultural Heritage; to EEE-Science project in schools for the dissemination of science; from VEROSH-Virtual ExploRation Of Science History; to "The Invisible Colours" that will design, set-up and pilot innovative multidisciplinary and interactive dissemination events targeting the general public.

4 - **Pedro J. Enrech Casaleiro** (University of Coimbra, Portugal)**, Nuno Peixinho, Ana Lourenço & Teresa Barata**, *Astronomical visual and material culture: Reviving the University of Coimbra Observatory*

The Coimbra Astronomical Observatory, established at the end of the 18th century, holds a remarkable material and visual heritage illustrating the research and teaching of astronomy at the University. The shift from astronomical research based on position and motion of astronomical objects to astrophysics, arrived with the introduction of solar physics marked by the acquisition of a Repsold and Sohne

photoheliograph before 1871. The regular establishment of a series of daily images of the sun was implemented after 1925 with the acquisition of a spectroheliograph in partnership with Meudon, Paris. Since then, spectral images of the sun, photographs, drawings, diagrams and interpretation graphics together with new instruments have accumulated and represent the longest running project of the Observatory until today. The Estado Novo, the fascist regime, implemented the construction of a new University Campus on the old grounds that included the demolition of the old Observatory in 1951. A new astronomical complex was built on the outskirts of Coimbra with six astronomical domes, main buildings, workshops and staff housing in a 7.2 hectares' enclosure. In the last two years the Observatory started a new science communication plan following the revamp of two astronomical domes, for a planetarium and a telescope, together with the Spectroheliograph dome and a fourth dome holding the astronomical collections. This paper discusses how the University of Coimbra Geophysical and Astronomical Observatory is envisioning renovation through the connection of its visual and material heritage. How to plan and revive an institution born in the 18th century with a rich history in a way to communicate, exhibit and research the astronomical heritage, bringing it to life within the current issues and arenas of astronomical science.

5 - **Cristina Luís** (University of Lisbon, Portugal)

Historical Biocollections. A time travel through Citizen Science in Portugal

In an era dominated by planetary-scale anthropogenic change and unprecedented biodiversity loss, biodiversity collections (biocollections) represent irreplaceable legacy information about our biosphere. Citizen science, usually described as the public involvement in scientific research, is a movement with great expansion in the last decade. In essence, however, citizen science practices are not new. Amateurs have been, for centuries, collecting biological specimens, recording observations in journals, and becoming experts on particular habitats or taxa, and many are the examples of scientists calling for data contribution by the public. However, an in-depth study on the history of citizen science in the area of biodiversity was never conducted. At the same time, historical biocollections are recognized as important biodiversity recording sources for conservation biology studies and several initiatives are underway worldwide, to digitize, retrieve and make accessible specimens related information. Alongside, other sources, such as museum catalogues, manuscripts, field notebooks and scientific publications, also hold significant information on biodiversity historical records, which can be used in conservation biology research. Moreover, their examination may also provide information regarding amateur collectors, making them resourceful materials to help tracing the network of amateurs involved in specimens' collection and description. It is key to know who these amateurs were and efficiently retrieve information from their work, turning it accessible for present and future scientific research. Here will be presented a research framework aimed at tracing the history of citizen science in Portugal and, alongside, retrieve biodiversity information from historical records, that may be used in biodiversity and conservation biology studies. This work promises a significant advancement in our understanding of citizen science and biodiversity monitoring and conservation in Portugal.

Room 2: **S40 - Picturing health under tropical medicine lens**

Convener: **Isabel Amaral** (Nova University of Lisbon, Portugal)

The Symposium here proposed deals with the history of tropical medicine from the point of view of the social, political and environmental determinants of diseases now considered "neglected". Illustrations on these diseases, the people who suffer from them and the people who study and confront them

require cross-perspectives combining not only disciplines such as entomology, parasitology, ecology, geography etc., but also visual and written testimonies and physical devices or tools used for the study and representation of natural, social and medical phenomena. Conventional narratives about the history of tropical medicine emphasize the North Atlantic axis, in other words, contributions pertaining mainly to Great Britain, France, Germany and the United States. The Symposium hopes to stress the importance of South-South interactions or what nowadays is called the Global South, still underestimated in narratives that consider countries of the northern hemisphere as "centres" of knowledge production that 'irradiate' to other parts of the globe.

References:
Hall J, Ross E. *Malaria: The Battle against a Microscopic Killer*. Glasgow, UK: Evimalar; 2012. *A Portrait of Diseases: Photographs from a Hospital in South Africa* (Berliner Medizinhistorisches Museum, 2003). Susan M. Squier, Parasites! Graphic Exploration of Tropical Disease Drug Development*, AMA J Ethics.* 2018;20(2):167-175. doi: 10.1001/journalofethics.2018.20.2.msoc1-1802.

Chair: **Daniele Cozzoli** (Pompeu Fabra University, Spain)

1 - **Kristin D. Hussey** (University of Copenhagen, Denmark)

'A pathological pilgrimage': Race and power in Patrick Manson's slide registers

By the close of the nineteenth century, the great Scottish physician Patrick Manson had already retired from his days of imperial service and was building his school of tropical medicine in the imperial metropolis of London. While he bemoaned that his age and infirmity kept him from taking up a 'pathological pilgrimage' to colonial spaces, he was able to rely on an extensive network of collaborators in the field to source the clinical material he needed for his research.1 Ever meticulous, Manson kept detailed registers of the over 300 slides he received from around the empire at the turn of the twentieth century, often including original letters from informants. This paper will consider the geographies embedded in Manson's mobile networks of slides. I will suggest that the scientific material surrounding Manson's collection of pathological slides can be used to reanimate the experience of being a tropical medicine research subject at the turn of the twentieth century. Tracing the slides' journeys from collection in the field to Manson's laboratory(s), I will consider issues of race and power in the ways that slides were collected and interpreted. Pathological material was often taken forcefully from indigenous peoples while Europeans were all too willing to part with samples of their blood to protect themselves and their families from the dangerous tropical climate. Preserved in these fragile glass preparations, tropical diseases themselves became objects of desire for researchers like Manson.

2 - **Isabel Amaral** (Nova University of Lisbon, Portugal)

Visual culture of medicine during the WWI: the Portuguese experience in Africa

This paper aims at reflecting on the concept of "neglected disease", in the context of the visual culture of medicine, by reflecting the Portuguese experience in Africa during World War I. The experience lived and reported by doctors, soldiers, missionaries in Mozambique and Angola translates into the senses, a lethal threat: tropical diseases. The blindness of military authorities blinds the European skills to prevent and treat tropical diseases. Several reports will be used, with images, interviews, reports, tributes and feelings from the medical profession that attest how much tropical diseases have been neglected in the war theatre. Why? Portuguese medicine proved to be completely powerless to deal, not only with diseases that soldiers brought from the metropolis, but also to deal with diseases found in tropical environments, particularly in swampy areas, where vectors of malaria and sleeping sickness

fought fiercely against the colonizers. This work aims to enlarge the debate on the visual culture of medicine and medical practices, in articulation with the history of tropical medicine in colonial milieu.

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3 - **Kathleen Walker-Meikle** (King's College London, UK)

Seeing skin: Diagnosing diseases of enslaved people in 17th-century Cartagena

This paper examines the diagnostic practices of medical professionals when assessing the health of enslaved people in Cartagena de Indias in the seventeenth century. When slave ships of the asiento (the licensed company with a monopoly for transporting slaves) arrived at the port, all would be examined by a medical team in order to calculate the reduction of the tax levied by the Spanish Crown on each individual judged to be infirm or disabled. This formal procedure of 'evaluation of damages' (reconocimiento de daños) was attested by a scribe in the presence of Crown authorities, and was carried out by two medical professionals, a physician acting on behalf on the Crown and a surgeon on behalf of the asiento, who would have to agree on the diagnosis for each individual. This paper, based on extensive archival research, details the diagnosis of thousands of people between 1663-1674 (during the asiento of Grillo y Lomelín). They were all examined by the physician Adam Lobo (physician and Protomedico) and either Ysidro de Leon or Francisco Ramirez (both surgeons). All medical examinations were done based solely on visual evidence, without any verbal communication. In keeping with the conference's theme, this paper attests a medical culture based purely on glances, that resulted overwhelmingly in only identifying skin afflictions and physical disabilities. This research also sheds light on the multiple acute and chronic conditions suffered by enslaved people in the seventeenth-century Caribbean and contributes to our understanding of early modern health and disease, in particular regarding skin ailments.

4 - **Daniele Cozzoli** (Pompeu Fabra University, Spain), commentator

Room 3: S39 - High speed films, animated gears, blinking cells, flat spheres: sensory and epistemic cultures of science and technology

Conveners: **Arianna Borrelli** (Leuphana University Lueneburg, Germany), **Florian Hoof** (Goethe-University Frankfurt, Germany)

Against the view of scientific knowledge as an abstract, disembodied content, the panel explores the constitutive connection between knowledge and the sensory means through which it is generated and expressed. Four case studies span from the middle ages, over modernity to the present day to offer comparative perspectives on the epistemic implications of different medial dimensions of technoscientific knowing in the fields of research, education, and outreach. They reflect on the visual, material and sensory aspects of science beyond the distinction of (material) form and (immaterial) content. The speakers in the panel have backgrounds in history, philosophy, media, film, and cultural studies, and museum design, demonstrating the productivity of integrating historical methodology with

interdisciplinary perspectives when studying the visual, material, and sensory cultures of science. In her study on scientific films in engineering (Italy, 1950s-1990s), which is based on archival material of the work of Achille Berbenni, Simona Casonato explores the sensory and aesthetic awareness of scientific filmmakers in laboratories. Tarja Knuuttila and Andrea Löttgers discuss the images of cells "blinking" produced with the help of flourescent proteins in synthetic biology. On the basis of observations conducted in the Elowitz lab at Caltech, they reconstruct the aesthetics and epistemic aspects of the practices behind these visualizations. That visualization devices are controversial concerning their sensory qualities is shown in Florian Hoof's case study on "gear films" in engineering (Germany, 1920s). Film sparks conflicts between educational strategies that rely on kinetic models or on animated kinetics on the flat cinema screen. The complex interplay of epistemic and sensory dimensions of knowledge is also at the center of Arianna Borrelli's analysis on medieval astronomy and cosmology. She discusses how scholars made celestial motion visible and manipulable through the haptic and visual acts of drawing geometric constructions and constructing instruments.

Chair: **Arianna Borrelli** (Leuphana University Lueneburg, Germany)

1 - **Simona Casonato** (National Museum of Science and Technology Leonardo da Vinci, Italy)
Ultra-rapid research in Italy 1950-1990. The art and science of specialized cinematography in engineering laboratories

Achille Berbenni (1931-2013) was an electrical engineer and scientific filmmaker who directed the Istituto di Cinematografia of the Politecnico of Milan (ICPM) from 1959 to 1998. Accounts of his work, found in the archives of Museo Nazionale Scienza e Tecnologia Leonardo da Vinci (MNST) and Politecnico, allow to shed a light on the uses of technologies for recording moving images as scientific instruments from the 1950s onwards. In Italy, the history of scientific and educational cinema is a recent field of enquiry (Tosi, 2004; De Ceglia, 2011; Alovisio and Bianchini, 2015; D'Amia and Mariani, 2017; Lussana, 2018) and many cases of "useful cinema" (Acland & Wasson, 2011) remains unexplored. A further analysis on the case of the ICPM and its relationship with relevant dissemination contexts, like the MNST, allows to study the contribution of moving images to the sciences, in the special perspective of filmmaker-engineers who had also strong interests in the humanities and in the arts (Casonato and Canadelli, 2019). Berbenni's case highlights how the use of cinema as a research tool is entangled with linguistic and expressive skills, by exploring the sensory and aesthetic 'awareness' of scientific filmmakers in laboratories. Berbenni was skilled in highly specialized techniques like ultra-rapid, x-ray and Schlieren cinematography, that he used in laboratory tests for the engineering faculty, as "a tool for measurement, analysis and documentation" (Berbenni, 1988), but he was also interested in a broader conception of cinema. He operated in international contexts, like the International Scientific Film Association, the SMTPE and the Encyclopaedia Cinematographica project at the Goettingen University. He built also a massive archive of scientific movies from all over the world, promoted educational courses on cinematography and was an acknowledged ethnographer of popular culture in northern Italy.".

2 - **Andrea Loettgers & Tarja Knuuttila** (University of Vienna, Austria)
What do we see when cells blink?

Novel visualization methods, which make use of green fluorescent proteins (GFP), have become central tools in cell biology. They have enabled the study of gene expression at the single cell level. These visualization techniques have been pivotal for the emergence of synthetic biology, since they provide a

possibility of observing earlier inaccessible processes within living and multiplying cells (Elowitz & Leibler, 2000). In constructing synthetic genetic circuits and implementing them in living cells, synthetic biologists explore possible forms of dynamical organization in biological systems. Since the early 1960s researchers have modeled genetic and metabolic regulation in terms of various kinds of networks, but it was not until the discovery of GFPs and the subsequent use of time-lapse movies that they were able observe gene regulation through blinking bacteria in growing colonies. These movies provided important evidence that the various hypothetical mechanisms presented by biologists might actually be realized (or realizable) by biological organisms. Yet such observability of "life at the single cell level" is far from straightforward. The crucial question concerns the relationship between the actual dynamic of the synthetic circuit and its representation in the movies. The situation is similar to that of X-rays (Pasveer, 2006). Like in the case of X-rays, whatever the snap shots are showing needs interpretation that involves taking into account the technologies employed in making those movies, as well as knowledge about cellular and genetic processes.

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3 - **Florian Hoof** (Goethe-University Frankfurt, Germany)

Overcoming flatness. Modelling and animating kinematic mechanisms

In the 1920s the AWF, a German parastatal commission for industrial efficiency started to produce 'gear'-films. They showed the technical details of gearboxes as well as animated models of mechanical and mathematical theories necessary for gear construction. 'Gear'-films were the first fully animated films produced exclusively for vocational training and succeeded existing strategies to teach kinematic theory and mechanisms that were based on vast collections of model mechanisms (Reuleaux 1876). This paper explores the debate about visual and sensorial education in pedagogy and psychology that was triggered by this shift from models to the new medium film. I argue that these discourses had a decisive influence on the epistemology of the medium film as a device for visual education. Film animations on the flat, non-touchable cinema screen put at stake educational concepts that were based on the idea of the 'illustrative model' (Montessori 1912). From this perspective a model not only shows details of an object but also gives the person a sensorial impression of the 'real' object in small scale. Contrary to this position, others argued that 'gear'-films would actually outperform 'gear'- models because of their visual qualities and potential. Moving images could be stopped, reversed and slowed down to discuss every little detail in vocational training. To refute the argument that the flat film screen would detract from a decent learning experience vocational training films were combined with stereoscopic pictures to compensate for the lack of the three dimensions of the 'illustrative models'. This led to an epistemological framework that rendered "visual" media as deficient compared to sensorial media such as models.

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4 - **Arianna Borrelli** (Leuphana University Lueneburg, Germany)
The flat sphere: Haptic, visual and verbal knowing in high medieval astrolabe manuscripts

The term astrolabe refers today to instruments made out of metal whose circular, rotating parts allow to perform astronomical and astrological computations thanks to a two-dimensional projection of the celestial and terrestrial spheres. However, when in the high Middle Ages (10-11th c.) knowledge on astrolabe design was introduced in the Latin culture from the Arabic one, the astrolabe, also called "flat sphere" ("plana sphaera"), was much more than a solid metal (or possibly wooden) instrument: it was a multi-layered complex of philosophical, astronomical and geometrical knowledge which scholars of the time could deploy by manipulating flat spheres in their head. This aim was achieved by internalizing the drawing procedures for constructing the complex set of circular lines which appears on extant astrolabes and especially on manuscripts. Historians have often scoffed at these early manuscript traces as half-baked attempts by Latin monks to grasp notions too complex for them. Yet not so much the drawn lines, but rather the haptic and visual act of drawing them, when embedded in a range of verbal and non-verbal, written and non-written strategies of communication, allowed Latin scholars to fully grasp and internalise the structure and mechanism of astrolabe gears - and of the divine order of nature which they saw it as represented.

Room 4: S23 - Universities and Their Cities. Visual Traces of Universities and Scholars in University Cities across Eras - 1

Conveners: **Milada Sekyrková** (Charles University Prague, Czech Republic), **Marek Ďurčanský** (Charles University Prague, Czech Republic)

The foundation of the university has always changed the face of the place where it settled. The symposium wonders whether the city and university have always lived in symbiosis, or what friction surfaces might have occurred in terms of shared space. The foundation of the university changed the organization of urban space. It required the allocation of a fairly large proportion of the urban area for the campus or individual university components. Often, the university has also been implanted in the surrounding residential units without losing a firm link with its center. There were higher demands on the level and functioning of infrastructure, transport and accommodation standards in the given center and its surroundings. All this applies to the entire period of existence of universities, from the Middle Ages to the present. The symposium presents various possibilities of functioning and problems in the coexistence of the original urban-type seat and university, using cases of universities in Central and Western Europe - Bohemia, Austria, Prussia, the Netherlands, Switzerland, Poland, Slovenia, Hungary.

1 - **Marek Ďurčanský** (Charles University Prague, Czech Republic)
University of Prague outside Prague

The paper will focus on the presence of the oldest and biggest Czech university in other Bohemian towns than in its main seat – Prague. Especially in the 20th century individual faculties, institutes and student colleges of Charles University were founded in Pilsen, Hradec Králové, Brandýs nad Labem, Poděbrady etc. Some of them were supposed to become the rudiment of regional universities, but they never did. The presence of the university, even in such partial form, influenced the everyday live in the city as well

as its situation in disturbed times (1968, 1989), when the students actively joined the protests against regime.

2 - **Robert Tomczak** (Basel University, Switzerland)

Visual traces of Basel University and Its Scholars (XVXVIII) - University Heritage as a Family Legacy

The city of Basel and its university were a unique example of a symbiosis between “town and gown”, which was expressed in architecture and visual traces in the 15th-18th centuries. Although the University was founded as a Catholic (1470), it soon became a Protestant (1529) and thus lost its former medieval privileges and part of its autonomy. The main patron of the university became the city, which cared for the worthy representation of the university as an important factor for the city’s prestige and economy. Therefore, in 1532 the University received the former Augustinian monastery because the former residence (specially bought from a rich burgher) was too small for a growing university. The old building, although minor and non-functional (former noble residence), was an architectural hallmark of the University, as it was located right next to the Rhine, by the main bridge. The city patrician, therefore, strived for a good representation of the university because many students came from the circles of wealthy bourgeoisie. With time, these young people became professors, so they began to represent the interests of their own professorial milieu and their families. This symbiosis of interests was expressed in epitaphs and gravestones placed in the city cathedral (or in the viridarium), which commemorated famous university professors (e.g. its first rector, Bishop George von Andlau) and their families. For this reason, families took care of epitaphs of university professors as an element of their own prestige. However, this symbiosis had negative consequences because during the 19th century the city decided to rebuild the old headquarters of the university and to demolish the old Augustinian monastery. For this reason, only the epitaphs of the university professors, which are the only visual reminder of the university tradition of the city, have been preserved to this day. This tradition, however, was cultivated by the professors' families, proud of the fact that their relatives were associated with the University. The aim of the paper is therefore to present, using numerous examples (architectural, visual), the visual symbiosis between the city and the university (in terms of representativeness and tradition), which created a specific local quality (strongly based on the family).

3 - **Andor Mészáros** (Eötvös Loránd University of Sciences, Hungary)

The Role of the University in the Formation of the Capital of Hungarian State in 19th Century

The first permanent university of Hungary was founded in 1635 in Trnava (Nagyszombat). The university moved to Buda, which gradually became the administrative center of Hungary, at the end of the 18th Century, then in 1784 to the neighboring Pest. Here the history of the university was closely linked to the Hungarian national and political movement. The major Hungarian institution of higher education became one of the most important cultural institutions of Budapest, which became the capital of Hungary after the Austro-Hungarian Compromise of 1867 and became a united capital city in 1873. From the seventies to the nineties were built the university's new, modern building blocks and campuses. In my lecture, I intend to present the relationship between the emerging Hungarian capital and the university, the scientific and public role of the university, and the location of the university buildings being built in the emerging modern urban space.

4 - **Adéla Jůnová Macková** (Academy of Sciences of the Czech Republic, Czech Republic)
Visual traces of Czechoslovak Orientalists in the interwar period

Personal collections of Czechoslovak scholars include archival documents as manuscripts, articles and monographs, personal as well as official correspondence, school reports, diplomas, papers related to their work at universities, learned societies or in politics, but rarely include truly personal materials as diaries, notebooks etc. that would introduce them in their roles as husbands, fathers, friends etc. Visual images of scholars represent extremely important archival materials that can uncover the personality of a scholar from many different points of view, that would be otherwise hidden. In my paper I would like to present various visual images (photographs, pictures, newspaper articles, postcards, caricatures) of the Czechoslovak Orientalists – František Lexa, Bedřich Hrozný, Vincenc Lesný, Alois Musil, Felix Tauer and Jan Rypka – to demonstrate their life's (un)official roles, to show how they officially presented themselves (or how they asked others to present their image), how they were seen by their contemporaries as well as by later scholar generations, and how these images were used, for example the famous picture of the founder of Czechoslovak Egyptology professor František Lexa with a sphinx.

Room 5: **S9 - The changing relation between visual representations and theoretical frameworks: tables, diagrams, plots, and drawings in the history of physics and astronomy - 1. Early modern astronomy**

Sponsored by *Società Italiana di Storia della Fisica e dell'Astronomia - SISFA* (Italian Society for the History of Physicis and Astronomy)

Conveners: **Roberto Lalli** (Max Planck Institute for the History of Science, Berlin, Germany), **Salvatore Esposito** (INFN Naples, Italy)

Historians of science have enormously increased our understanding of the broader cultural contexts' influence in shaping the way practitioners have represented physical phenomena and data in the scientific as well as popular literature. Visual arts, local practices, devices, pedagogy, are among the many interpretative lenses historians have employed to analyze scientists' production of visual representations of nature. This symposium aims to integrate these approaches by exploring the interrelation of visual representations of both abstract and physical objects with the changing theoretical models and frameworks in the history of physics and astronomy. It does so by providing a venue to compare case studies discussing the practices of visual representations in two complementary and interconnected ways. On the one hand, cases are investigated with a focus on visual representations understood as paper tools to conceptualize physical phenomena and shape calculation practices. On the other, panelists reflect on the role of different kinds of theoretical entities, such as beliefs, predictions, and modeling, in the form of the actual visual representations of physical data and phenomena or even in creating the possibility that these objects could be visually represented at all. The symposium is organized in two sessions, each focusing on a specific epoch. Session I deals with the practices of early modern astronomy: The first two talks interpret visual representations as paper tools with strong epistemic content in calculation practices and in relation to world-system debates; the following two talks analyze instead how theoretical frameworks in natural philosophy shaped the representation of astronomical objects using comparative perspectives. Session II deals with twentieth century physics and astrophysics: the first two talks assess the role of statistical techniques' in the visualization of space signals out of the noise; the following two examine the role of paper tools in

investigating theoretical objects such as black holes and space time particle interactions. This symposium is organized and sponsored by the Italian Society for the History of Physics and Astronomy (SISFA).

Chair: **Salvatore Esposito** (INFN Naples, Italy)

1 **- Stefan Zieme** (Humboldt University Berlin, Germany)

Knowledge Cultures and Translations: Latin-Arabic Traditions of the Almagest

Until the 15th century, knowledge of the Almagest in the Latin West was constituted by Gerard of Cremona's translation from Arabic into Latin. The text of Gerard's translation has been examined carefully and its dependence on two different Arabic variants is well studied. However, the tables of the Latin-Arabic Almagest have not been scrutinized, and the relation to their Arabic or Greek counterparts is unstudied. In this talk, I will analyze the historical mathematical structure of tables in the Latin-Arabic tradition of the Almagest in comparison to their Arabic and Greek precursors. While Gerard's text has proved to be a slavish translation from Arabic templates, the tables will turn out to be significantly different. The tables for the chord, declination, and solar equation appear to be recomputed in order to match Ptolemy's textual explanations, which, in contrast, generally diverge in both Greek and Arabic tradition. The analysis of tables, therefore, sheds a new light onto knowledge cultures and their transmission and translation of knowledge.

2 - **Flavia Marcacci** (Pontifical Lateran University, Italy)

Solving the clash among world systems in a glance! Astronomical tables as visual tools, 1610-1687

Between Galileo and Newton, astronomical handbooks and works constantly searched for data and evidences to understand and establish the correct world-system. The clash was essentially between the heliocentric and geo-heliocentric cosmological models. Astronomers as Giuseppe Biancani (1566-1624), Johann Georg Locher (1592-1633ca.), Nicolaus Mulerius (1564-1630) and others published books full of tables, in some respects similar to the tables of authors of Early Modern Science (Chabás-Goldstein 2009). What was new was that the same data about planets and stars were calculated and explained inside contemporaneously Ptolemaic, Copernican and Tychonic systems. This literature was never studied systematically by scholars, contrary to the previous period, which on this issue received a little more attention. Especially Giovanni Battista Riccioli (1598-1671) carried out comparisons between the different approaches and solutions to solve the question. He constantly resorted to tables to show and shortly explained different solutions to the several problems raised by ancient and coeval astronomers. Thus, Riccioli organized various kind of tables, even though one of these was very original: the comparative tables, where the right choice had to be visually clear. Tables became the best visual tool for one purpose (as it happened also in non-Italian contexts, Daston 2015): his objective was to choose the absolute hypothesis (hypothesis absoluta) employing a strong observational database and a deductive system of theoretical evaluation of data (Marcacci 2018). Comparative tables became an important visual instrument for the debate about the right world-system before Newton.

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3 **- Pasquale Tucci** (University of Milan, Italy)

What did Leonardo and Galileo see observing the Moon?

Leonardo and Galilei observed the Moon almost a century the one from the other. Their pictures are very different; those of Galileo are much more detailed. Differently from Leonardo, who had tried unsuccessfully to design a device able to enlarge distant objects, Galilei had the opportunity to have a telescope that he used to observe celestial objects. But the difference between the two visual representations doesn't depend on the telescope. Galileo had a theoretical context, able - at least in Galileian view - to explain the many anomalies of lunar soil. Leonardo too had argued that, having the Moon the same aspect of the Earth, she would be constituted by the same elements, in contrast with his own Aristotelian and Ptolemaic assumptions. In my talk I'll try to highlight how Leonardo's and Galileo's drawings of the Moon, far from being a mere transposition on paper of what they had seen either with the naked eye or through the telescope, are heavily theory-laden. Leonardo was convinced that the phenomena observed on the Moon could be analyzed according to a principle of visual analogy with terrestrial phenomena. Galileo, on the other hand, could take advantage of two cultural phenomena developed in the course of the sixteenth century. In astronomy, the theoretical framework of reference changed with the publication of Copernicus' De Revolutionibus. And in Geometry, with the publication of various Treatises of Perspective, the same object could be drawn from different points of view. Moreover, the studies on the geometry of chiaroscuro, largely used by the artists, were deepened. Leonardo had already used these techniques in his drawings of machines and in his paintings. Galileo would make great use of this technique in his drawings of the Moon.

4 - **Anna Jerratsch** (Max Planck Institute for the History of Science Berlin, Germany)

Forms and Practices of Visual Representations in Early Modern Cometary Tracts

As frightening and impressive phenomena, comets in the early modern period encouraged intensive communication processes. German vernacular pamphlets of the 16th and 17th centuries offer a unique insight into a multifaceted discourse on the knowledge and interpretation of comets. Visual Representations like images or diagrams are important parts of those tracts that fulfilled different functions: They were used to seek and create attention in order to attract an audience. They offered explanation and meaning production by visualizing observational, natural philosophic, astrological and historical data which was then used to popularize different ideas about comets. This paper evaluates these forms of data throughout a crucial time period of 150 years in order to elaborate on the development in how comets were perceived, explained and interpreted. By showing how different ways of presenting cometary data were related to certain interpretive frameworks of natural philosophic theories, prognostication and divination, I want to allude to the ambiguous character of the knowledge on comets between stability and progress in order to challenge traditional historiographical narratives which present the change of the knowledge on comets as a linear process of rationalization and naturalization.

Room 6: **S75 - Internationalism, Nationalism and Localism. Images and Places of Mathematics in Europe from Napoleon to the Wars of the Twentieth Century - 1**

Sponsored by *SISM - Società Italiana di Storia delle Matematiche* (Italian Society for the History of Mathematics)

Conveners: **Maria Teresa Borgato** (University of Ferrara, Italy), **Erika Luciano** (University of Turin, Italy)

Mathematics has always had an international character in its development and teaching: transversal to countries and societies, although it has developed unevenly in different contexts. From the Napoleonic period to the Great War, national states played an important role in the dissemination of education and in the promotion of mathematical research: in Italy, Germany, France, the British Isles and, in general, throughout Europe. With the World Wars of the twentieth century, the positive function of the national states entered into a crisis and, exaltating the nationalist components which, along with some fertile ground, as in Poland for example, led to totalitarian governments. In reaction, after the Second World War, internationalism was progressively affirmed, even if the national states guaranteed, and still guarantee, most of the funds available for education and research. In this symposium we would like to investigate the debates and effects of this evolution, through the analysis of education and research promotion policies implemented in public or private institutions (national academies, associations, etc.), and taking into consideration different communication tools and vectors of circulation of mathematical knowledge (scientific journals, correspondence, etc.). Particular attention will be paid to material culture: models, archives, libraries, documental patrimonies.

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Chair: **Maria Teresa Borgato**

1 - **Luigi Pepe** (University of Ferrara, Italy)

The Institutes of the Republics and the Kingdom of Italy: French Model and Italian Experiences

The organizational model of the 'Institut', created in 1795 in France, was exported and transposed to Napoleonic Europe (Italy, Holland, Spain). The 'Institut' brought together the most distinguished scholars in the different fields of science, literature and the arts, offering positions and ensuring public funding. The traditional hierarchy between disciplines was thus overcome and the egalitarian ideals of the *Encyclopédie* were realized. A reference organizational model was born for the national academies of many countries, up to the present day.

2 - **Brigitte Stenhouse** (Open University, UK)

The representations of British mathematics in the early nineteenth century

In this paper I will examine the representations of the decline of British mathematics in the early nineteenth century, through the correspondence and writings of Mary Somerville. I would furthermore consider how Somerville mobilised this rhetoric to situate herself within a visible mathematical community, through her submissions to mathematical periodicals and her interactions with Henry Brougham's Society for the Diffusion of Useful Knowledge (which resulted in her 1831 translation of Laplace's *Mécanique Celeste*).

3 - **Elisa Patergnani** (University of Ferrara, Italy)

Models and textbooks for technical education in Italy

This work aims to analyse the many innovations brought about by the Napoleonic reforms, which involved educational institutes devoted to the formation of army cadres in important centres of the Italian Peninsula; the focus will mostly be on the teaching of mathematics, the study syllabuses and the increasingly important influence they exerted over the formation of artillery and engineering bases, culminating in their challenging the place of classical humanistic formation. Under study are several manuals devoted to the teaching of the aforementioned subjects; they were often works by eminent mathematicians whose hindsight and knowledge inspired the minds of future generations of military men from the old Italian States, who were to form the newly-born nucleus of the national army and fight for the unification of Italy in the decades following the Congress of Vienna.

4 - **Erika Luciano** (University of Turin)

The theory of practice': Quintino Sella and the role of scientific collections from Turin's Lezioni di mineralogia to Lincei's presidence (1847-1884)

During the first half of the nineteenth century, many protagonists of Italian Science took part in the renewal of techno-scientific studies with their use of collections and laboratories and a model-based didactic methodology. The Kingdom of Sardinia was relatively advanced in this regard, mostly thanks to the work of Carlo Ignazio Giulio and his pupil Quintino Sella. In 1852, they founded the Regio Istituto Tecnico, which in 1861 would become the Reale Scuola di Applicazione per gli Ingegneri and later, in 1906, the Polytechnic. With a review of unpublished material held in Turin, Biella and Roma archives, this talk will show how Sella treasured his experiences abroad (1847-1852) in order to design new research and teaching practices. The methodological approach devised by him along his travels to England, Switzerland, Germany, Belgium and France was masterfully developed in his Lezioni di Mineralogia (1860-61). We will also illustrate Sella's involvement in the construction of crystallographic and mineralogic collections, cabinets and library at the Lincei's Academy under his presidency.

Room 7: **S26 - Spaces of Visual Epistemology**

Convener: **Maria Teresa Costa** (Max Planck Institute for the History of Science Berlin, Germany)

The history of art and the history of science have increasingly converged over the last decades creating a methodological affinity that is markedly evident in both the expansion of art history into a history of images (Bildwissenschaft and visual studies) and the growing interest of historians of science in visual

sources and material artefacts. Putting into dialogue both disciplinary histories and related methodologies, the symposium aims to unfold a new perspective through the analysis of spaces of visual epistemology, that is, of spaces in which knowledge arises through images in a broader sense, spaces such as laboratories, studios, museums, and exhibitions. Analyzing their interconnections, overlaps, and collisions beyond disciplinary boundaries, the symposium aims to reflect on both the potential of thinking with images and on the epistemic significance of experimentation and process: as hybrids of materiality and imagination, these are all workshops of visual knowledge. Following their history and their architectural evolution, such places cannot be defined conclusively since their topography reflects transitions and paradigm shifts within art, science, and technology. This makes a deep analysis of both the network of agents and the institutions mediating these cultural exchanges necessary in order to also consider the objects themselves as being inseparable from the history of their media of transmission. Media and displays will therefore not simply be analyzed as tools for seeing, but as epistemic mechanisms that are essential for the transfer of knowledge and the widening of the disciplinary discourse of both art history and the history of science. In this sense, particular attention will be devoted to the shift introduced by digital technologies (as infographic) in visualization processes, which has enhanced the epistemic potentialities of diagrams, models, and simulation strategies both in art and science.

Chair: **Maria Teresa Costa** (Max Planck Institute for the History of Science Berlin, Germany)

1 - **Alena Williams** (University of California San Diego, USA)
Jean Painlevé and Experimental Cinema in the Palais de la Découverte

French naturalists and filmmakers Jean Painlevé and Geneviève Harmon performed a subversive detournément of wildlife and nature films, creating over 200 films, many of which focused on land and sea animals. This paper analyzes Painlevé's 1937 film Voyage to the Sky— created for the central science display in the Palais de la Découverte on the occasion of the 1937 International Exposition of Arts and Techniques Applied to Modern Life in Paris. This paper articulates the nesting of these spaces of visual epistemology at the world's fair where modern cosmological science unfolded within the political context of a major world exhibition. Influenced by Surrealism, Painlevé explored the boundaries of reality, illusion, and the so-called "convulsive beauty" found in nature, likening his approach to cinema to a research process. As he pointed out in his 1955 article on scientific film, "it never would have occurred to the pioneers of cinema to dissociate research on film from research by means of film." Situating Painlevé's work squarely within mid-twentieth century debates on the interrelation of politics with scientific and experimental film, this paper will examine cinema's central role in modern knowledge production and exhibitionary display. It will explore the way the night sky and the cinematic screen have become sites for the projection of the cultural imaginary. Created for French Nobel Laureate in Physics Jean Baptiste Perrin's new science museum, Voyage to the Sky explores astronomical distances in space, illustrating how the moving image—in all its expanded forms—became the premiere pedagogical means of advancing and propagating scientific ideas at world's fairs, museums, and planetaria.

2- **Hans-Jörg Rheinberger** (Max Planck Institute for the History of Science Berlin, Germany)
Strategies of Making Visible in Experimentation

The talk will analyze a number of strategies of visualization that belong to the realm of the laboratory. The examples on which these considerations will be developed are taken from the early history of molecular biology. Special attention will be given to indexical visualizations as they occur in biochemical

preparations and in work with viruses and phages in vitro. The talk will look at the primary traces that this work generates, and then see how they are translated into data that become amenable to digital processing.

3 - ***Stefanie Bürkle*** (Technical University of Berlin, Germany)

Studio and laboratory. Workshops of Knowledge and Spaces of Failure

The talk will present the results of Bürkle's art and research project "Studio and Laboratory, workshops of knowledge" (2017-19), which compared architectural spaces of art and science. Whether in works of art or in scientific research, only the results of the creative process have been visible. What happens behind closed doors in labs and studios remains as invisible as it is mysterious. Part of the project consisted in researching these unfamiliar sites of creation by photographing laboratories and art studios throughout Berlin. Bürkle's photographs feature deserted spaces for development and thought, full of materials, tools, experiments, and set-ups whose purposes remain hidden for the viewers. These photographs focus on the spatial imprint of processes, exploring analogies between experimentation processes in both studios and laboratories. The project started in 2000 with a series of photographs of scientific buildings. Most of these architectures never fulfilled the scientific prospections; they were strictly not functional in the sense they should have been. These disfunctional architectures lent to Bürkle's fascination for the spatially manifested failures. At the same time, the artist discovered similarities between artistic and scientific methods: the matter of improvisation as part of experiments were often assembled as bricolages, resembling very much to the way artists are working in their studios. Besides the failed architectures of sciences, the aspect of failure as part of every process was also an intriguing phenomenon that occurred within the making of the "Studio and Laboratory" project. Failure is not really admitted or outspoken either in the world of science or the world of art. During the spatial research for the project the issue of failure occurred up in a lot of the conversations with artists and scientists as an important issue in the creative process; it often shows up as a spur to success.

4 - **Katrin Glinka** (Humboldt-University Berlin, Germany)

Visual Representations of Thought: on Museum Displays and Visualization Interfaces

Visualizations and exploratory interfaces are often developed for the purpose of analyzing and/or (re)presenting larger quantities of data and information. Apart from data visualizations in the context of specialized academic research, (interactive) visualization interfaces that are designed for non-expert audiences are nowadays a recurring form of visual representation or narration e.g. in data journalism, scrollytelling, or as a mean to offer access to cultural collections. In this talk the production of meaning will be discussed as something that exists both in exhibitions and museum display as well as in a visualization as digital display. Both produce meaning by arranging and positioning visual resources and objects in correlation to each other and both are based on (scholarly) interpretation of the material and objects at hand. Consequently, just as exhibition displays, visualizations as well have to be analyzed with regards to the epistemic functions and mechanisms of representation (in this case of objects or of collections). Taking the challenging concept of "similarity" as a vantage point, the talk will illustrate the need for transdisciplinary research at the intersection of computer sciences and the humanities. The talk wishes to contribute to a discourse that reflects upon the epistemologically challenging operations and translations that accompany the display of digital data, images, and visualization while referring to (or representing) physical objects and collections.

References:
Florian Windhager, Paolo Federico, Gunther Schreder, Katrin Glinka, Marian Dörk, Silvia Miksch, and Eva Mayr. *Visualization of Cultural Heritage Collection Data: State of the Art and Future Challenges*. IEEE Transactions on Visualization and Computer Graphics, 2018.

Room 8: **S15 - Marginalising or expanding personal experiences of nature? On the (loss of) authority of field research in 20th century geophysical sciences**

Conveners: **Matthias Heymann** (Aarhus University, Denmark), **Dania Achermann** (University of Bern, Switzerland)

Far into the 20th century, personal observation and sensual experience played an important role in the production of knowledge about nature. The field researcher and his/her senses were considered as a valuable and legitimate part of the process of knowledge production. Chorographical traditions in weather observation, botany or plant geography, field investigations of soils, plants, glaciers and deserts as well as the exploration of unknown places are well-known examples. On the other hand, personal observation and sensual field experiences also elicited debate, caution, reluctance and rejection, if its subjective character appeared not to match established norms of reliability and objectivity. During the 20th century, approaches in the field sciences professionalized in many domains. New technologies such as kites, balloons, submarines and ice drills helped to expand field research approaches. Others, such as radar, rockets, satellites, weather buoys, sonar systems and computer modeling proved powerful alternative venues of investigating ice, soils, hydrological cycles, weather, climate and many other geophysical processes on many different scales. Particularly in the postwar era, in some domains local field research, personal observation and sensual experiences of nature appeared to have experienced a loss of authority, devaluation and marginalization. This session is interested in investigating questions such as the following: Which impact did new technologies, research approaches and shifting epistemological interests have on field research and the role of personal experience in the twentieth century? How did scientific and political contexts such as colonialism, world wars and the Cold War, big science, infrastructural globalism and global environmental concerns inspire or challenge local scale field research. In which disciplines and research domains have field research and sensual experiences lost (or gained) authority? How were transformations of field research negotiated? Which impacts did the expansion, transformation or marginalization of field research have?.

Chair**: Kristian Hvidtfelt Nielsen** (Aarhus University, Denmark)

1 - **Robert-Jan Wille** (Utrecht University, Netherlands)

Sounding the aerial ocean. Maintaining a transcontinental network of sensible weather balloons at the Lindenberg Aeronautical Observatory, 1905- 1915

Is it still field research if things do the field work instead of humans? Take for example ‘unmanned’ weather balloons, which act as ‘proxies’ for personal observation and local sensory experience. But weather balloons do not close down the field as a space, they merely intensify field research and even open up new spaces such as the stratosphere. It is possible to maintain that technologies of remote sensing alone made ‘big field science’ possible. Especially data-hungry sciences such as world meteorology [Katharine Anderson, ‘Marine meteorology: observing regimes and global visions, 1918-1939’, in: Katharine Anderson en Helen Rozwadowski ed., *Soundings and crossings. Doing Science at Sea, 1800-1970* (Sagamore Beach MA) 213–244] and its spin-off discipline atmospheric physics made

extensive use of remote sensing tools from the beginning of the twentieth century. Maritime meteorologists used passenger ships and buoys, unmanned weather stations at isolated places were connected through telegraph wires, but what really revolutionized meteorology was the transnational maintenance of networks of regular weather balloon ascents. In this expansion process, expeditions changed character and became 'frontier exploration' for central observatories that had increasingly become 'high maintenance' themselves. Instead of collecting regional data, the fully human-staffed expedition was now sent to the tropics and the polar area, and the work in Europe itself became a matter of technological maintenance. But this work should still be considered field work as well: it never fully became 'indoor science'. In this talk I will focus on the Prussian Lindenberg aeronautical observatory under the founder and director Richard Assmann between 1905 and 1915. How did the observatory reorganize meteorological field work through organizing massive campaigns of high-altitude balloons?

2 - **Vladimir Janković** (University of Manchester, UK)

The Balkans as Fieldwork: Jovan Cvijić's Visceral Ethnography of Lands in Strife and Turmoil

This paper addresses the scientific fieldwork and travels of Jovan Cvijić, the most prominent Serbian geographer of the early twentieth century, whose study of the Balkan geology and population won him a status of authority in both science and politics, having achieved international fame for his study of Karst (Ford 2007) while also consolidating the study of geography at the University of Belgrade and serving as an adviser on the negotiation of national borders in the Serbian delegation at the Paris Peace Conference in 1918 (Trgovčević 2004). Yet while modern scholarship on Cvijić has dwelt on his published work in geology, anthropo-geography, ethnology pedagogy and politics, virtually ignored are the personal, infrastructural and other labor-intensive aspects of his fieldwork and travels – known as 'annual excursions' – in Bulgaria, Old Serbia, Bosnia, Montenegro, Greece, Albania, and Romania, findings from which became the foundation for his theoretical and political ideas (Kovačević 2016). I argue that Cvijić's movements during outdoor fieldwork, ethnographic labour, organizational effort and communication skills played a pivotal role in his anthropogeographical representation of the Balkans and the region's political destiny. A large portion Cvijić's scientific work revolved around practical matters: he took pains to procure travel permits from the Porte, secure armed protection in remote areas, arrange lodging and food, meet with local chiefs, mobilize local guides, secure working animals, and toil through mud and karst while carrying the equipment he needed for cartographic, geological and instrumental observation in situ. I argue that these visceral experiences conditioned Cvijić subsequent scientific reflections on the nature of the region. For this presentation, I concentrate on the visual documentation produced during these excursions. Using numerous sketches Cvijic made en plein air, I look at the techniques whereby Cvijić inscribed vernacular landscape into geological script, transferring an irreducible experience of a place into a montage of geomorphological features and so creating a distinct, scientific identity of places. I demonstrate how in using these images Cvijić weaved visual cues with lexic memes, blending place-names with mineralogical jargon, morphing landscapes into stratigraphy and, as a result, translating fieldwork into knowledge.

3 - **Dania Achermann** (University of Bern, Switzerland)

"A strong back and love for snow and ice": Diversification in glaciological research from the 19th to the 20th century

In the 19th and until the mid-20th century, European glaciology was a field science dominated by geological questions and characterised by a strong focus on glacier volume and dynamics. Observing and measuring volume and behaviour, as well as monitoring and mapping of glaciers were main

objectives of glaciological expeditions. The knowledge gained from field work in the alps were transferred and expanded in the Arctic. After World War II, this began to change. Physicist and chemists developed a stronger interest in glaciers and ice, and set up a novel field of ice core research, characterised by laboratory studies of ice samples. The introduction of mathematical flow models, new instruments such as special radiation counters and ice drills, as well as a new interest in the relationship between glacial ice and climate history led to a new kind of physical-chemical glaciology. However, this technology-intensive laboratory work has neither replaced nor marginalised traditional field research but expanded the range of research practice, approaches and questions in glaciology and led to a “close cooperation between the geochemist and the field glaciologist”.(Baird, P.D. and R.P. Sharp 1954. "Glaciology", *Arctic* 7: 3-4. p. 150).However, the alpine and the polar researchers have formed two different communities. This contribution will shed light on the reasons of this diversification of glaciological practice by analysing the role of instruments, the shifts of epistemological interests, the cooperation between field scientists and laboratory researchers and the influence of regional as well as global politics.

4 - **Matthias Heymann** (Aarhus University, Denmark)

Understanding and misunderstanding aridity and drought: From the UNESCO Arid Zone Programme to modelling and remote sensing approaches

At the end of the 20th century, several scientists noted widespread misconceptions about aridity and desertification resulting from inappropriate studies and information disseminated by the United Nations. Historians Diana K. Davis and Perrin Selcer showed that a lack of understanding of arid zones rooted in misguided colonial ideologies that were propagated by UN initiatives such as UNESCO’s Arid Zone Programme (1951-1964) and adopted by other UN Agencies (Selcer, Perrin. *Patterns of science: Developing knowledge for a world community at UNESCO*. PhD diss., University of Pennsylvania, 2011. Davis, Diana K. *The arid lands, History, power, knowledge*. Cambridge: MIT Press, 2016) Alarmist and misleading narratives of progressive desertification put the blame on destructive local practices such as deforestation and overgrazing. This paper investigates UNESCO’s Arid Zone Program and subsequent new research approaches based on satellite-based remote sensing and computer modeling of aridity and drought. It argues that the Arid Zone Program offered an effective framework that helped develop and spread new interdisciplinary research approaches to improve knowledge about arid zones, which rooted on a combination of localscale field research and larger-scale remote sensing techniques. The myth of progressing desertification and misguided colonial expertise, however, characterized much of its political rhetoric and public communication. Particularly during the 1970s and 80s, misguided narratives of progressing desertification dominated the understanding of aridity and drought. This paper suggests that broader scientific and political contexts need to be taken into account to understand a resurgence of these alarmist narratives. Local-scale climatological field work was increasingly replaced by remote sensing and modeling approaches to investigating aridity, which failed to appreciate local climatic variations such as extended droughts. Proliferating environmental concerns, on the other hand, amplified the dissemination of alarmist narratives.

Room 9: **S71 - How to create a new scientific school? On some international contacts and collaboration of mathematicians and logicians in the first half of 20th century**

Convener: **Danuta Ciesielska** (Polish Academy of Sciences, Poland)

The main topic of the symposium will be the process of the internationalisation of mathematics in the first half of the 20th century. The first International Congress of Mathematicians was held in Zürich in 1897. The organizers included prominent mathematicians from different countries like Felix Klein (Germany), Andrey Markov (Russia), Franz Mertens (Austria) and others. The congress was attended by 208 mathematicians from 16 countries. Up to the WWI the Congress in Zürich was followed by congresses in Paris, Heidelberg, Rome and Cambridge. As a result the contacts between mathematicians from different countries were more frequent. During the Great War the situation in Europe changed dramatically. Later, after war, independent states (like Poland, Hungary) again appeared on the map of Europe. Russia, Austria and Germany were no longer empires, Russia became a communistic country. In the 1930s, the Nazi in Germany and Fascist in Italy ruled in their countries. Anti-Jewish terror started. It was a very difficult time for international cooperation. But against all odds in those times, mathematicians continued the increase of collaborations. In Russia and Poland new mathematical schools were created. The idea of specialization, started by mathematicians working in algebraic geometry in Italy, was after the Great War implemented to Poland and Russia. In Warsaw Sierpiński and Mazurkiewicz created a school of topology and foundation of mathematics, in Moscow Lusin created a school of real functions. We are going to talk about this two schools and their collaboration. We want to show how studies in Göttingen under Klein and David Hilbert helped Polish and Russian mathematicians in getting contact. We also want to analyze the role of the old generation in internationalisation of science.

Chair: **Wiesław Wójcik** (Jan Dlugosz University in Czestochowa, Poland)

1 - **Wiesław Wójcik** (Jan Dlugosz University in Czestochowa, Poland)
Warsaw Mathematical School - its sources and impact on the development of world mathematical logic

The Warsaw mathematical school is inseparably connected with three mathematicians: Zygmunt Janiszewski, Stefan Mazurkiewicz and Wacław Sierpiński. They are regarded as the founders of this school. Its research focused on set theory and geometric (general) topology. However, one must not forget about other scientists who significantly expanded the scope of research of this school. On the one hand, there are the creators of the Warsaw school of logic (Jan Łukasiewicz, Stanisław Leśniewski, Alfred Tarski), and on the other, mathematicians gathered around issues related to mathematical analysis, trigonometric series theory, probability theory and mathematical statistics (Aleksander Rajchman, Antoni Zygmund, Stanisław Saks, Jerzy Spława-Neyman) or algebraic topology (Karol Borsuk, Samuel Eilenberg). The sources of this research can be found in the new theories and research programs related to such names as: Bernhard Riemann, Gottlob Frege, Henri Poincaré, and David Hilbert. What is also important is the cooperation of Polish mathematicians with mathematicians from other countries and common creation of new theories, e.g. Sierpiński and Lusin, on descriptive set theory, Jerzy Neyman with Egon Pearson or Zygmund with Raymond Paley. The emigration of some Polish mathematicians to the United States caused by the outbreak of World War II is crucial for the spread of the achievements of the Warsaw mathematical school. The building of strong research centers in the United States by Alfred Tarski, Antoni Zygmund and Samuel Eilenberg is of great importance. Analysis of the nature of

research and the achievements of these centers shows their relationship with the Warsaw mathematics school.

2 - **Danuta Ciesielska** (Polish Academy of Sciences, Poland)
Felix Klein and David Hilbert foreign students in Göttingen

The last decade of 19th century and the first three decades of 20th century are a "mecca period" in the history of Georg-August University in Göttingen. The city was a world centre for exact sciences. The university was visited by scientists, especially by those who wanted to start their careers under David Hilbert and Felix Klein. I will present an unexpected role of the mathematical courses in Göttingen. This academic events were the place for the creation of lifelong contacts between scientists from different culture, sometimes between people belonging to nations in conflict, like Poles and Russians. I want to show how international character of the discipline and personal attitude of teachers helped people in getting contact. Klein's and Hilbert's courses were playing very important role in this process. Klein's "Dozent Manuel" (stored in the archive of the university in Göttingen) is a unique source for the story. In this document there are names of students, dates, names of lectures and seminars. I will show some diagrams, grids and tables presenting an extract of information obtained from the Klein's "Dozent Manuel". In the case of Hilbert such a document did not survive, but fortunately many notes from his seminars remained. These documents helped me to elaborate a similar illustrations of Hilbert's role in the process of internationalisation of mathematics. I will present some widely known Polish and Russian participants of the Klein's and Hilbert's courses.

References:
R. Siegmund-Schultze, *Rockefeller and the internationalisation of mathematics between the two World Wars*, Berlin 2001. R. Tobies, *Felix Klein Visionen für Mathematik, Anwendungen und Unterricht*, Berlin 2019.

3 - **Galina I. Sinkevich** (Saint Petersburg State University of Architecture and Civil Engineering, Russia), ***International mathematical contacts of Russia in the first half of the 20th century***

At the beginning of the 20th century, there were 12 Imperial Universities in the Russian Empire that trained professors for the whole country. Those, who graduated in purpose to prepare for a professorship, went for 1-2 years abroad, where they were attending lectures by leading mathematicians in Paris, Berlin, and Göttingen. Russian mathematicians took an active part in the International Mathematical Congresses. Some of them delivered plenary lectures. The period 1913-1921 was very difficult for Russia. The First World War, revolution and civil war broke international relations. Here the role of a Polish mathematician Wacław Sierpiński and the journal "Fundamenta Mathematicae", which continued publishing papers written by Russian authors, is invaluable. After 1924, scientific life in the Soviet Union gradually began to acquire sustainability, scientific journals began to be published and international events held. Since 1924, Russian mathematicians continued their participation in the International Mathematical Congresses. In 1927 (Moscow), in 1934 (Leningrad) the AllRussian Congresses of Mathematicians, in 1930 (Kharkov) the All-Union Congress of Mathematicians took place. These congresses were attended by foreign guests. Since 1932, the Soviet Union began to conduct specialized international mathematical conferences: Conference on Aerodynamics and Hydrodynamics (1933), International Conference on Tensor Differential Geometry and its Applications (1934), First International Topological Conference (1935). The scientific significance of this conferences can hardly be overestimated, so many important results that served as the beginning of new directions in topology were made in the reports. After that, the All-Union Conference on Functional Analysis (1937), the All-Union Conference on Algebra (1939), the First All-Union Conference on Mathematical

Statistics (1940), the Conference on Functional Analysis and Functions of a Complex Variable (1940) were organized in the Soviet Union. I will present talk about this times and facts.

4 **- Joanna Zwierzyńska** (Polish Academy of Sciences, Poland)

Scientific international contacts cooperation about a century ago in the light of correspondence between Samuel Dickstein and Władysław Natanson

International cooperation is an extremely important aspect of scientific activity, without which it is difficult to imagine conducting research today. What was this matter a century ago? We will look at this issue from the perspective of the correspondence of Samuel Dickstein and Władysław Natanson, who were important figures for the history and organization of Polish science, having extensive contacts at home and abroad, whose impressive activity lasted for several decades. Their rich correspondence has been preserved in the Polish archives: 86 letters from Dickstein to Natanson and 44 letters from Natanson to Dickstein. They are fascinating research material, not yet developed and containing, among other things, information on organizational matters related to the history of Polish science and international cooperation.

Room 10: S56 - Visual, Material and Political Cultures of Zoological Gardens - 1

Conveners: **Oliver Hochadel** (Spanish National Research Council - CSIC, Spain), **Miquel Carandell-Baruzzi** (Autonomous University of Barcelona, Spain)

In the last twenty years or so, the history of zoological gardens has been the topic of a considerable number of innovative studies, including the history of science, cultural studies, human-animal studies and adjoining fields. Nevertheless, many questions have only been addressed in a very tentative manner. Leaving behind a rather institutionally oriented historiography this symposium would like to focus on the visual, material and political cultures of zoological gardens. What were zoo visitors supposed to see? How did they experience exotic animals? How did the regimes of displays change over time? This symposium is also interested in the concrete make-up and functioning of the zoo: how is it run on a day-to-day basis? How are animal enclosures built and maintained? Who takes care of animals and what specific knowledge do people working in the zoo need to have? This leads to questions of how the zoo is connected with the outer world. How do the living animals get into the zoo and what happens to them once they die? How are zoos connected with each other and how does knowledge on how to run a zoo circulate among them? The symposium will also ask for the political dimension of zoos. What ideologies did they represent? What kind of nature did and do they pretend to recreate? A total of eleven papers 2 and one commentary will present a rich variety of case studies from the late eighteenth century to the present. The symposium thus hopes to point to new research agendas in the history of zoological gardens, and more generally, in human-animal studies.

Chair: **Juliana Adelman** (Dublin City University, Ireland)

1 - **Helen Cowie** (University of York, UK)

A Tale of Two Anteaters: Madrid 1776 and London 1853

In 1776, the first living giant anteater to reach Europe arrived in Madrid from Buenos Aires. It survived six months in the Real Sitio del Buen Retiro before being transferred to the newly-founded Real

Gabinete de Historia Natural. Seventy-seven years later, a second anteater was brought to London by two German showmen and exhibited at a shop in Bloomsbury, where it was visited by the novelist Charles Dickens. The animal was subsequently purchased by the Zoological Society of London, which classed it 'by far the most important addition, in a scientific point of view, which has been made to the collection since its commencement' (The Times, 7 October 1853). Drawing on recent work in animal biography, this article assesses the reception of the two anteaters and considers their cultural and scientific significance. I examine the logistics of the exotic animal trade and trace the transatlantic networks that permitted anteaters – and knowledge about them – to move between continents. I also study the technologies of representation that enabled the insectivores to reach new audiences. By focusing in detail on the lives of two exceptional anteaters, the article illuminates understandings of the species more broadly and shows how different spaces and places shaped the creation and dissemination of zoological knowledge. I emphasise, in particular, the tensions that emerged between imperial and colonial science and the competing knowledge regimes of the natural history museum, the menagerie and the field.

2 - **Oliver Hochadel** (Spanish National Research Council - CSIC, Spain)

In life and death. Avi, the emblematic elephant of the Barcelona Zoo

Born around 1875, the Indian elephant Avi spent the first part of his life in the private collection of animals of the wealthy Barcelonese banker Lluís Martí-Codolar. In 1892, Martí-Codolar sold his collection to the city of Barcelona. It became the nucleus of the Barcelona zoo. Soon Avi became the most popular animal of the new zoo, drawing large crowds. There are numerous photos of the pachyderm, many of them showing him in "interaction" with the visitors. Avi also figured in a number of caricatures in the Barcelonese press, often in conjunction with political criticism. Avi died in May 1914, yet his second career as a public animal was only about to begin. The taxidermist Lluís Soler i Pujol was charged to mount the skeleton of the elephant as well as his hide. For the remainder of the twentieth century Avi's remains were exhibited in the Natural History Museum of Catalonia. This paper will use Avi's biography to explore the cultures of natural history of Barcelona in the late nineteenth and in the twentieth centuries. Due to the numerous traces Avi left in different media and the collective memory of the Barcelonese, he represents a form of popular natural history. This paper will discuss how this elephant was reconfigured, renamed, relocated, repaired and remembered. Avi was more than just an object of knowledge. He oscillated between zoos and natural history museums, between entertainment and education, between exotic animal, "emblem of Barcelona", "friend of children" and not least as an "exemplary Catalan", well behaved and patient.

3 - **Marianna Szczygielska** (Max Planck Institute for the History of Science, Berlin, Germany)

Rendering Animal Bodies Between the Zoo and the Natural History Museum in Poznań (1924-1945)

In this presentation I map out knowledge exchange and material circulation of animal bodies between the Zoological Garden and the Natural History Museum in Poznań in Western Poland during the interwar period. Even though the zoo and the museum were founded in the second half of the nineteenth century and maintained provincial character within the German Empire, after the First World War both institutions gained the status of Polish national heritage. Nevertheless, they encountered problems with sustainability, as well as with establishing their own institutional identity and social legitimacy. In 1924 the museum was relocated to the zoo grounds, allowing for intensive exchange of knowledge and traffic in animal bodies. These exotic animals that failed to acclimatize in

the zoo, ended up on the museum dissection table. Meanwhile, some paleontological artifacts from the museum collection provoked new breeding projects. Focusing on two restitution projects partially carried out in the Poznań Zoo – namely, the reintroduction of the European bison (*Bison bonasus*), and the breeding back of the extinct tarpan wild horse (*Equus ferus ferus*), – I highlight the renewed interest in domestic fauna as an accessible resource for recrafting institutional and national identities. In doing so, I pay careful attention to the processes of valuation and devaluation of animal bodies, and especially the shift from exotic to rare native species as valuable assets for zoological collections and 5 conservation efforts. Given that zoos and museums were key for the development of the biological perspective in Western Europe (Nyhart 2009), I wonder how infrastructural ruptures and limited access to international trade markets shaped the practices of collecting, exhibiting, and protecting endangered species in eastern Europe. By analyzing the logistical strategies of these two "marginal" institutions, I trace the ways in which they impacted both local and global scientific research and its popularization.

4 - **Violette Pouillard** (Ghent University, Belgium)

Knowledge production, animal experiences, and the zoo as a laboratory

Since the birth of the zoo in the early nineteenth century, zoo animals have been submitted to various experiences in order to make them cope with the requirements of captivity. These experiences were largely conducted on an informal basis, although sometimes formed part of elaborated programmes, and are so intrinsic to the zoo, I will argue in this contribution, that this institution, often depicted by opponents as a prison, can be better understood in terms of a laboratory. This paper will address the experimental nature of the zoo by blending a cultural approach with an animal perspective which focuses on the materiality of captivity, via a study of animal experiences in the Paris menagerie and the London and Antwerp Zoos from the early twentieth century onwards, a period associated with the decline of acclimatization as a science. In the nineteenth century, acclimatization was a scientific issue, forming part of the transformist impetus in France, as well as an applied imperial science, which aimed to better exploit useful foreign animals. It was therefore also a day-to-day practice, which sought to test and to improve the ability of exotic animals to survive in Western metropoles. The scientific aspects of acclimatization gradually faded away in the late nineteenth century due to lack of success and interest, but the day-to-day practice of habituating wild animals to captivity remained de facto an integral part of zoo management. This contribution will demonstrate how acclimatization as a practice led to the conduct of further experiments (dietary, medical, psychological, social, or, 6 more recently, ethological and conservationist), conducted either at the zoo or in connected laboratories. The zoo therefore appears as a place of local knowledge production and as a nexus of international scientific networks, influenced by, and themselves shaping, interactive cultures with animals.

Room 11: **S20 - Visualizing and Modelling Sensory Actions (VMSA) for Inquiring Science & Technology into History - 1**

Convener: **Raffaele Pisano** (Lille University, France)

The symposium explores the transition, scientifically-culturally, from the sensory inquiring of objects in Nature to scales/measure-and-modelling phenomena (physics, mathematics, geometry and medicine); including the awareness of scholars due to the limits of the human senses. Artisans and architects bordering science, man of war, scientists built/performed instruments for observations-mixed-sensory experiences (levers and centre of gravity, bodies fall and trajectories, culture of machines and

mechanics, fluids and modelling gases-and-electricity, theorems and principles, nanotechnologies, etc.). These case studies are part of the history of science, ideas & technology: e.g., the relationship micro-mega measures telescope-microscope, nanoscales-machines, etc.). Some VMSA to be discussed, but not limited to, are:

1. Exploration quantities (e.g. measure primary and calculate derivate)
2. Inspiration instruments/observations (e.g. measures by sound, rhythm, geometry, pendulum angles).
3. Overcoming human senses (e.g., telescope, microscope)
4. Rethinking the relationship observation–measurement–modelling (e.g., analytical theory of heat, physical–mathematical interplays)
5. Visualising: predicting or discovering? (optical direct instruments, geometrical light modelling).

Chair: **Raffaele Pisano** (Lille University, France)

1 - **Raffaele Pisano** (Lille University, France)

Visualizing and Modelling the Concept of Cycle as Dynamic Relationship Physics-Mathematics into History: Science or Applied Art?

Sadi Carnot's *Réflexions sur la puissance motrice du feu* (1824) deals with heat machines (gases) by: a) caloric, b) cycle, c) ad absurdum proof theorem for calculating efficiency (atypical for physics at that time), d) impossibility of a perpetual motion, e) irreversibility paths. The cycle (two adiabatic and isotherms) is a scientific arguing/method to visual results by a sort of creative diagram (no measures) which never appeared in the history of science. His thought drawing – piston and cylinders by 3/4 stages – develops his whole thermodynamics through verbal reasoning only; plus seven cycles of arguing. The mathematical cycle by Clapeyron (1834) is different and without a metric. Where did the cycle idea come from? Sensory? Scientific Cultures? What kind of visualising and relationship? In 1799 at Napoleon's court (formally 1800) Volta's battery could have inspired his father Lazare's works (1803) for the conceptualisation of a cycle and later his son: the efficiency is calculated after the springs have returned (cyclically) to their original state. Thus, the lack of a similar cycle before 1824 should be marked. I discuss the possible origin of the idea of a scientific cycle starting from Sadi, following the hypothesis of an analogy with the electric circuit in Volta's battery.

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2 - **Paolo Bussotti** (University of Udine, Italy)

The Visualization of Leibniz's Cosmological Model

Immediately after the publication of Newton's *Principia*, Leibniz proposed a cosmological model (1689–1690?). He aimed to find a mechanism in order to explain Newton's inverse square distance law by means of a series of devices, which were not merely reducible to Newton's centripetal forces. Leibniz's cosmological model intended to realize an appropriate modification of vortex theory, which might also explain the origin of gravity. He performed, in a series of diagrams, several physical magnitudes: they were the fundamental elements of his cosmological model. The visual aspect is an important issue in

his scientific culture. The diagrams represent the physical meaning of the magnitudes introduced by Leibniz and are a fundamental key to guess Leibniz's cosmological conception. The visualization also allows a cultural comparison between Newton's and Leibniz's cosmological ideas. The sensory aspects of Leibniz's planetary theory are connected to the view. In my talk, I clarify all the nuances introduced by Leibniz in his planetary theory as well as their visualization insofar as it was proposed in Leibniz's diagrams.

References:
Bertoloni Meli D (1993) *Equivalence and priority: Newton versus Leibniz.* Oxford, Clarendon Press.
Bussotti P, Pisano R, (2017) *Historical and Philosophical Details on Leibniz's Planetary Theory as Physical–Structural Model*. In: Pisano R, Fichant M, Bussotti P, Oliveira ARE (eds). *The Dialogue between Sciences, Philosophy and Engineering. New Historical and Epistemological Insights. Homage to Gottfried W. Leibniz 1646-1716.* London. London College Publications, pp. 49-92. Bussotti P (2015) *The complex itinerary of Leibniz's planetary theory. Basel, Springer-Birkhäuser.* Leibniz GW (1689, 1860, 1962) *Tentamen de Motuum Coelestium Causis*. In Leibniz ([1849–1863] 1962), VI, pp. 144–161. Leibniz GW (1690?, 1860, 1962) *Tentamen de Motuum Coelestium Causi*. Zweite Bearbeitung. In Leibniz ([1849–1863], 1962), VI pp. 161–187. Leibniz GW ([1849–1863], 1962) *Mathematische Schriften*, 7 Vols. Gerhardt CI (ed). Hildesheim, Olms.

3 - **Julien Gressot & Romain Jeanneret** (University of Neuchâtel, Switzerland)

Modelling of a "chaîne opératoire" as a Visualisation Method for the Material Analysis of a Culture of Precision with the Case Study of the Observatory of Neuchâtel (1858-1880)

Founded in 1858, the Observatory of Neuchâtel main missions are to determine, keep and transmit time. To carry out these tasks, a series of operations is necessary, from observing and measuring the transit of a star using a meridian circle, to recording these transits on a chronograph, then keeping the time with precision clocks, to sending a time signal to the state and watch industry via the telegraph network. For the creation of this scientific institution was commissioned Adolphe Hirsch (1830-1901), who then contacted the best astronomical instrument manufacturers of his time. The correspondence between this young scientist and the manufacturers of scientific instruments is a precious testimony to the negotiation around astronomical precision in the second half of the 19th century. These discussions led to the establishment of a technical system in 1860, which will be the subject of improvements over a period of twenty years to correct instrumental errors and reduce the role of the human factor in the observation process. This talk aims to analyse the implementation of this apparatus for determining, keeping and transmitting the time, through the reconstruction of a "chaîne opératoire" allowing to visualise both the arrangement of scientific instruments and the daily operations of astronomers. Drawing on the skills of a conservator of scientific instruments and a historian of science, this "chaîne opératoire" is the result of the analysis of the Observatory of Neuchâtel's instruments collection and the analysis of the Observatory's archives.

References
Aubin D, Bigg C, Sibum O (ed) (2010) *The heavens on earth. Observatories and astronomy in Nineteenth-Century Science and Culture*. London. Duke University Press. Canales J (2001) *Exit the frog, enter the human: physiology and experimental psychology in nineteenth-century astronomy*. British Journal for the History of Science 34:173-197. Wise Norton M (1995) *The values of precision*, Princeton. Princeton University Press.

4 - **Joseph Kouneiher** (Nice-Côte d'Azur University, France)

Visualizing the Measure of Immeasurable

Understanding of what we see and how we see it is constantly evolving. Vision in science can help illuminate how visualizations take us from sight to insight. Indeed, visualizations challenge existing

intuitions, discovering new guidelines, and designing new methods and increased our ability to make sense of what we see.

In this lecture, we want to critically analyze how images and visual cultures work in the scientific and scientific–social worlds. Starting from the idea of measuring the immeasurable we will trace of the phenomena of transforming a data of measure to a visual and detected sciences. Measuring can be very crude or rather sophisticated. Recently modern physics offer an unusual example of measuring the immeasurable: Gravitational waves in some manner is a measuring of the immeasurable in space, in some sense hear the unheard shape of the space-time. We will try to answer the questions:

- Can we measure everything?
- How are we to value things for which science is yet to devise a metric?
- How are we to visualize things that it is theoretically impossible to measure? etc.

References:

McCormick BH, DeFanti TA, Brown MD (eds) (1987). *Visualization in Scientific Computing*. IEEE CSP Los Alamitos, ACM Press. Pickover CA (ed) (1994). *Frontiers of Scientific Visualization*. NY, John Willey Inc. Hentschel K (2014) *Visual Cultures in Science and Technology*. Oxford, OUP. Rosenblum LJ (ed) (1994). *Scientific Visualization: Advances and challenges*. IEEE CSP Los Alamitos, ACM Press.

Pause from 11.00 to 11.15

Tuesday 1 September, 11.15 - 13.15

Room 1: S1 - Mobile Materials: Mutable Meanings and Knowledge Modulation - 1

Conveners: **Caroline Cornish** (Royal Holloway University of London, UK), **Brooke Penaloza-Patzak** (University of Vienna, Austria)

Surviving documentation of sixteenth- and seventeenth- century cabinets of curiosity demonstrates that the accumulation of objects and their recontextualization as specimens and data has long been understood as an integral process in the creation of scientific knowledge. Throughout the modern era, scholars have collected materials encountered under diverse circumstances and assembled these into new object constellations – collections that have allowed them to consolidate, (re)organize, investigate, create, and reconfigure knowledge about places, peoples, processes, and things. There is, too, always the possibility of the movement of objects through space and administrative processes resulting in the opposite of knowledge creation, namely loss (see References). The aim of this two-part session, which interweaves research into objects spanning from natural history and ethnographic specimens to high precision instruments and biodata, and from the sixteenth to the twenty-first century, is to critically investigate the implications of object mobilities for processes of knowledge creation, both within and between cultural contexts and scientific disciplines. Speakers will problematize the Latourian notion of cycles of accumulation (see References); consider how knowledge is lost, gained, or altered when material objects are mobilized; and how objects delimit or transcend spatial, temporal, and disciplinary contingencies of meaning.

References:

Londa Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Harvard University Press, 2004); Londa Schiebinger and Robert N. Proctor, *Agnotology: The Making and Unmaking of Ignorance* (Stanford University Press, 2008); Geoffrey N. Swinney, "What Do We Know About What We Know? The Museum Register as Museum Object," in eds. Sandra Dudley et. al. *The Thing About Museums. Objects and Experience, Representation and Contestation* (Routledge, 2012), 31-46. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard University Press, 1987).

Chair: **Brooke Penaloza-Patza**k (University of Vienna, Austria)

1 - **Caroline Cornish** (Royal Holloway University of London, UK)

Knowledge Lost, Knowledge Regained: 19th Century Museums and Cultures of Object Circulation

In the 21st century the legislation and codes of ethics surrounding museum disposals – by referral to other institutions or by destruction – means that the circulation of museum objects across broad spatial, temporal and epistemological contexts is a relatively rare procedure. Conversely, in the 19th century, the constant circulation of specimens and artefacts around circuits of collection was a key feature of museum practice. Contemporary participants well understood the factors for this: through the exchange of duplicate specimens, they could extend the geographic and taxonomic reach of their collections; they could conduct research on taxonomy, the evolution of species, and on the geographies of people and the natural world; and for science and civic education purposes, there was a parallel need for universal collections. Bruno Latour has characterised these episodes of specimen acquisition as 'cycles of accumulation', proposing a progressive model in which incremental knowledge systematically accrues to objects as a result of those objects' very mobility. In this paper, using empirical research data, I offer an alternative model to Latour's – one in part informed by Londa Schiebinger's notion of 'agnotology'– one in which knowledge is lost, ignored, or altered through the mobilisation of objects. Through following the trajectories of a series of 'duplicate' objects in and out of museums in the UK, USA and Australia in the late 19th century, this paper explores the spatial, temporal, and epistemological impacts of knowledge production, alteration, and loss, and further demonstrates how lost knowledge can be reunited with objects through contemporary humanities research programmes.

2 - **Lawrence Dritsas** (University of Edinburgh, UK)

Scottish Missionaries and the Bemba: Ethnography, Exchange and Colonial Encounter

The decades immediately before and after the turn of the twentieth century saw a flourishing of ethnographic writing about British Central Africa (now Zimbabwe, Zambia and Malawi), a region undergoing rapid colonisation. This paper is concerned with connections between ethnography and the material artefacts that appear as evidence and example in the texts. In this paper, three processes evident during this period of knowledge-making are followed. First, many of these objects were collected within the framework of the dissemination of Christianity and the expansion of the colonial enterprise in British Central Africa. Therefore, the paper focusses on the role of Scottish missionaries linked to the London Missionary Society in collecting these objects and, consequently, their impact on the development and display of the ethnographic collections from this region in National Museums Scotland. Second, these objects are deeply implicated in the first encounters between these missionaries and the Bemba, a significant ethnic group inhabiting the region that is now Zambia's Northern Province. The paper attempts to reconnect written narratives of encounter to the material artefacts of Bemba origin acquired by missionaries during the meetings. The presence of the objects in

Scottish collections today hints at moments of exchange and delicate negotiations of status and power over a century ago. Third, the paper examines the appearance of such objects in early ethnographic accounts of the Bemba. By examining these processes and by reconnecting words and things, the paper charts the movement of objects from Africa, to Scotland and into print.

3 - **Leendert van der Miesen** (Humboldt University Berlin, Germany)

Mobile Music: Images and Instruments on the Move in the Correspondence of Marin Mersenne

For over 10 years leading to the publication of his monumental *Harmonie universelle* (1636-7), Marin Mersenne (1588-1648) collected notes, images, and other music-related materials. Although musicologists and historians of science have long devoted attention to Mersenne's work and its position in the history of acoustics, little attention has been given to either the nature of Mersenne's material sources or the ways in which he went about collecting them. With the help of his patron Nicolas-Claude Fabri de Peiresc, his materials travelled far beyond Europe into the Middle East. In return, Mersenne and Peiresc received manuscripts, images, and observations, traces of which can be found in his printed works and archives, while some have simply disappeared. A closer study of the mobility of materials on sound and music in early modern correspondence networks can lead to a better understanding of the ways music and sound were made into an object of study in the early seventeenth century. By examining this mobility, we can investigate the broader social and material ramifications of early modern knowledge production. Mersenne appears here as only one of many figures in this network, which also includes merchants, missionaries, travellers, artisans, and translators. By focusing on the movement of musical instruments and their depictions, this paper sheds new light on the sensorial aspects of early modern practices of collecting. The early modern period saw not only new ways of depiction and perception in visual cultures; it also explored new sounds and methods of capturing music in writing. In order to be mobilized, knowledge on sound was continuously inscribed and mediated. This paper foregrounds the mobility of objects and images in Mersenne's network, focusing on moments when knowledge was lost or altered, positioning Mersenne in a wider culture of collecting in the early modern period.

4 - **Bronwyn Parry** (King's College London, UK)

DNA Testing: Centres of Calculation and the 'Copernican Revolution' of Bioinformational Data Extraction

Just as some of the world's great collecting institutions became hubs for the concentration of highly valuable biological specimens and forms of associated data in the Victorian era, so are new corporate establishments now becoming vital loci for the accumulation of highly valuable forms of human bioinformation. New 'inscription devices' such as ancestry DNA spit testing kits provide a means to capture data about a person's origins, genealogy, biological relatedness and even predisposition to disease, without ever having to encounter that individual 'in real life'. These 'renditions' of a person's biology are now being mobilised globally, circulated beyond the mundane confines of the domestic house to the obscure cloud based archives of the Ancestry.Com, 23 and Me and MyHeritage.Com. Each has become the contemporary equivalent of a Latourian Centre of Calculation, focal points for accumulations of data in which knowledge is extracted, combined and redeployed for profit or power. In this paper I examine the emergence of these 'master repositories' and consider how corporate collectors now systematically order, concentrate, discipline and circulate our extracted bioinformation as a saleable product, the use of which is now financialised across multiple online platforms with neither the knowledge nor informed consent of its providers.

Room 2: **S41 - Soviet-French links in genetics**

Convener: **Jérôme Pierrel** (Bordeaux University, France), Sergey Shalimov (Russian Academy of Sciences, Russia)

Science diplomacy is now an acknowledged part of the tools of the so-called soft-power [Sokolov, Haegeman, Spiesberger and Boden, 2019]. As a result, in the case of countries which, like France and the Soviet Union, do own a long tradition both in scientific research but also in international collaboration, studying long term trends may be a meaningful window both on science but also on diplomacy. In this respect, the consequences of the Lysenko affair are not only felt inside the Soviet Union, but one might expect also them to be felt in international scientific cooperation. Soviet-French links in life sciences predated World War II [Barbara, Dupont, Kolchinsky and Loskutova, 2012]. In the case of genetics, these links, which, until now, have not been studied in details, deserved more scrutiny not the least because of the Lysenko affair but also of the birth of molecular biology. The aim of this symposium is to fill this gap. What was the general landscape of French-Soviet relationship in life sciences in the late 1960s, when genetics enjoyed a renewal in the Soviet Union? Did this relationship benefited either from the space exploration or the development of molecular biology? To put this collaboration in perspective, earlier French-Russian exchanges in zoology serve as a reference point for comparison.

References: Barbara, J.-G., Dupont, J.-C., Kolchinsky, E.I., Loskutova, M.V. (editors). *Russian-French links in biology and medicine.* Nestor-Historia, 2012. Sokolov, A., Haegeman, K., Spiesberger, M. and Boden, M. Facilitating EU-Russian Scientific and Societal Engagement. Science Diplomacy, 2014, 3 (4).
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Chair: **Jérôme Pierrel** (Bordeaux University, France)

1 - **Sergei I. Fokin** (Russian Academy of Sciences, Russia)

Russian zoologists on French soil. Guests - Roscoff Biological Station, hosts - Villefranche Zoological Station

Travel to France by Russians zoologists associated with several biological marine stations. Among of them Villefranche, the Russian Zoological Station (1886 till 1931) (VZS); the marine research station also called “Laboratoire Arago” – Banyuls-sur-Mer (1881) and the Roscoff Biological Station – (Station Biologique de Roscoff) – SBR (1872) should be mentioned at first. The last two institutions were created by the Sorbonne zoologist, professor Henri de Lacaze-Duthiers. There were (are) not only a research and training centres in marine biology and oceanography, but places where scientists from all over Europe and not only had possibility to exchange ideas. The Russian presence in VZS is well documented, which cannot be said about SBR. Who was Russian investigators, and when they visited SBR is a main goal of this study. Partly it could be find out also reasons why they visited this beautiful seashore of Brittany (Bretagne). If for VZS our calculation gives the general number of visitors close to 400, and among of them about ½ were Russians (1886 –1914), the number of Russian zoologists at SBR was much smaller. According to the Station visitor book – “Station de Biologie Marine de Roscoff” (1872–1926), we can recorded around 40 persons, came from the Russian Empire (before 1914) and some Russian emigrants worked there after 1917. Among of them such well-known scientists as A. Kowalevsky, A. Danilevsky, P. Mitrophanow, A. Kholodkovsky, S.Metalnikov, C. Davidoff, S. Pereyaslawzewa et al. Some of them worked in Roscoff 2-3 times or more. In Soviet times, these ties were completely destroyed and the first Russian, Prof. G. Poljansky appeared there only in the early 1960s. In the presentation will be given some comparative analysis of the Russian presence and activity in different European marine biological stations, first of all in France. Some personalities will be considered precisely.

2 - **Sergey Shalimov** (Russian Academy of Sciences, Russia)

Soviet-French links in biology in the second half of the 1960s

The period of the 1960s was marked by the close collaboration between USSR and France in different areas. This was largely due to the policy of French president Charles de Gaulle, who was in power during this time. As well as the development of trading relations and cultural links, a significant qualitative shift has occurred in scientific and technical cooperation. At the same time, the process of revival of "disgraced" genetics started in the USSR in the second half of the 1960s. One of the main elements of this process was the development of the international contacts of Soviet scientists. In connection with, this the paper is devoted to the contacts between Soviet and French biologists in the context of fruitful cooperation of two countries during this period. Successful Soviet-French collaboration in science and technology allowed Soviet biologists to visit French scientific centers and to participate in different scientific events, which were held in France. During such foreign trips, Soviet scientists mastered the new techniques of researches, informed the international scientific community about their results and evaluated the research level of foreign laboratories. However, the general problems of Soviet science hindered the development of Soviet-French links. "Cold War" and "Iron Curtain" raised serious difficulties. Specifically, quite often Soviet researchers faced a ban for the trips abroad. At the same time, there was heavy regulation for the visits of foreign scientists. According to the documents, such kind of bureaucratization led to incompetence in the formation of Soviet delegations and the financial problems of Soviet biologists during the foreign trips. Besides, French researchers visiting the Soviet Union, couldn't see all laboratories they wished and had a risk to get low-quality service in the hotels and restaurants.

3 - **Jérôme Pierrel** (Bordeaux University, France)

French-Soviet symposiums in molecular biology, 1974-1992, from a French perspective

While scientific cooperation between France and the Soviet Union started before the famous State visit of the French President De Gaulle in the USSR in 1966, the agreement signed at that time was seminal because it structured this cooperation until the end of the Soviet Union (Rey, 1991). Space missions and high energy physics were the most prominent projects involved, but at the same time, life sciences were also included. Nevertheless, in the area of molecular biology, the scale of the cooperation was lower compared to physics and also, it started later. The first French-Soviet Symposium "on the physicochemical basis of life" took place only in 1974. However, this symposium attracted key figures from both States in this area. Notably in France, biochemist Marianne Grunberg-Manago, later President of the French Sciences Academy, was picked as an organizer on the French side. In this communication, thanks to archives from French participants in these symposiums, we show that there was a relatively small number of regular participants. Strong links between the participants resulted but contrary to space missions or high energy physics, in molecular biology, it was not possible to design a "big science" project which may be used for advertisement.

References:

Rey, Marie-Pierre, *La tentation du rapprochement: France et URSS à l'heure de la détente (1964-1974)*, Publications de la Sorbonne 1991.

4 - **Laurence Roche Nye** (Sorbonne University, France)

Life sciences in orbit: Scientific cooperation, technology and know-how transfer in space radiobiology during the Cold War

Scientific cooperation has potential for the transfer of information with technological applicability (Friedenson: 2016; Krige: 2019) The 1966 Cooperation Agreement on space sciences including astronomy, meteorology and telecommunication signed between France and the Soviet Union

represents a leading example of scientific collaboration programs established during the Cold War “at the partner’s mutual advantage”. The space agreement was a part of a broader French foreign policy intented to be transformative in regulating international tensions between East and West. Experience with that agreement shows that there are potential net benefits to France in access and regular use of Soviet orbital stations. However, the value to France varied widely from one component of the agreement to another. Life-sciences, namely gravitational medecine and- biology, becomes a new research field within the scientific cooperation agreement on space since 1971. Collaboration on research in space radiobiology, a salient knowledge for the survival of the living subject to hazardous cosmic rays, shows France’s ambition to reassess its national expertise in biological suborbital spaceflight and extend it to orbital flight on Soviet spacecraft, prior to a programme of human space flight of its own. We argue in this communication, that if scientific exchanges on radiobiology produces mutual benefits for each partner, it includes in the preparation and implementation of the lifesciences experiments transfers of Western technology linked to specific know-how produced by national research, highly beneficial for the Soviet partner. This paper stems from a thesis in slavic studies, international relations, held in 2017 at Université Paris Nanterre. From an historical perspective, my inquiry combines the methods of the oral history and archival work, and it intends to confront Soviet and French points of view.

Room 3: **S8 - Quantification of Taste - Food and Drink as Matters of Science**

Convener: **Alwin J. Cubasch** (University of Innsbruck, Austria)

Food and drink are interwoven with a multitude of social practices that shape their preparation, consumption and the social interactions around them. These quotidian practices are embodied, rest on tacit knowledge and rely on sensory experience rather than explicit and scientific knowledge. Especially a sensory culture of taste, smell and texture plays a significant role in preparing food and determining its quality and healthiness. What happens however, when sensory cultures and practices of food become of interest in science? Through four case studies on the history of food science, this panel asks how science started to quantify ephemeral sensations as taste, smell and texture in order to supplant quotidian practices of food with scientifically informed ones, showcasing how socio-economic contexts and biopolitics of health affected the scientification of food. As Cornu demonstrates, scientific practices of taste became the centerpiece of early attempts to create a market for mineral water in 18th France. For chemists, systematic knowledge of chemical components through their taste offered a way to assessing mineral waters healthiness. Fedoul argues that scientific strategies to assess the taste of wine played an essential role in promoting wine as a “cultural” beverage. At the same time, these tasting protocols negotiated the occupational boundaries and areas of expertise between oenologists and sommeliers in the early 20th century. Gennerman, shows how gas chromatography–mass spectrometry and nuclear magnetic resonance were combined with flavor profile methods to study and optimize flavorings in contexts of mass production and marketability after the Second World War. Węgiel on the other hand establishes how government agencies tried to shape food consumption in communist Poland with a top-down approach of nutritional science and dietary advice that aimed at creating a new national and scientifically grounded polish cuisine and taste.

Chair: **Alwin J. Cubasch** (University of Innsbruck, Austria)

1- **Armel Cornu** (Uppsala University, Sweden)

Tasting healing waters - The sensory experience of chemists in early modern France

Taste as a sensory experience is difficult for science to capture because of its immediate and highly individual nature. It seems, by the means of its immediacy, to escape the mediation of culture and thus provide a more genuine experience of the world. But it is also widely known to vary from person to person, likening it to an unreliable whim of the mind. In order to make tasting a part of the formal analysis of edible goods, both of these aspects have to be confronted. In this paper, I present a case of this dichotomy of taste, as it pertains to chemistry, medicine and the taste of water. If mineral waters can now be considered drinks, they were for much of early modern Europe considered to be remedies. Their taste varied significantly, from fresh and fizzy to unpleasantly sulphuric. This variety led scientists to question whether taste could be associated with certain physiological effects. Taste could often be linked to the presence of certain chemical components, but not systematically. Added to that, the problem of the individuality of the experience of taste could not be satisfyingly resolved. As the stakes in understanding the nature of mineral water increased with their popularity, an incentive was created to rationalize the sensory experience of drinking mineral waters. In turn, the scientific vocabulary used to describe the taste of waters grew in influence into the wider discussion about mineral waters. My study participates in the wider research direction which seeks to include sensory experience as a way to complement textual material (Roberts, 1995; Mandelkern, 2015). By interrogating the sensuous experience of chemists, I question the supposed erasure of the sensory culture of science with the rationalization of chemistry at the end of the eighteenth century.

2 - **Sénia Fedoul** (University of Lyon, France)

The making of an oenological discourse - Boundaries of taste and expertise between oenologists and sommeliers in France during the Interwar Period

“Knowing how to taste wine” reminds us that tasting is considered as an “art” in France, and even as an “art of living” (Elias, 1973), producing a social effect of “distinction” (Bourdieu, 1979). The skilled practice of tasting is thus a major factor of the social and cultural making of wine as a mythological object, or even a “totem” (Barthes, 1957). During the Interwar Period, oenologists set up a protocol of wine tasting as well as a normalizing discourse, the “cold” oenological discourse that focused on the criteria of “bad taste”. But in an era of curative conception and Pasteurian tradition, tasting became an issue: Could it really be ranked as a scientific method? This question appears in a context of criticism of contemporary winemaking practices, like pasteurization, that were accused of standardizing taste while debates raged between proponents of “natural” and “sophisticated” wines. My aim in this paper is to highlight the role of oenologists in the discourse on scientific tasting on the one hand, and of the sommeliers on the other. Oenologists collaborated with sommeliers in order to circulate the technical culture of sanitary tasting, while sommeliers for their part translated elements of the discourse of gastronomy to invent a “hot” discourse on wine, focusing on the link between “terroir” and taste in order to promote French regional wines in a context of cultural regionalism that was codified into certifications of origin (French system of “appellation d’origine contrôlée”, AOC). The paper thus focuses on the implementation of a protocol of wine tasting, with its specific vocabulary and aims to evaluate its impact on the recognition of the expertise of those two professions. Skilled tasting and agenda setting were the main methods by which oenologists and sommeliers obtained and solidified their status of wine experts. At the same time wine itself crystalized in the collective imaginary as a “cultural” product that was rooted in the narrative of “terroir”.

3 - **Paulina S. Gennermann** (University of Bielefeld, Germany)
Getting to the core - Analyzing flavors and fragrances in the postwar period

When Otto Wallach and Hermann Staudinger started to work on the structural analysis of flavor and fragrance substances, technologies like mass spectrometry, nuclear magnetic resonance (NMR), and Gas chromatography–mass spectrometry (GC-MS) were not yet established as methods in organic chemistry. Being introduced as serviceable instruments into the chemical research on flavors and fragrances after World War Two, they revolutionized a whole discipline. As flavor and fragrances are often volatile compounds, particular instruments and methods are necessary in order to analyze their components and structures. Especially mass Spectrometry and GC-MS proved to be the necessary methods for defining precisely the structural characteristics of flavor and fragrance compounds, and therefore those methods are intensively used in flavor and fragrance research since the early 1950s (see: E. Frérot/L. Wünsche, 50 years of Mass Spectrometry at Firmenich: A Continuing Love Story, CHIMIA, 2014, 160-163; C. Reinhardt, Shifting and Rearranging. Physical Methods and the Transformation of Modern Chemistry, SHP Publications, 2006). Nevertheless, the human senses of smell and taste are still important measuring instruments in this area of research. The "Flavor Profile" developed by Arthur D. Little, Inc. established the human sense of smell as an objective measurement to evaluate flavors and fragrances (see: Nadia Berenstein, Designing flavors for mass consumption, THE SENSES AND SOCIETY, 2018, 19-40). Both methods are essential for the flavor and fragrance industry. During this talk, I will present those two different types of quantification, to elaborate their function for the industry, and to sketch the development of the flavor and fragrance industry after the Second World War.

4 - **Alwin Cubasch** (University of Innsbruck, Austria) commentator

Room 4: S13 - Teaching science with light projection: regimes of vision in the classroom, 1880-1940 - 1

Conveners: **Nelleke Teughels** (KU Leuven, Belgium), **Wouter Egelmeers** (KU Leuven, Belgium)

In the early 19th century, the ideas of reform pedagogues such as Johann Heinrich Pestalozzi (1746-1827) gave rise to a didactic turn towards the visual that criticized an exclusive textual mediation of knowledge through books and lectures (Depaepe 1999). The pedagogues and policymakers who strove for a more child-centred approach to teaching were soon joined by media producers and marketers in their aim to transform the classroom into a multimodal space for learning. From the turn of the 20th century onwards, teachers were increasingly pressured to incorporate high-profile media technologies such as stereoscopes, lantern and film projectors into their lessons (Cuban 1986). The accuracy of photographic images and the flawless projections enabled by these new technologies inaugurated new regimes of vision and sensoriality that equated light with truth and vision with knowledge (Eisenhauer 2006). At the same time, projection-aided lessons provided powerful commentaries on what was shown, conditioning pupils' practices of looking and giving rise to particular ways they were supposed to understand the world (Good 2019). We propose a two-part symposium engaging with educational uses of light projection from diverse perspectives. The papers explore this topic in relation to the material and practical aspects of visual teaching and the various regimes of vision that are engendered by the use of visual media technologies.

Chair: **Nelleke Teughels** (KU Leuven, Belgium)

1 - **Michael Markert** (University of Göttingen, Germany)

Casting long shadows on experimental physics. The lectures of Robert Wichard Pohl (1884-1976)

Most teaching aids used at schools and universities around 1900 such as material models, wall charts, books, and last not least the chalkboard were universal and omnipresent. Particularly in science education, (academic) teachers "staged" an ensemble of teaching aids in front of the class (Degler et al. 2019). With the rise of attention-concentrating media like magic lantern slides and film teachers incorporated new and different ways of performing knowledge about science. One outstanding and telling example are the shadow projections of experimental physicist Robert Wichard Pohl, developed at Göttingen University from the 1920s onwards – and still in use today. Pohl established a new kind of phenomena-focused demonstration setups that he projected on the wall of the lecture hall using arc lights (Wittje 2011). The cinematic and modern look-and-feel of Pohl's lectures attracted students and scientists from a wide range of disciplines and nations especially around 1930 and in the 1950s. His demonstration experiments and the accompanying textbooks spread throughout Europe and beyond, as one could buy Pohl's setup from teaching aid distributors. Currently, I am in the early stages of a research project on the production, enactment, and reception of Pohl's experiments. I would like to discuss the conceptual and methodological approach I will use and which draws on the fields of history of science, material culture studies and ethnography.

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2 - **Wouter Egelmeers** (KU Leuven, Belgium)

The visual narratives of 'patchwork' slide series and 'scientific' viewing in Belgian schools

During the late-nineteenth century, pedagogues aimed to attain a more effective and professional knowledge transfer by introducing the magic lantern to the classroom. The lantern's new popularity in educational settings was enabled and furthered by the introduction of photographic slides. Their direct and 'objective' relation to the depicted reality had led to a connection of magic lantern projection with the depiction of 'truth', thus furthering the scientific respectability of the medium (Ruchatz 2003). Publishing companies were quick to grasp this, producing and selling large amounts of slide series for school use. Good (2016) has argued that teachers were not always in favor of new technologies and often combined them with simpler, more do-it-yourself varieties of media. This critical attitude, however, could also take other forms, as is exemplified by various archival collections of educational slide series in Belgium containing commercial slides mixed with slides that teachers had produced themselves. This paper engages with a number of these 'patchwork' slide series to delineate the way in which teachers created their own visual narratives by combining images from various sources. An analysis of lessons on scientific themes sheds light on the ways of seeing that were taught. Was the objectivity of photographic images really as decisive as has been suggested? Or did the flexibility of working with rearrangeable glass slides enable teachers to adopt a strategy of trained judgement (Daston and Galison 2007) that could be employed to teach their pupils how they were supposed to see?

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Daston, Lorraine, and Peter Galison. *Objectivity*. Brooklyn: Zone books, 2007. Good, Katie Day. "Making Do with Media: Teachers, Technology, and Tactics of Media Use in American Classrooms, 1919–1946". *Communication and Critical/Cultural Studies* 13, nr. 1 (2 January 2016): 75–92. Ruchatz, Jens. *Licht und Wahrheit: Eine Mediumgeschichte der fotografischen Projektion*. Munich: Fink, 2003.

3 - **Adeline Werry** (University of Louvain, Belgium)

Two forms of teaching for two types of slides and lantern projections

Since the beginning of the 19th century, children have been given a privileged place in society, which has led to a rethinking of their needs, particularly in terms of entertainment and education. In this context, the importance of the image for the child has increased. Indeed, the notion of pleasure through images has emerged, as well as the idea of facilitating the transmission of knowledge and interpersonal skills through images (Renonciat, 2011/2016 and Saint-Martin, 2003). The introduction of the projection lantern in different educational contexts reflects this increased role of the image. Within these educational contexts, we wish to distinguish two types of teachings in their relationship to the lantern: moral education and intellectual education. The first is mainly transmitted by projections in homes or during catechism classes. The second type of teaching is transmitted more in the classrooms. The presentation will focus on this distinction and on the following hypothesis: depending on the type of teaching envisaged (moral or intellectual), the visual regime of the images of the glass plates and the type of device vary. In the case of moral teaching, the arrangement of the plates follows the model of narrative sequences: the images respond to each other and form a visual narrative in itself, which does not necessarily require the presence of a text (Marion, 1997). In the case of intellectual teaching, the image projected is attractive (Gaudreault, 2008), but not necessarily meaningful. We encounter then a visual regime that follows the model of thematic sequences (related to the lesson subject) that require the commentary of a teacher. To study this distinction, we will analyze plates from Belgian collections and archives such as those of the Huis van Alijn of Gent, which present slides built according to these two visual regimes.

4 - **Sabrina Meneghini** (De Montfort University, UK)

Lantern slides in geography lessons: imperial visual education for children in the British colonial era

This paper will explore the use of the photographs produced in the early twentieth century by the British photographer-artist Alfred Hugh Fisher for the Colonial Office Visual Instruction Committee (COVIC) to facilitate British school education. In 1907 COVIC hired Fisher to create a photographic documentation of the peoples and lands ruled by the British Empire. COVIC utilized the images he captured during his three-year journey to produce sets of lantern slides and textbooks for use specifically in geography lessons. Through the analyses of the teaching activities, which involved the reading of the textbooks and the projection of the images through the medium of lantern slides, the paper will demonstrate COVIC's employment of visual material as a strategic educational tool to promote imperial consciousness amongst British children. Drawing from my broader PhD project, Classroom Photographic Journeys: Alfred Hugh Fisher and the British Empire's Development of Colonial-era Visual Education, my paper will discuss and explore how COVIC intended to use the visual material and textbooks to create an imperial vision for children. I will therefore investigate COVIC's pedagogical approach to lantern slides for disseminating a particular visual ideology that was intended to shape the knowledge of children across the British Empire. The talk will specifically explore its implementation in the metropole. Discussing the role of photography in COVIC's project will allow me to clarify, through reference to empirical evidence, how imperial visual education was constructed and delivered. In doing so, I will argue that an empirical investigation into Fisher's collection is crucial to explaining how visual media was used to indoctrinate children. Through the analyses of the textbooks, which guided children on what and how to look at images, the paper will provide a useful analytical window into understanding how the pictures corroborated the written word.

Room 5: **S10 - The changing relation between visual representations and theoretical frameworks: tables, diagrams, plots, and drawings in the history of physics and astronomy - 2. Twentieth century physics and astrophysics**

Sponsored by *Società Italiana di Storia della Fisica e dell'Astronomia - SISFA* (Italian Society for the History of Physicis and Astronomy)

Conveners: **Roberto Lalli** (Max Planck Institute for the History of Science, Berlin, Germany), **Salvatore Esposito** (INFN Naples, Italy)

Chair: **Roberto Lalli** (Max Planck Institute for the History of Science, Berlin, Germany)

1 - **Luisa Bonolis & Juan-Andres Leon** (Max Planck Institute for the History of Science, Berlin, Germany), ***Imaging gamma-ray air showers. The role of novel visual techniques in the birth of very high-energy gamma-ray astronomy in the 1980s***

Astronomy is a predominantly visual practice. Its main tools of representation and analysis are based on the capture of signals coming from far away, which are then used to reconstruct the way an object would be 'seen', even if the register itself was made not by retinal cones but technological equivalents such as photographic emulsions or electronic means. New forms of astronomy with roots in particle physics challenge these notions: ground-based, gamma-ray astronomy in particular came from the cosmic-ray tradition, which in the mid-20th century was extremely fruitful in its analysis of fundamental particle interactions occurring during the last fraction of a cosmic ray's existence going through our atmosphere. Since the last third of the century, the practices and techniques of this field tried to trace the source of the most energetic processes in the universe that originate cosmic rays, at which matter and high energy gamma radiation are manifestations of the same violent 'non-thermal' phenomena. Their most fertile outcome has been the Imaging Atmospheric Cherenkov Technique (IACT), which since its first detection in 1989 has become one of the fastest-growing means of astrophysical inquiry. The Cherenkov 'telescopes' on the ground are not 'seeing' the astrophysical objects themselves, but reconstructing the outcome of their emitted signals' interactions with the atmosphere, which is acting as a huge detector. From these traces the source and energy of the incoming rays can be inferred. The useful interactions are vastly outnumbered by those caused by cosmic particles that, due to their charge, have lost all useful astrophysical information. Hence, the act of 'observing' in this field depends heavily on the rejection of more than 98% of the detection events through visual analyses embedded in theoretical considerations and simulations. The resulting data and images exist in an epistemic space that merges theory, observation, and simulation, and is inherently statistical.

2 - **Adele La Rana** (University of California Riverside, USA)
Visualizing the invisible, listening to the inaudible: the explosion of Supernova 1987A and the alleged revelation of gravitational waves

On February 23rd 1987, a supernova explosion became visible to the naked eye from the Earth. To make the SN1987A relevant to the history of physics, however, was its invisible part. The 1987 supernova radiated a large amount of neutrinos into space, allowing the first observation of extragalactic neutrinos by the Kamiokande-II and IMB detectors. Alongside this Nobel discovery, there was a minor but significant episode, connected to another emission not perceptible to human senses: gravitational radiation. Unfortunately, none of the three cryogenic resonant antennas specially designed to detect gravitational waves from supernovae was in operation. Instead, the room temperature bar GEOGRAV

in Rome was operative and recorded some peaks of energy innovation, in coincidence with the neutrino events revealed at the Underground Neutrino Observatory in the Alps and even with some peaks recorded by Joe Weber's antennas in Maryland. The case of SN1987A is emblematic for the history of gravitational waves research and is here analyzed in the perspective of understanding how the complex concept of "observing a gravitational signal" (or "listening to a gravitational signal", as a widespread analogy with sound waves suggests) evolved over the years. The possibility of digging out a gravitational signal from the noise which buries it, allowing to make it visible, is strongly connected to the development of the theoretical models of the sources and to the progress of the signal analysis techniques. In general, to be able to observe a gravitational signal it is necessary to have an idea of its structure. To be able to see, it is necessary to fore-see. In the absence of a reliable model, as for the supernova explosion, what does "observing" mean? How could Joe Weber, Edoardo Amaldi and Giuliano Preparata claim to have detected gravitational waves emitted by the SN1987A and how those analyzes can be read today?

3 - **Stefano Furlan** (Max Planck Institute for the History of Science Berlin, Germany)
"If I can't make a picture, I don't understand": John A. Wheeler's visual style and gravitational collapse

By many accounts of his students, J.A. Wheeler (1911-2008), in his lectures, was really good at conveying 1. the feeling that the history of physics was a living enterprise in which they were getting involved; 2. a distinctively visual representation (also through Wheeler's famous blackboard drawings) of the relevant physical processes. Especially since Wheeler was "teaching in order to learn", those are indeed features of his way of exploring new physics, as it is clear from the research notebooks in his archive as well as from his landmark textbook Gravitation (1973), not by chance written with two of his former students. The above intertwinement of visualization, storytelling and formulae seems close to a notion called "narrative knowing" – perhaps not named with the greatest felicity, but denoting a mixture of words, technicalities, pictures and narratives that sounds pertinent to Wheeler's case. In order to show the cogency of all of this, it can be recalled that, among the main reasons (if not the main one) of Wheeler's popularity, there are, needless to say, black holes; and the understanding, as well as the teaching and popularizing, of the physics of gravitational collapse is a paradigmatic example to see Wheeler's style at work, both in his private and public aspects. Naïve views of science may assume that this is just something related to communication skills, advertising, pedagogy - but when paradoxes and conceptual issues around those entities aroused, such as in the case of the information paradox, the specific way in which physicists were trained in Wheeler's Princeton school of general relativity shaped their approach to the problem, what they wanted to hold firm no matter the cost, and also their occasional failure to have a fruitful dialogue with different perspectives - not unlike some situation in today's theoretical physics.

4 - **Salvatore Esposito** (INFN Naples, Italy)
Feynman diagrams, or visualizing the quantum world

The physical description of natural phenomena takes place, according to Galilei, through mathematical laws concerning mathematical objects (sometimes created, along with the related formalism, just for the problem to solve). However, the introduction in physics of such abstract objects is always accompanied by their visual representations, which are completely functional to the understanding of the description itself, and is intimately related to the mathematical formalism adopted. We here analyze the case study of Feynman diagrams, which pictorially describe space-time particle processes in quantum electrodynamics and, more in general, in quantum field theory. Introduced in the middle of the 20th century as a tool to simplify lengthy calculations, their usage has revolutionized theoretical physics, from quantum electrodynamics to nuclear and particle physics, and even solid-state theory and

gravitational physics. While pointing out the strict relationship between such visual objects and the underlying mathematical description, we here focus on how Feynman diagrams have helped to transform the way how physicists see the world in the present age.

Room 6: **S76 - Internationalism, Nationalism and Localism. Images and Places of Mathematics in Europe from Napoleon to the Wars of the Twentieth Century - 2**

Sponsored by *SISM - Società Italiana di Storia delle Matematiche* (Italian Society for the History of Mathematics)

Conveners: **Maria Teresa Borgato** (University of Ferrara, Italy), **Erika Luciano** (University of Turin, Italy)

Chair: **Erika Luciano** (University of Turin, Italy)

1 - **Maria Teresa Borgato** (University of Ferrara, Italy)

Hermite and Brioschi: Scientific and academic relationships at the end of the nineteenth century

The relationship between Charles Hermite (1822-1901) and Francesco Brioschi (1824-1897) originate from the common research interests of the 1850s on the theory of forms, elliptic functions and the solution of algebraic equations. Brioschi then considered Hermite the only French mathematician at the forefront of international mathematical research. During the famous journey undertaken in 1858 by Brioschi, Betti and Casorati to visit the main European research and higher education centers, the two mathematicians had the opportunity to confront each other directly. Brioschi always pursued the goal of internationalization, in mathematical research as well as in higher education and political action, aimed at modernizing the country. Common scientific interests between Hermite and Brioschi continued throughout their existence. Several letters intervened between the two in the year 1858, when the general solution (by radicals and elliptic functions) of the fifth degree equation was reached. The originals have come down to us only in part, since Hermite's correspondence was destroyed in a fire after his death, while important groups of letters he sent to Stieltjes, Mittag-Leffler, Genocchi, and Markov were published. The common research topics and the correspondence with Brioschi are reconstructed here starting from the letters and memoirs published in the mathematical and academic journals of the time, and from the references contained in other correspondences. An unpublished 9-letter correspondence from Hermite to Brioschi (August 1882-August 1897) from the Polytechnic University Archives in Milan is also presented. Both Brioschi and Hemite had not abandoned research on elliptic and hyperelliptic functions, and on linear differential equations (Lamé equation and its generalizations). The letters contain references to these works, in addition to academic policy and university life.

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2 - **Nicla Palladino*** (University di Perugia, Italy), Maria Rosaria Enea & Giovanni Ferraro

Determinant theory in the 19th century in Italy

From the studies of Cramer, Bézout, Vandermonde, Laplace, Lagrange, Gauss, Binet, determinant theory appeared in a clear form thanks to Augustin-Louis Cauchy who developed what was a technical device into a new autonomous mathematical discipline. In 1841 Jacobi's fundamental works on the argument were published. While Arthur Cayley developed the subject and invariant theory came out of it, the scientific community felt the need for manuals conformed to all scholars who wanted to make use of the theory in other fields of mathematics or applied sciences. It was only in 1851 that William Spottiswoode published the first treatise on Elementary Theorems relating to Determinants where he wrote: although the principal theorems are familiar to the more advanced mathematicians, there has hitherto been no elementary work upon the subject, to which reference can be readily made by the student. In the following years several textbooks appeared and played a significant role in the process that led the new theory to consolidate. Italian mathematicians remarkably contributed to this process publishing four textbooks from 1853 to 1862 (we exclude algebra texts containing chapters on determinant theory) . The authors were Francesco Brioschi in Pavia, Giusto Bellavitis in Venice, Giuseppe Ianni and Nicola Trudi in Naples. In this paper we will discuss the above-mentioned Italian textbooks: especially we will show that Brioschi's book aimed to introduce the students to the application of determinants to technical and physical problems. Bellavitis's book was strongly influenced by Brioschi's. The approach of Ianni and Trudi were very different. In particular Trudi was not interested to technical applications of the theory but rather he aimed at organizing the theory of determinants by means of demonstrations that were clear and, at the same time, rigorous and general without relying on symbolic and concise forms.

3 - **Riccardo Rosso** (University of Pavia, Italy)

Seminar activities and mathematical research in Germany in the second half of the 19th century

In the second half of the 19th century, the renewal of mathematical studies in Italy was supported by a gradual internationalization process. As it is well known, in 1858 Enrico Betti, Francesco Brioschi and Felice Casorati undertook a journey in Europe, to visit the main universities and to become acquainted with the organization of mathematical research and higher education. The strong connections established with many German mathematicians is well documented in the correspondence of the following years of Betti, Brioschi, Cremona and others. In particular, Felice Casorati returned to Berlin in 1864, where he discussed with Kronecker and Weierstrass. In that period, a system of fellowships was established to allow the best students to complete their mathematical education in an international context. In this work, starting from the joint influence of Riemann and Weierstrass in the composition of Felice Casorati's Teorica, we will outline a general picture of the diffusion of German mathematical culture in Italy in the second half of the 19th century.

4 - **Erwin Neuenschwander** (University of Zurich, Switzerland)

Striking Parallels: Nation building and renewal of mathematics in Risorgimento Italy and its effects on Germany

It is well known that the mathematical sciences stagnated in Italy in the 18th and first half of the 19th century. Only in the second half of the 19th century, did they flourish again in connection with the political unification of Italy. The younger Italian mathematicians and physicists (G. Battaglini, E. Beltrami, E. Betti, F. Brioschi, L. Cremona, etc.) participated enthusiastically in the wars of liberation. Later they took over important political offices and tried to raise the level of mathematics and technical-scientific education in their country by creating and developing appropriate institutions (Politecnico di Milano, Scuola Normale Superiore di Pisa, etc.), and scientific journals (Annali, Giornale di Matematiche

etc.). Less known is the influence of this resurgence of sciences outside of Italy. Recent studies show that the new Italian successes had a strong resonance in Germany, whose political unification came about ten years after the Italian one. E.g., Johann August Grunert (1797-1872), in the literary reports of his *Archive*, reports in detail on the personnel and institutional changes in Italy and praises them in the highest tones. Similarly, Karl Weierstrass wrote to Casorati in 1867 that nowhere was the upswing of the sciences followed with more lively interest than in Northern Germany. The lecture outlines the political and socio-cultural background of this development that later on led to the Golden Age of Italian mathematics under G. Castelnuovo, F. Enriques, F. Severi, V. Volterra, and made the new state a leading science nation alongside Germany and France, eventually leading to the global interconnection of the sciences of our time.

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A. Guerraggio, P. Nastasi, *Italian Mathematics between the Two World Wars*, Birkhäuser 2006. *Mathematicians in Bologna 1861-1960*, ed. S. Coen, Birkhäuser 2012. F. Brechenmacher et al., *Images of Italian Mathematics in France*, Birkhäuser 2016. *Mathematical Correspondences and Critical Editions*, ed. M.T. Borgato, E, Neuenschwander, I. Passeron, Birkhäuser 2019.

Room 7: S7 - An University style: appearance and image of Russian universities and their inhabitants of different epochs

Conveners: **Alexander Sorokin** (Tyumen State University, Russia), **Mikhail Gribovskiy** (National Research, Tomsk State University, Russia)

Compared to European universities, Russian universities are noticeably younger. The formation of a university culture in Russia only happened in the 18th century, although some attempts to create professional schools in Russia date back to the 16th – 17th centuries. Russian universities quickly became the site of the emergence of new social practices, an important part of the urban landscape and the subject of public reasoning. This is unsurprising, since the university – as a center of concentration of intellectual forces and even with elements of self-government – was in many ways a unique institution for Russian society during the monarchy. The Soviet era made higher education somewhat less elitist, but the cult of Enlightenment characteristic of this time helped to preserve the high statute of the University and the "university persons". In the 21st century universities face new challenges atypical of previous eras. Today, the university competes for a place in the sun with mass culture, the Internet, and independent intellectual centers. In view of the trends in University Studies and History of Science the problem of transmitting intellectual culture images by the University, as well as the problem of the university's perception by insiders and outsiders in different eras are important and relevant. The folllowing issues will be discussed during the symposium.

– Sources on the visual history of Russian universities,
– Visualization of university life in the Russian Empire / Soviet Union / Russian Federation,
– Russian University through the eyes of insiders – professors and students,
– Russian University in the view of government and society,
– The image of a Russian university in fiction (literature, cinema, theater),
– The image of a Russian university in media and mass culture.

Chair: **Alexander Sorokin** (Tyumen State University, Russia)

1- **Mikhail Gribovskiy** (National Research Tomsk State University, Russia)

University professor of Tsarist Russia: Appearance, material culture, social characteristics

The paper is devoted to the reconstruction of the image of the Russian pre-revolutionary university professor. Although the profession was not a quantitatively significant part of Russian society it played a prominent role in the life of a few university cities (slightly over 10). The professors represented the intellectual elite of the Russian Empire and as such were prominent and important figures of urban communities.

The paper will deal with the following aspects:

- Appearance. How did the rules prescribe professors in the service to dress and did they always abide by these rules;
- Material culture of professors. The size of their salaries and other income. The quality of life. Structure of consumption. Accommodation. Material wealth in professor's houses;
- Social characteristics. Social background. Sex. Marital status. Average age. Geography of residence.

The presentation will be used images illustrating the appearance and material culture of a Russian professor of the 19th – early 20th century.

2 - **Hanna Bazhenova** (Institute of Central Europe, Poland)

Warsaw Imperial University: Perception by contemporaries and historiographic trajectories

Warsaw University has an interesting and turbulent history. Warsaw's first university was founded in 1816 but was closed after the Polish Insurrection of 1830/31. It took thirty years for the university to be restored as the Main School in 1862. It was very popular among Polish youth who finally had the opportunity for university education in what was considered the Polish lands of the Russian Empire. In 1869 however, the Polish-speaking Main School was transformed into the Russian language Imperial University which was to serve the political strategy of integrating the Kingdom of Poland into Russia. This institution had existed in Warsaw for 46 years, until in 1915 the Polish-speaking University replaced it. The Imperial University was forced to evacuate to Rostov on Don where it has remained ever since. For many decades Warsaw Imperial University continued to be the most disputed issue in the 200-year history of Warsaw University. For a long time Polish historiographic tradition perceived the Russian-language University as a foreign body and as a part of the hostile imperial machine, and tried to distance itself from the university's history. At the same time Russian scholars studied the history of this academic institution as an important part of their national history that gave birth to Rostov University. The aims of this paper are: firstly, to ascertain contemporaries' attitude towards Warsaw Imperial University and its faculty members, and secondly, to find out what were and what are the current Polish and Russian narratives about this institution. It also aims to investigate how the context of Warsaw University Bicentennial influenced the perception and presentation of the university's controversial past by contemporary Polish and Russian historiography.

3 - **Dmitry Khaminov** (Tomsk State University, Russia)

The image of history in universities of the Asian periphery and the perception of historians by Imperial and Soviet authorities

The focus of the proposed research is placed at the intersection of several related areas: historical research science, social and political science, and new local history. It enables to implement a systemic approach to the phenomenon of historical knowledge, which plays a key role in the process of combining heterogeneous geocultural environments into one national whole. The Russian geocultural environment is unique; as a sociohistorical phenomenon, it remains underrepresented in the historiography and needs further comprehensive exploration. As a systemic whole, it manifests itself, first and foremost, in the process of the multilevel co-organization of geoeconomically and

socioculturally different macroregions. While this external aspect of Russia's space-time dynamics has been studied relatively extensively, its internal semantic counterpart, which ultimately determined the interaction between the central cultural and historical core and the regional periphery, features multiple scientific gaps. It must be pointed out that the nature of this interaction was quite regular and was by no means limited to the measures of administrative and territorial development of the integrated areas. The ideocratic nature of the national socio-governmental organism inevitably involved a number of powerful re-translators of ideas and worldview frameworks intended to maintain the reproduction and complimentary forms of perceiving the environment and its self-description, and to solidify them in the public mind. (In other words, Russia is perceived as the process of the spatial inflation of the transhistorical existence rather than just a geographical location). Since its institutionalization, the system of higher historical education and science has been one of the most important retranslators that not only enabled the continuity of times and the succession of generations during the change of political regimes, but also preserved the cultural unity of vast and qualitatively different areas under fundamentally new socioeconomic conditions.

4 **- Alexander Sorokin** (Tyumen State University, Russia)

Soviet professor: transformation of the image of Soviet scientists in Russian cinema in the second half of the 20th and beginning of the 21st centuries

After the end of the Great Patriotic War, the image of Soviet scientists began to be actively used in the media. On the one hand, the second half of the 1940s to the 1960s saw major discoveries and achievements of Soviet scientists in the fields of physics, space, cybernetics, etc. On the other hand, the image of scientists embodied such qualities as industriousness, determination, morality, which corresponded to the basic ideological principles of the Soviet state. At the same time, during the late Soviet period, the image of a Soviet scientist underwent changes against the backdrop of: 1) increased participation of scientists in socio-political processes within the USSR (dissident movement, open letters from scientists to authorities, etc.); 2) the participation of scientists in large-scale scientific and technological projects as an element of the confrontation between the USSR and the USA during the Cold War.

The paper will address the following issues:

1. key positive and negative traits in the image of Soviet scientists / professors in Soviet cinema;
2. the influence of socio-political processes in the Soviet and Russian state in the 1990s - 2000s. on the transformation of the image of Soviet scientists / professors in domestic cinema;
3. the influence of the Cold War and the confrontation between the USSR and the USA in the scientific and technological sphere on the formation and transformation of the Soviet scientist's / professor's image;
4. The influence of technopessimism on the transformation of Soviet scientist's / professor's image.

5 - **Vasiliy Mironov** (National Research Tomsk State University, Russia), commentator

Room 8: **S25 - Historicizing climate futures: representational politics and public imaginaries**

Convener: **Vladimir Janković** (University of Manchester, UK)

During the last fifty years, scientific representations of climate futures have become unidirectional in nature, eclipsing the conventional static or cyclical views of climate evolution. Current positions heavily lean towards scenarios of continuous, positive radiative forcing in which anthropogenic drivers override the natural variability and all but eliminate the likelihood of alternative outcomes until at least 2100 (IPCC 2013). Historically, however, directional representations competed with alternatives, most notably with the steady-state (or oscillatory) ideas associated with geographic latitudes or physiognomies of regional lands. Even within earlier directional frameworks, terminal glaciations ceded to terminal meltdowns, benign variability to apocalyptic extremes, floods to deserts. And arguments were raised as to whether such trends should be countered with equanimity, hope, despair, curiosity, technofix, political change, or transformative economies. This panel examines how particular representations of climate (and climate pasts and futures) become available as subjects of scientific research, influencing present decision making and public imaginaries. The panel explores how different conceptualizations of climates gain traction and articulate shared panoramas of environmental and political destinies. Acting as dynamic, politically expedient clusters of projections, these representations translate the complexities of science into syncretic but intuitive fictions that inform the governance of environmental and political affairs of the present. In doing so, climate futures embody and make visible scientific results in ways in which they can forge political argument and public policy. For example, the combination of directionality and anthropogenicity in climatology during the 1970s, resulted in its transformation from a largely geographical exercise into a computer-intensive security problem of the first-rate importance. The speakers will contribute to addressing themes that include, but are not limited to:

- Representations of climate and climate change in modern history
- The politics of weather and climate change representations
- Histories of scenario science and impact assessments
- National differences in approaches to climate risks
- Representations in paleoclimatology and climate modelling
- Visions of stability and visions of change
- Media framing of climate futures

Chair: **Vladimir Janković** (University of Manchester, UK)

1 **- Jonathan Oldfield** (University of Birmingham, UK)

Greenhouse Paradise: Climate Futures and Soviet Agriculture Scenarios

This paper explores the debates that emerged during the late Soviet period with respect to climate futures and agriculture scenarios. Agricultural output dominated domestic politics for much of the Soviet period with successive Soviet regimes attempting to boost overall levels of production in the face of an urbanising trend and a growing population, albeit with limited success. The agricultural question was thus deeply entwined with the science concerning climate warming that emerged during the 1970s-80s. In order to animate the discussion, the paper examines the ideas and published output of Soviet scientists such as O.D. Sirotenko, M.I. Budyko, and G.V. Menzhulin. Their work was characterised by a number of distinct narratives ranging from a sober assessment of the risks and challenges associated with climate change for national agricultural output, through to unguarded eulogising of the potential

benefits of a warming climate for the country's agricultural potential. The paper also provides a critique of the collaborative initiative between Soviet and Western scientists, which was driven forward via the International Institute for Applied Systems Analysis (IIASA) in Austria during the 1980s. This initiative resulted in one of the earliest meaningful interventions in the climate change-agriculture debate and drew attention, amongst other things, to the possible boost to Soviet wheat and rye production resulting from forecast changes in climate.

2 - **Julia Lajus** (National Research University Higher School of Economics, Russia)

'Warming of the Arctic' in the 1930s - 1940s and its Influence on Soviet Discussions about Arctic Climate Fluctuations

The phenomenon known as 'warming of the Arctic' in 1930s – 1940s undermined the understanding of climate in historical times as relatively stable. Not only meteorologists, glaciologists and geophysicist but also oceanographers and marine biologists became interested in its causes and future predictions. In the Soviet Union this interest was especially strong. The explanations of "fluctuations" in the Arctic climate were primarily linked to the role of solar radiation that were characteristic of the Soviet approach to Arctic climate. However, this approach later became one of the factors that hindered the acceptance of anthropogenic causes of global climate change. This might have created sn intellectual legacy of the Arctic research that lead to climate denialism in Russia that is more often expressed by polar scientists than other researchers. This paper focuses on the analysis of climatic changes in the Arctic. It looks into how these changes were discussed by Soviet polar scientists and how these discussions in different time periods had been connected and disconnected with relevant international discussions.

3- **Robert Naylor** (University of Manchester, UK)

The Bryson Synthesis: Piercing a Fog of Economic Complication with a Calamitous Climate Future

During the 1970s, climate change transitioned dramatically from a niche pursuit within the physical science community to an important subject of policy discourse. The canonical explanation for this includes a series of climate anomalies occurring in the first half of the decade which heightened awareness and concern over climate change and its devastating effects. These events included the 1972 poor harvest in the Soviet Union that instigated controversial grain purchases from grain-producing nations, a 'wet fall' in the same year in the United States which prevented crops being harvested, and a series of droughts in the Sahel region of Africa that caused widespread starvation, especially amongst populations reliant on pastoralism. In this paper I will show how these climate events were synthesised into a politically powerful narrative by controversial climatologist Reid Bryson, and how this narrative resonated with important figures in the US political establishment in the context of an unprecedented economic and cultural environment. This calls into question the established histories by claiming that these events did not increase climate awareness through their intrinsic physical nature, but by their use as a political tool to construct the atmosphere as a dynamic object of fear.

4 - **Vladimir Janković** (University of Manchester, UK), commentator

Room 9: T3 - Mathematics, Education and Arts

Chair: **Matteo Martelli** (University of Bologna, Italy)

1 - **Mao Dan** (Shanghai Jiaotong University, China)

Correlation between Failures of Mathematical Sciences and Their Roles in Education: Comparing Hellenistic-Principate Period and Renaissance

When the Roman Empire finally brought peace to the Mediterranean World, disciplines like philology underwent considerable revival, yet mathematical ones, i.e., geometry, arithmetic, astronomy, optics, harmonics, mechanics, didn't quite so. During the next 3 centuries, the number of great masters who advanced those knowledge was too few to constitute an academic community, the situation being in sharp contrast with the theoretical importance these disciplines were attached to in the descriptions of the educational system of liberal arts. By comparing the teaching conditions in schools, academies and universities and living methods of teachers and professors in the Hellenistic Principate period and the Renaissance, it could be concluded that the relatively smaller scale of educational institutions, thus the higher level of mobility for teachers in the late Hellenistic Period and Principate, as the better timing concerning mathematics for the establishment of teaching positions in the Renaissance, would account for the phenomena that mathematical sciences basically failed to revive in Principate period yet succeeded during the Renaissance, which laid the foundation for the Scientific Revolution. The comparison and analysis will be mainly focused on Roman Egyptian schools, Hellenistic philosophical schools and Renaissance universities in Italy, the Empire and England.

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2 - **Matteo Torre (Liceo Scientifico L.B. Alberti, Italy**)

Symmetries and asymmetries: a path through the history of physics, mathematics and art

High school physics textbooks often (too often) turn their attention to all the mathematical and physical aspects that highlight elements of symmetry, neglecting the importance that asymmetries have played in the evolution of recent and past discoveries of physics. Galileo himself praised the imperfection of the Moon, seeing imperfection as a creative and beauty power. The paper aims to highlight how the beauty-symmetry and symmetry-creativity binomials, so popular with teaching and dissemination, are not always correct and that some asymmetries have generated the evolution of physical concepts, as well as interesting mathematical insights. A didactic path for the high school, experimented in the years 2018/19 and 2019/20, will also be described, moving from Galileo to the Higgs boson, thanks to the popular and educational power of art.

References:

Weyl, H. (1962). "La simmetria", Feltrinelli, Milano. Wigner, E. P. (1960). "The unreasonable effectiveness of mathematics in the natural sciences", Richard Courant lecture in mathematical sciences delivered at New York University, May 11, 1959, Communications on Pure and Applied Mathematics. 13: 1–14.

3 - **Loredana Biacino** (University of Naples, Italy)
Relationship between abstractionism in the arts and in mathematics at the beginning of the 20th century

At the beginning of 20th century a deep crisis broke out in the European positivistic culture: some artistic classical forms were questioned (abstractionism, expressionism etc. in art, dodecaphony in the music) in the scientific field a more problematic vision of the world arised (e.g. Einstein's relativity in 1905). The trend towards mathematical abstractionism started after 1850 by means of the divulgation of non-Euclidean geometries, where ideas commonly considered as intuitive and linked to the immediate representation of the world were proposed, and developed following the examples of pathological functions given by Riemann, Weierstrass, Darboux and others. In 1883 Hermite wrote of his fright and horror for the lamentable 'plague' of functions which do not have derivatives. Indeed, while generally derivable functions can be intuitively thought of, and graphically represented, this is not possible for functions which do not have derivative at all. The 20th century begins with the papers by Baire, Borel, Lebesgue who in their researches give right of citizenship to pathological sets and functions. The thesis by Lebesgue in 1902 about measure and integration and the paper by Fréchet in 1906, where abstract spaces are introduced for the first time, ratify the birth of a new discipline where the classical relation between world and mathematics is twisted and, as in the arts, a less regular and deeper aspect of the things is searched. Some of these common aspects will be investigated.

4 - ~~**Maria Rosaria Enea** (University of Basilicata, Italy) & **Riccardo Rosso** (University of Pavia)~~
~~***Preparing A Generation Of Young Mathematicians***~~ **[CANCELLED]**

Among the steps that the Italian government took to improve education at the University level soon after reunification, a system of fellowships was established to allow the best graduates in different disciplines to make direct acquaintance with the most important European scientists. Among the mathematicians awarded with these fellowships we mention Luigi Bianchi, Alfredo Capelli, Francesco Gerbaldi, Salvatore Pincherle, and Giuseppe Veronese. At the end of each Semester spent abroad, the young scholars had to send the Ministry a report on their activities including a description of the courses and seminars they attended. Hence, these reports are important documents testifying the impressions exerted on them by highly specialized courses. Moreover, at the end of their fellowship, the scholar went back to Italy taking with them the lecture notes on the courses they had attended. In several cases, these notes became an important vehicle to diffuse mathematical culture in Italy since they formed the backbone of courses that the scholars delivered in Italian Universities, when they started their academic careers. In this talk, we will focus upon the experience of Bianchi and Gerbaldi, who attended courses by Klein in München and Leipzig, respectively.

Room 10: **S57 - Visual, Material and Political Cultures of Zoological Gardens - 2**

Conveners: **Oliver Hochadel** (Spanish National Research Council - CSIC, Spain), **Miquel Carandell-Baruzzi** (Autonomous University of Barcelona, Spain)

Chair: **Juliana Adelman** (Dublin City University, Ireland)

1 - **Clemens Maier-Wolthausen** (Zoological Gardens Berlin, Germany)
Stocking a Zoo. Sources for Live Animals 1844-2020 - the Case of Berlin

The logistics behind the stocking of zoos with live animals were and still are at the base of their institutions. Early zoos had a variety of sources for animals, most importantly diplomatic gifts. With the

advent of a bourgeois culture of self-education and the growing popularity of zoos, they required even more animals for the curious eye of the population and for the growing class of educated citizen. Besides the continuity in diplomatic gifts, all zoos could now rely on networks of professional traders. The often meagre conditions of husbandry and exhibition programs aimed at displaying the widest possible range of taxonomies required a steady influx of new animals leading to a systematic exploitation of African, Asian and South American fauna. Some zoos, like the Zoo Berlin, organized their own (hunting) expeditions besides being major clients of traders. The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora ended these ways of stocking zoos and necessitated a move to internationally coordinated breeding programs like the European Endangered Species Program (EEP). It also enhanced the changes in zoo-husbandry, zoo-architecture and economic planning that had begun in the early 1950s towards more sustainability in the zoo stock. The proposed paper is a case study of the ninth-oldest modern zoo in the world in Berlin and explores the varying efforts to stock its collection and to maintain a steady supply of (especially charismatic) animals into its enclosures since 1844. Based on a wide array of archival sources from the zoo archive it focusses on the changing strategies of acquisition, tracing organizational, budgetary and architectural changes as well as developments in human-animal-relations. It argues that colonial traditions continued way into the era of decolonization and reflect the rigidity of the institution zoo to changes.

2 - **Mareike Vennen** (Humboldt University Berlin, Germany)

The Zoological Garden in Berlin - Practices and Politics of Zoo Logistics and Urban Ecologies

Exhibiting living animals in zoos requires a socio-technical network operating in the background that ranges from global (colonial) trading infrastructures to urban systems of supply and disposal. Taking logistics as a critical analytical category for zoo history allows to redefine the alleged stable material borders between the zoo and the urban space, local and global ecologies. Based on archival material and ethnographic studies from the Berlin Zoological Garden, the talk first focuses on the material culture, the knowledge and the practices of transporting, keeping and disposing zoo animals. The aim is to show how infrastructures shaped and shape the keeping of the animals, the maintenance of the facilities as well as the research in zoos. By following the itineraries of animals into and out of the institution throughout the 20th century, historical changes can be highlighted. In a second step, the talk aims at examining in more detail the relationship between the zoo and the city on the basis of different episodes from the history of the Berlin Zoo. How did and does the zoo depend and at the same time shape the urban environment, its administration, management and politics? The entanglements can be found at different levels, ranging from pest control and animal disposal to garden and (urban) wildlife management. By exploring the zoo within this broader scientific, administrative and infrastructural framework and network, the talk aims at rethinking zoo ecologies as part of a history of urban ecologies.

3 - **Miquel Carandell-Baruzzi** (Autonomous University of Barcelona, Spain)

Mediterranean Dolphins from Miami: Knowledge and practices in the Aquarama of the Barcelona Zoo in the 1960s

In May 1965, in the midst of Franco‘s dictatorship in Spain, four Bottlenose Dolphins traveled by boat from Miami to the Barcelona Zoo. They became the first inhabitants of one of the first Dolphinariums in Europe. The construction of the “Aquarama” was the pinnacle of a great transformation of the Barcelona Zoo: from an old fashioned zoo characterized by its cages to a bigger and modern Zoo in the Hagenbeck style. The arrival of the Dolphins was preceded by two trips of the Barcelona Zoo director, accompanied by an architect and a politician, to visit the installations of the Miami Seaquarium and the Los Angeles Marineland. The dolphins arrived in Barcelona accompanied by a trainer that stayed in Barcelona for some weeks. According to the Miami dolphin experts, the dolphins brought to Barcelona, as they were from the Caribbean, would not endure temperatures below 17 degrees Celsius. Yet the Barcelona Zoo keepers knew that specimens of the same species lived in the Mediterranean, where temperatures could be as low as 10 ºC in the winter. So what should be done with the dolphins in the Barcelona Zoo?

Should they listen to the American experts and cover them all through the winter? Or it was worth to try to see whether the dolphins would survived lower temperatures? In this talk I want to reflect on how knowledge and practices about a completely new animal and its keeping was built in the Barcelona Zoo. What were the sources of the Barcelona Zoo keepers? How did they gather information on everything that relates to the building and keeping of a dolphinarium, an entirely new institution? What were the similarities and particularities of having dolphins in the Barcelona Zoo?

4 - **Wiebke M. Reinert** (Kassel University, Germany)

The Seals' Applause, the keepers' tip. Interspecial con/figurations of labour, leisure and popular science at the zoo, 1850-1970

Zoos not only profoundly reshaped the spatial and cognitive frame in which people have perceived and interacted with animal beings. (Ito 2012: 189) They also contributed a great deal to the modern con/figurations of animals and popular science. With a focus on specific animals, i.e. the popular sea lions, and on animal keepers, this paper aims at examining the zoo »from the enclosures«. ›The Seals' Applause‹ does at the same time imply the almost iconic ›applause‹ that they themselves seemed to perform with their fins and the aspect of popular culture, the applause that seals received – an interspecial con/figuration as such. It also touches upon the ›work‹ that sea lions contributed to the zoo and its history. They became, it is argued, significant actors in the history of popular science, as they literally animated and supported the scenery of education mixed with entertainment that became so constitutive for modern urban life. With such a »view from ground level«, a »perspective taken from a position alongside animals« (Fudge 2017: 264), questions of materiality also come to the fore. Enclosures' materials, food, water supply, not least the animals themselves were part of a growing global trade and zoo industry. This also includes the role of the keepers who rehearsed special behavior with the seals, who worked on sea lions ›juggling‹ plates on their nose, pulling strings and hoisting flags, transforming animal behavior and perceptions. ›Work‹ is thus conceived of in a twofold sense of con/figurations: Firstly, as the practical integration of animals into animal husbandry systems, vocational training and popular entertainment; secondly, as ›editorial‹, symbolic ›work‹, which helped to semiotically integrate animals, providing the appropriate ›texts‹ to fit animals into the urban pleasure culture of modern times.

Room 11: S16 - Contextualizing mechanism in twentieth century biology: visual and material cultures of description, narrative, and cooperation

Conveners: **Dominic Berry** (London School of Economics, UK), **Hanna Lucia Worliczek** (University of Vienna, Austria)

The rise and growth of mechanistic thought and explanation has been a central theme in the historiography of biology in the twentieth and twenty first centuries. However, this historiography often treats mechanism and mechanistic thought as a distinct and distinguishable element within biology, one which was more or less uniform, and which possessed its own momentum. By contrast, a contextualist approach finds mechanism to have been co-extensive with a host of other developments and practices in biology that were occurring simultaneously. Putting mechanism in its place requires attention to its relationships with other elements of biological practice, theory, and representation. In this panel we particularly reflect on the importance of descriptive biology, narrative science, experimental interventionism, and interdisciplinary cooperation. All four papers speak to mechanism, and by placing it in association with these additional elements, have the capacity to change our appreciation of what mechanism did to and for biology. Our four cases span molecular, cellular, and organismal mechanistic scales, each addressing biological phenomena that fostered multi-disciplinary attention. All four adopt the approach of integrated history and philosophy of science in order to bring to life the epistemic

questions faced by historical actors, and offer more or less appropriate terms in which to understand their philosophical and historical significance. For each of us, the recognition that mechanism and mechanistic thought mattered for our actors is a starting point, one which might then: mask significant differences between approaches to mechanism (Berry); or overshadow elements of research that have been underappreciated (Worliczek); or supply a meeting point for cooperative scientific practices which test biology's universality (Schürch); or help scientists productively manage partial accounts of unique events (Bonnin).

Chair: **Mathias Grote** (Humboldt-University Berlin, Germany)

1 - **Hanna Lucia Worliczek** (University of Vienna, Austria)

"Merely descriptive" and therefore dismissed? Descriptive epistemic practices of modern cell biology in the context of evolving mechanistic-explanatory demands and innovative imaging technologies after 1950

The phrase "Seeing is believing", used by contemporary cell biologists, highlights the pronounced visual culture of modern cell biology and the importance of visual evidence in this discipline which has been present since its formation in the 1940s. Microscopic visualizations have played and continue to play a crucial role in describing, explaining and understanding cellular structure and function. Historiographic and epistemological accounts of modern cell biology are dominated by questions concerning the development of mechanistic explanations of cellular functions, with a focus on the interrelation of microscopic imaging and experimental-interventional analyses. This perspective marginalizes description as an epistemic practice, and the impact of descriptive knowledge. Consequently, historical trajectories of changing constructions of descriptive qualities as designators for valuing or dismissing research and their impact on contemporary cell biology remain unexplored. Using changes of cell biology's visual culture since the 1950s as a heuristic lens, this paper explores descriptive practices and their interrelation with a proposed "mechanistic imperative" which the discipline continues to feel to this day. Mechanistic explanations of cell functions became a designator for research worth publishing in major cell biology journals during the 1970s, in parallel to a decreasing appreciation of "pure" morphology using electron microscopy, observational and qualitative studies, and ultimately "merely descriptive research". At the same time, and contrary to these developments, some researchers were able to publish detailed molecular-morphological descriptions of the cytoskeleton in the 1970s and 1980s thanks to their application of new imaging techniques. This new descriptive body of knowledge was used simultaneously to inform mechanistic hypotheses about cell motility and their experimental-interventional testing. Based on these findings, this paper asks (i) how interpretations of "description" by cell biologists have changed; (ii) to what extent new imaging techniques promoted phases of valuing and devaluing descriptive practices; (iii) which dichotomies (e.g. observational/experimental, exploratory/hypothesisdriven) have been mobilized when dismissing research as "merely descriptive" and (iv) how researchers evaded such a dismissal.

2 - **Dominic Berry** (London School of Economics, UK)

Mechanisms or nature narratives? Erwin Chargaff on DNA-protein binding

The term mechanism came to describe a great variety of biological phenomena in the twentieth century. The widespread adoption of mechanism as a key discursive and epistemic meeting ground in biology has served to disguise some otherwise starkly different conceptions of the phenomena in question. This paper explores what might be gained by challenging the actors category of mechanism with the alternative notion of 'narrative'. In some cases narrative acts as a competitor term, doing all of the things mechanism might do but differently and with different outcomes. Other times narrative may work in tandem with mechanism, filling in gaps that are left out or providing additional epistemic support. This paper pursues these suggestions in the mode of integrated history and philosophy of science by concentrating on the DNA-protein binding research conducted by Erwin Chargaff (1905-2002). Chargaff

occupies an unusual historiographical position. Well known to historians of science as a commentator and critic of the sciences, particularly critical of molecular biology, his own research programme has rarely received scrutiny. Historians of molecular biology - who have the most to learn from Chargaff - typically mention the importance of his 'rules' and then move swiftly on. This paper pushes deeper into Chargaff's own epistemology, and argues that he is best appreciated as dealing not necessarily with mechanisms of biochemical change (though mechanism was his own preferred term) but rather narratives of nature. The latter concept is explained, and its usefulness demonstrated by better articulating Chargaff's differences with the molecular biologists.

3 - **Caterina Schürch** (Ludwig-Maximilians University Munich, Germany)
Ascidians and urine: on the materiality of mechanism research

Some research approaches may appear deliberately obtuse at first glance: In the early 1920s, for example, American biophysicist Selig Hecht used ascidians and clams in order to study vision. Ten years later, a group of chemists and botanists in Utrecht set out to study plant growth by purifying a growth-promoting substance from human urine. In both cases, however, the respective approaches were chosen very consciously and discussed in detail. I use these two episodes to throw some light on the material, practical, and social conditions of mechanism research. In doing so, I will take up a claim made in Philosophy of Science, namely that the search for mechanisms fosters cross-disciplinary research activity. Philosophers have argued that very different evidence and insights are needed to provide a satisfactory mechanistic explanation for a phenomenon. Since disciplines impart different skills and capacities (e.g. in the operation of instruments or the application of theories), the combined effort of representatives of different disciplines is (and was) needed. However, it is still unclear how such interdisciplinary research was coordinated and implemented. My questions include: How did researchers with different professional backgrounds, methodological standards, instruments and concepts agree on a common approach?; How did biologists and chemists become interested in investigating a specific mechanism in the first place? In this talk I argue that, in the examples examined, the scientists' decisions depended first and foremost on their skills and the material and conceptual resources available to them. On this basis, they decided what mechanism to investigate, no matter how distantly related it might appear.

4 - **Thomas Bonnin** (Bordeaux University, France)
Narrative vs. mechanistic explanations of the origin of eukaryotes

The arrival of eukaryotic cells, cells with a nucleus, is considered a major evolutionary event. Explaining the emergence of eukaryotes has been a subject of interest amongst biologists from the early 20th century to the present. This presentation explores the form, rather than the content, of these explanations. I focus on two representative hypotheses: the phagotrophic theory from Tom Cavalier-Smith (first formulated in 1975) and the hydrogen hypothesis from Bill Martin (first formulated in 1998). I argue that these two explanations, despite sharp divergences, display important similarities. They both provide a unique causal story for the event of interest, while remaining sketchy, leaving some elements unexplained. They are also only partially organized with respect to chronology and spatiality: some parallel events at different scales occur without a clear ordering, while others are provided with a much more "streamlined" explanation. I confront this state of affairs with epistemological tools that have been identified as useful for the explanation of unique events, namely "narrative explanations" and "ephemeral mechanisms". However, narratives and mechanisms have been argued to be mutually exclusive. I illustrate with my case study, that elements of these explanations can instead be present simultaneously in a given explanation. I also argue that both narratives and mechanistic explanations can only partially account for some of the elements in Cavalier-Smith and Martin's hypotheses, such as their partial organization. This presentation, then, will shed light on the continued work needed to refine our understanding of (a) the relation between narrative and mechanistic explanations and (b) the explanation of unique events in historical sciences.

Pause from 13.15 to 13.45

Tuesday 1 September, 13.45 - 15.45

Room 1: S2 - Mobile Materials: Mutable Meanings and Knowledge Modulation - 2

Conveners: **Caroline Cornish** (Royal Holloway University of London, UK), **Brooke Penaloza-Patzak** (University of Vienna, Austria)

Chair: **Caroline Cornish** (Royal Holloway University of London, UK)

1- **Carlos Sanhueza-Cerda** (University of Chile, Chile)
Building Precision: Installation in Chile of a Repsold Meridian Circle at the National Astronomical Observatory of Chile (1908-1913)

This contribution seeks to situate a case study in order to describe how the installation in Chile of an astronomical measurement and observation object can help us understand the role of instruments in early 20th century techno-scientific dynamics. On the basis of Chilean and German archival materials dating from 1908 to 1913, we analyze how the discussions between instrument manufacturer Repsold and Brothers in Hamburg and National Astronomical Observatory of Chile Director Friedrich W. Ristenpart, and their attempts to build a space of precision. These communications demonstrate how the process of installing a precision device mobilized a set of local knowledges which allowed the obtained data to be validated. Among these forms of knowledge include the physical location of the instrument, its adjustment, calibration and assembly. This case study provides detailed insight into the functioning of the Latourian notion of cycles of accumulation in the dynamics of the construction of knowledge.

2 - **Brooke Penaloza-Patzak** (University of Vienna, Austria)
Following Instructions and Changing Directions: Knowledge-making in and between Sites of Ethnographic Specimen

Two central qualities that often characterize scientific specimens as such is a spatially finite nature by which they are delimited and comprehended in a physical sense, and a physical portability in the course of which they are transformed into exemplars once mobilized beyond their points of origin. Objects and phenomena which cannot feasibly be made to comply with these criteria—mountain ranges, for example, archeological ruins, or comets—are transformed into specimens by way of sampling, plaster casting, photographs, drawings and diagrams. Regardless of medium, and once loosed from their points of origin and resituated at research sites, these specimens become raw materials in the production and transfer of scientific knowledge. In this sense, the means by which specimens are organized at these sites exerts a powerful and at times implicit influence on knowledge creation and the transmission of specific scientific perspectives. In 1893, four handwritten and pages of specimen cataloging and exhibition instructions and diagrams were sent from the Royal Ethnological Museum in Berlin to the Worlds' Columbian Exposition in Chicago. Some years later, these appeared, reinterpreted, in the anthropology department at the American Museum of Natural History in New York City. Consider local circumstances as well as transnational disciplinary discourses, this presentation investigates how notions regarding specimen hierarchies, normative conceptual categories and the relationship between

humans and their environment were reconfigured in and behind exhibition halls in the course of their transmission between these research sites.

3 - **Jessica Ratcliff** (Cornell University, USA)

Model India: Making Meaning with Opportunistic Collections at India House, London c. 1825-55

In 1855, the East India Company opened the doors to a new wing of its museum at its headquarters on Leadenhall Street. Known simply as the "New Museum" at India House, the first great room into which a visitor would enter was, as the Illustrated London News put it, "filled to overflowing with models of buildings, shipping, rites and ceremonies, manufacturing machines and implements, native races and castes, public works &c." Thousands of miniature models, made of wood or clay, lined the towering, largely label-free, shelves. Many of the models were of tools or instruments, often for artisanal and agricultural production, and especially related to textile production. There were also models of modes of transportation— palanquins, carts, wagons, and dozens of different boats. There were models of people working at dozens of different tasks—planting, spinning, weaving, barbering, cooking, snake-charming— and of marriages, religious ceremonies, courts of law, military exercises, etc. Model households depicted the comfortable lifestyle of the wealthy classes. And interspersed between cases were larger architectural models such as the tomb of vanquished enemy Ranjit Singh and a scale model of the wealthy and vibrant city of Lucknow. This paper explores the history of the Company's model India collections, focusing in particular on the scale models of industrial arts that where designed and commissioned by the amateur mathematician and Persianist Margaret Tytler during her residence in Patna in Bihar between 1817-23. Constructed by local artisans (and sometimes modeling the modeller), the models were initially only for Tytler's own use, but sets of Tytler's models eventually made their way to India House. Here I will explore the dynamics of production, use and value that surrounded so-called opportunistic collections of the kind represented by the Company's unplanned acquisition of Tytler's models. Thus, the central question to be explored here is not "why was the Company interested in forming a model India within India House?", but "once the Company had accumulated a model India within India House, how did actors come to value or make use of that collection?"

4 - **Marianne Klemun** (University of Vienna, Austria),

"Special Commission" Meteorites: Fireballs and Short-term Sensations

In the nineteenth century, the meteorite collection at the Natural History Museum in Vienna was considered one of the best collections of its kind in the world. Inventories of acquisitions at a global level were compiled without interruption, with some of them giving the names of the donors. However, what the inventories and levels did not mention was the role of circulation prior to the acquisitions, the path of the materials as well as their stopovers that changed their meaning. This is what this paper will focus on. Unlike *naturalia*, meteorites were documented according to the location of their initial appearance, the "scene" of the incident itself. Eyewitness interviews evoked and created object knowledge which was conveyed via gobetweens – sometimes far away in India or Africa –, and the finds transformed from incidents to changeable scientific objects through chemical analyses and depending on different epistemic approaches of many persons involved. In 1751, the spectacular impact of a meteorite in Croatia created a sensation and criminological documentary interest among the authorities of the country. The object itself was immediately transported to Vienna and, next to insignia and memorabilia, incorporated into the Imperial treasure chamber. Apart from the explanation that the fireballs had just fallen from the sky, the view emerged that meteorites were extra-terrestrial. Incorporated into the natural history collection, the documents, together with drawings, as well as the object were attributed a scientific meaning, and this triggered controversies. The object was given a new status, getting relevance as evidence of a unique historical event. When, almost a hundred years later, meteorite research reached its peak, these documents were re-examined from a philological and a natural scientific perspective; the "case" was re-opened and the object transformed and integrated into a new context.

Room 2: **S3 - Learning by Doing and Doing to Learn: Skills, Texts and the Materiality of Surgical Knowledge in Early Modern Europe - 1**

Conveners: **Elaine Leong** (University College London, UK), **Maria Pia Donato** (CNRS - Institut d'Histoire Moderne et Contemporaine, Paris, France)

Chair: **Iolanda Ventura** (University of Bologna, Italy)

This pair of linked symposia explores the material, textual and visual history of surgical knowledge and practice in early modern Europe. In the past decades, historians of medicine and science have scrutinised early modern scholarly practices and book culture, rediscovered minor genres of medical writing and reframed key issues concerning the relation between theory and practice. Yet, these research trends have only tangentially touched upon surgery. Historians of surgery have instead largely focused upon mapping the contours of a very elusive occupational group. While excellent studies have illuminated medieval and renaissance learned surgery, the knowledge cultures of common practitioners remain largely unexplored. This is particularly the case for 16th and 17th centuries, where little scholarly attention has been devoted to surgical education and training. Although scholars agree that surgery was a highly mobile activity, implying different skills and levels of literacy and learning, not much is known about how these were actually acquired by practitioners along their life, diverse as they were from the modest bloodletter to the university-trained surgeon. The eight papers in our symposia shine light on the changing landscape of surgical culture across Europe c. 1500-1700. Our papers situate the rich and complex knowledge practices of surgeons of all stripes within multiple circuits of transmission. We analyse printed and manuscript books as texts and material objects to tackle the appropriation of knowledge by different audiences, both within the trade and beyond it. Examining images, instruments and other learning aids, we chart their role in the transfer of know-how and skills, extending our understanding of surgical training and education. Taken collectively, these papers offer new perspectives on the process of learning by doing and doing to learn.

1 - **Heidi Hausse** (Auburn University, USA)

Building a Surgical Armory: Johannes Scultetus in Ulm, c.1631-1645

This paper is about practicing and writing surgery in Ulm during a moment of remarkable disruption caused by the Thirty Years' War. The period of 1631-1645 comprised the years in which violence from the ongoing conflict impacted the work of Ulm's greatest early modern medical practitioner and author: Johannes Scultetus (1595-1645). Scultetus' career and writings highlight the multifaceted relationships among bodies of surgical knowledge learned in lecture halls of universities, in Latin and vernacular treatises, and in hands-on work with patients. A native of Ulm, Scultetus was a doctor of anatomy and surgery educated at the University of Padua by such luminaries of Renaissance anatomy as Girolamo Fabrizi d'Acquapendente (1533-1619) and Adriaan van den Spiegel (1578-1625). In 1625, he took up the position of town physician of Ulm, where he practiced for twenty years. Scultetus, doctor of surgery, was a member of the college of physicians, and appeared only to have performed surgery himself in extraordinary cases. His impact on surgery in Europe came from his widely circulated treatise, Armamentarium Chirurgicum (1655), later translated into German as Wund-Artzneyisches Zeug-Hauβ (1666). Part I of his treatise, famed for its detailed illustrations of surgical instruments, in many ways follows the learned example of Acquapendente. Part II, however, is a collection of case histories that draw readers into the stormy years of unrest in and around Ulm that created the extraordinary cases—the injuries caused by duels, marauding soldiers, sieges, and open battle—which required Scultetus to employ in practice some of his treatise's most well-known illustrated instruments. Drawing on Scultetus's Wund-Artzneyisches Zeug-Hauβ and supplemented by archival records and chronicles from Ulm, this paper uses Scultetus' case histories of 1631-1645 as a way to explore a particularly complex example of the many-layered ways of learning and doing surgery in early modern Europe.

2 - **Maria Pia Donato** (CNRS - Institut d'Histoire Moderne et Contemporaine, Paris, France)
Books, manuscripts and the material culture of surgery in early modern Italian hospitals

Like elsewhere in Europe, major hospitals in early modern Italy provided education for apprentice surgeons. Depending on the number of years they served, their role in the internal hierarchy, the courses they attended and examinations taken, they could then apply for a license in 'low' or 'high' surgery. Although surgical training in hospitals was fundamentally a matter of observing and acquiring a very gradual hands-on experience, by the midseventeenth century formal lectures on surgical theory and practice were established in cities like Rome, Naples, Florence and Turin. Who were the lecturers, and what did they actually teach and how? Drawing on manuscript lecture books and supplemented by archival records, this paper investigates surgeons' training in Italian hospitals in the seventeenth and eighteenth centuries, a period of tremendous change in medical and scientific culture. Surgeons' lecture notebooks, which still await in-depth consideration, do in fact enable insight into the culture, social status and mobility of practitioners. They raise questions about the relation between theory and practice in hospital training while documenting the scholarly practices and intellectual techniques of surgeons of supposedly lower rank. Last but not least, they offer clues on intergenerational bonds and professional solidarity. I will discuss manuscript surgical lectures both as texts and objects placing them in the context of the authors' printed output and of surgical literature in general. I will particularly focus on lectures on tumours by three generations of Roman surgeons. I argue that this part of surgery allows a more profound understanding of how the surgical culture evolved and how it was transmitted and appropriated.

3 - **Carolin Schmitz** (University of Cambridge, UK)
Surgical Textbooks Meet Legal Records: Instructing and Witnessing the Practice of Surgery in Early Modern Spain

In Spain, as in other European contexts, the long 17th century was a thriving age for the publication of surgery texts written in the vernacular. As guides for surgical practice, many of them served to instruct young surgeons in the various fields of their profession. Between the late 16th and early 18th century, the most prominent examples, like Juan Fragoso's Cirugía Universal (1587) and Juan Calvo's Primera y segunda parte de la cirugía universal del cuerpo humano (1580), maintained their success throughout the period, counting each with more than dozen reeditions. Building on their popularity, this paper turns to the question of perception and aims to make a first attempt to see how these texts were appropriated and put into practice, in particular, by common practitioners. Given that lower ranked yet numerous practitioners like rural surgeons, barbers and phlebotomists rarely produced or left behind any writings by themselves, in order to recapture their experiences, this paper draws on legal records documenting medical encounters. Produced by diverse courts of justice (criminal law courts, the Inquisition, and royal appeal courts), these judicial proceedings accused practitioners of surgery of trespassing their realm of expertise and hold rare information on their practice, including material evidence, such as original licenses, recipes listing ingredients used in the preparation of ointments and plasters, as well as patient testimonies describing the surgical procedure. Now, bringing together courts records and textbooks, this approach hopes to shed light into two directions: first, to assess how much of the knowledge written and circulated in books found their way into the daily practice of common practitioners; second, to gain a more profound understanding of how surgical practice on the ground looked like by gathering evidence of techniques that extended the standard knowledge printed in manuals.

4 - **Elaine Leong** (University College London, UK)
Illustrating Surgery: Print, Images and Vernacular Surgical Manuals in Early Modern England

Early modern London booksellers' shelves were well stocked with a range of general surgical manuals purporting to present the 'whole art' or 'prooved practise' of surgery. These offered instruction in a range of areas from anatomy to wound treatment to the use of instruments to recipes for drugs.

Between 1525-1700, c. 150 works (in new titles and reprints) were printed. These included books by prominent members of the Company of Barber and Surgeons like William Clowes, Thomas Gale and John Woodall, and translations of works by well-known authors such as Ambroise Paré, Fabricius von Hilden and Johannes Scultetus. Given that these handbooks were designed to transmit surgical skills and, in many cases, effective use of instruments, it might come as a surprise to modern readers that only a small portion were illustrated. In fact, only c. 30 editions (or around 20 individual titles) contained images of instruments and devices, bandages, depictures of operations and anatomical figures. This paper explores the place of images during a significant shift in English surgical print. In the first 100 years or so, the field was dominated by translations of medieval manuscripts and contemporary continental authors, driven largely by members of the Company of Barber and Surgeons. By the 1650s, the field shifted to continual reprints of titles by local practitioners such as James Cooke's Mellificium Chirurgia (illustrated) and Thomas Brugis' Vade mecum (not illustrated) and translations from German, French and Dutch authors. By tracing illustrations across this shift, this paper will interrogate the changing use of text and image in the printed transmission of surgical knowledge and practice and the place of books in surgical education. Attending to the widespread practices of vernacular to vernacular translations, it will also investigate how knowledge, technologies and skills moved across linguistic, national and geographical boundaries.

Room 3: **T12 - Medicine and Society**

Chair: Marco Bresadola (University of Ferrara, Italy)

1- **Elisabeth M. Yang** (Rutgers University, USA)

Constructing the Moral Infant in American Medical and Scientific Discourse, 1850s-1920s

In this paper, I explore the philosophical and social constructions of the moral infant in American medical and scientific discourse from the 1850s to the 1920s. While historians, sociologists, and literary scholars have written extensively on the history of child-rearing and child health, very little has been done that focuses on the history of infants as moral agents and persons. I investigate conceptualizations of the moral agency and personhood of infants in nineteenth-century American medical texts and child-rearing manuals to disentangle the interweaving of hegemonic religious, scientific, and philosophical conceptions of the infant and infancy during the popularization of a Darwinian approach to child development in the 1860s and the growing mechanization of the child's body in the early twentieth-century. My research aims to historicize and problematize the moral infant whose being and development had increasingly captured the attention of psychologists, physicians, politicians, and parents during a period in which child health and welfare burgeoned as a moral, scientific, and political enterprise in America. My analysis begins with Andrew Combe's Treatise on the Physiological and Moral Management of Infancy (1854) and ends in the 1920s during which advice for cultivating the "moral" infant is supplanted by advice for rearing the "normal" infant, from religious discourse to a secular, scientific discourse. Tracing the history of the "moral" infant in American medical discourse reveals the moral dimension of medicine and the interplay between science and religion in the construction of the human person.

2 - **Carlo Bovolo** (University of Piemonte Orientale, Italy)

Catholics towards Eugenics in the First Half of 20th Century

The paper deals with the Catholic approaches and attitudes about the eugenics in the first half of the 20th century, focusing on the Italian context and on an international comparison. The eugenics studies and policies produced strong discussions and oppositions also within the Catholics. Their opposition were scientific, political, theological: they criticized the lack of scientific basis in some eugenic

hypotheses and defended the human freedom from the interventions of the governments, in order to safeguard the role and the influence of the Catholicism and its morals in the culture and society. Catholics opposed mostly towards the Nordic current of eugenics, spread in the Anglo-Saxon and German world, characterized by strong interventions (sterilization, abortion, birthcontrol) and by the idea of an artificial selection of the humankind. A Latin current of eugenics, however, based mostly education, prevention and demographic development, and spread in Catholic Countries, gained consideration from sector of the Catholic movement, like Agostino Gemelli, key figure of the Catholic science in 20th century. Condemning and refusing the Nordic eugenics policies, catholic scientists and intellectuals (such as Gemelli, Fallon, Muckermann) approved and embraced the Latin eugenics, stating that the Catholic morals represented the best and most effective eugenic principle. Among Catholics several approaches and attitudes towards eugenics were born, from the opposition to the acceptance, sharing the same aim: claiming the cultural, social, political and also scientific role of the Church and of Catholicism in an issue involving many fields (theology, medicine, biology, sexuality, (bio)politics). Catholics tried to build a Catholic way to eugenics, in accordance to the Faith, and consequently to gain a public recognized role in the eugenic debates. The paper intends to underline the contributions of Catholic scientists in the eugenic debate and policies and to evaluate the circulation of eugenic topics among Italian and European Catholicism

3 - **Fedir Razumenko** (University of Calgary, Canada)

Cancer 'Epidemic', Quackery, Innovation, and Justice in Canada: how 'strangers' began approaching the bedside in the mid-twentieth century

Over the first half of the twentieth century, the medical profession had only limited means to treat cancer – surgery, radium, and x-ray – which remained hardly accessible to the majority of patients. Given the poor cure rate and intolerable side-effects of the conventional therapy, a market for alternative treatments burgeoned. Commissions for the investigation of cancer remedies were established across Canada since 1938 to check the spread of alleged quackery – Essiac, Hett's serum, Ensol etc. – which undermined the authority and prosperity of orthodox doctors. Simultaneously, unorthodox practitioners were increasingly extending influence by using nostrums. Glyoxylide, better known as the Koch treatment, was one of those questionable cancer remedies invented by the eponymous Detroit doctor in 1920. After mostly unsuccessful American governmental and judicial campaigns to curb its use as anti-cancer panacea, the nostrum gained notoriety and was licensed by Dr. Arnott, a Canadian physician based in London, who managed to popularize its use country-wide in just a decade. In London, ostensibly by circumstance, the first patient was treated for cancer with Cobalt-60 on October 27, 1951, twelve days earlier than in Saskatoon, where the first in the world Cobalt-60 teletherapy unit was installed on August 17. Analyzing archival materials from medical-scientific committees and governmental commissions in Ontario, Saskatchewan, Alberta, and British Columbia, I uncover the nearpowerlessness of the medical profession against dissenters supported by the public favoring Glyoxylide. The unveiling of Cobalt-60 teletherapy, I suggest, gave a chance to the profession to reinstall its authority. The College of Surgeons and Physicians of Saskatchewan designated the Koch treatment a quackery in its 1951 annual meeting and its report reached all Canadian provinces. Dr. Arnott immediately reacted with a lawsuit. Ultimately, the Canadian Supreme Court ruling of 1954 marked a turning point for a public demonstration of how the professional regulation from the inside introduced the outsiders' interference through the court system. Thus, I argue the medical profession set the trend for disputing medical matters in Canadian courts which gradually empowered the patient and the abused human subject to successfully challenge the medical authority.

4 - **Dolores Steinman & David A. Steinman** (University of Toronto, Canada)
Reassessing Medical Exploration of Blood Flow Patterns

Our research - focused on the correlation between complex vessel geometry and corresponding blood flow patterns – endeavors to design innovative technological applications, whilst based on historical methods of diagnosis and visual representation of the phenomenon. Both examination and representation of blood flow have been particularly tricky to achieve, as access to the unseen living human body was practically impossible for the major part of human history. Since Hippocrates, pulse sounds were used as diagnosis tools, while until the Middle Ages, representations were based on animal models, extrapolation from palpation and auscultation and the imagination of artists trusted with illustrating the anatomical text. Dissections, followed a few centuries later by the discovery of x-rays, and that of the UltraSound in the last century, provided clinicians with technological tools that allowed a multi-sensory inspection of the human body. We consider our work a fitting case study for the theme of the conference, as our research - through accurate bi-modal (visual and aural) representations of the perturbed blood flow - strives to allow clinicians timely detection of critical flow disturbances and assessment of clinical consequences. From initial mathematical models based on patient data, to visual representations inspired by anatomic illustration conventions, to new representational paradigms stemmed from collaborations with visual and sound artists, cognitive scientists and anthropologists, our work aids the clinician through “flow caricatures” of key moments (an automated carousel, novel twist on the zoetrope) with an aural component. Situated at the intersection of medicine, sciences and technology, our research has the privileged position of building on historically “sensory diagnoses cultures” while creating noninvasive innovative strategies.

Room 4: **T22 - Cosmology**

Chair: **Qi-Han** (Chinese Academy of Sciences, China)

1 - **Gerd Grasshoff** (Humboldt University Berlin, Germany)
Computational history of science for material objects - ancient sundials

Ancient sundials are material witnesses of a sophisticated astronomical knowledge, with which an ancient cosmological understanding of the daily events is connected to astronomical regularities. In a large research project of the Excellence Cluster TOPOI, data on all known ancient sundials have been newly established in the last ten years. The stock of the sundials catalogued up to then doubled to more than 800 objects. More than 250 objects have been digitized using the latest 3D techniques and published open access (http://repository.editiontopoi.org/collection/BSDP). Only with these data is it possible to obtain reliable information about the geographical latitude, which the ancient craftsman assumed for the construction. Modern algorithmic procedures in so-called computational notebooks (Jupyter) allow a systematic investigation of the published digital models. The procedures and notebooks as well as the obtained data are themselves immediately published in the open access repository Zenodo at CERN according to the FAIR standards of the European Commission for open science. The methods used are thus archived in a scientifically reproducible and sustainable manner. The paper introduces the methods of computational science of material witnesses of the history of science. Archival holdings of material objects thus become scientifically accessible for novel methods of analysis and expand epistemic access to historical sources that fundamentally change our knowledge of textual sources for historical research.

2 - **Valerie Shrimplin** (Gresham College, UK)

Circles, Spheres and Globes: Models of the Universe as Depicted in Art

Following an introduction on classical and scriptural views of the shape of the earth/universe and how these were depicted in art and architecture, the development of globes out of the concept of a circular cosmology will be considered. Emphasis will be placed on the concept of the circular universe and the mystery of its centre, as well as the relation between terrestrial and celestial systems of cosmology. Classical and medieval depictions of the earth/universe appear to have laid the foundation for the development of the globe and spherical terrestrial and astronomical structures from the early sixteenth century. Discussion of examples of the depiction of globes in famous paintings will then demonstrate the significance of globes in the promotion and acceptance of the new Renaissance learning and world view – whether cosmological, geographical or political. With the earliest terrestrial globe (Martin Behaim's Erdapfel) dated to 1492, such works as Hieronymous Bosch's triptych, The Garden of Earthly Delights (c 1500) appears significant and, as early as the 1530s, globes (as opposed to images of the sphere of the earth or universe) started to figure prominently in painting. Sixteenth-century works such as Jan Gossart, Young Princess c 1530; Hans Holbein's Ambassadors (1533); and the Armada Portrait of Elizabeth I (1588) demonstrate the geographical and political significance of globes. They were followed by works by Flemish and Dutch artists, including Rembrandt (seventeenth-century) and later Italian and French examples. The depiction of globes in art has actually continued into our own age (the Wikipedia logo or Alberto Ruggieri's work symbolising concern for the planet), demonstrating the significance of the depiction of globes in art in the context of the age and culture in which they were produced.

3 - **Genco Guralp** (San Diego State University, USA)

Seeing as Knowing: The Cosmological Image and the Making of Evidence

One of the most celebrated images Hubble Telescope produced is the Hubble Deep Field (HDF), which was made public in January 1996 by the Space Telescope Science Institute. The accompanying press release described the iconic picture as follows: "One peek into a small part of the sky, one giant leap back in time. The Hubble telescope has provided mankind's deepest, most detailed visible view of the universe."1 Some galaxies contained in the image were so distant that they "date back to nearly the beginning of the universe." This led the director of the Institute to wonder whether "we might somehow be seeing our own origins in all of this." According to another scientist, the image could be the "equivalent of the Dead Sea Scrolls." Pronouncements such as these are emblematic in cosmology: the image is interpreted as directly linking the viewer with the answers to the deepest questions of humanity. In our habitual interaction with these images, we comfortably take them as straightforward markers of knowledge, in line with the pronouncements of the cosmologists. This discourse is indicative of a high confidence in the cosmological image. My paper probes what lies beneath the image regime of contemporary cosmology that makes this confidence possible: how do these images gain their compelling representative value? Using the discovery of the accelerating universe as a test case, I offer a historical analysis of how inscription devices function in cosmological image making and how these images are employed as evidence. To this end, I examine how scientists construct various inscription media to perform as imagemakers. Following Kittler, I analyze the "spectrum of the general data flow" and the practices of inscription through which the image becomes evidence. Finally, I examine the channels of interpretation that enable scientists to "read" a product of a series of technical interventions as an immediate photograph of the universe.

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4 - **Eve-Aline Dubois** (University of Namur, Belgium)

A Steady-State Explanation for Cosmic Microwave Background

In 1965, Penzias and Wilson published their Measurement of excess antenna temperature at 4080Mc/s. This result was quickly interpreted as the Cosmic Microwave Background (CMB), an experimental evidence in favor of the Big Bang scenario. Fred Hoyle and his associate researchers (Wickramasinghe, Narlikar...) were supporters of the competitor theory: the steady-state model. They had to explain the CMB data in the frame of a stationary universe, with an infinite past. They interpreted the cosmic radiation as a local effect. The interstellar grains absorbed and re-radiated stellar light at the observed range of frequencies. Our contribution will study the CMB's steady-state explanation from the first ideas emerging in the late sixties to the nineties quasi-steady-state theory. Indeed, to preserve the steady-state model, with stationary universe and matter creation, the cosmic radiation could not be the relic of a primitive state and the first light emission. Some scientists developed a complete physical model to explain the radiation as the product of interstellar grains (or iron whiskers in later interpretations). We investigate this idea with modern tools and recent results, and to present whether it could explain a uniform CMB and could reproduce actual fluctuations measurement.

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Room 5: **S54 - Popular Representation / Misrepresentation of Modern Physical Theories - 1**

Sponsored by IUHPS / DHST Commission on the History of Physics

Conveners: **Jaume Navarro** (University of the Basque Country, Spain), **Alexei Kojevnikov** (University of British Columbia, Canada)

The first decades of the twentieth century saw a plethora of reactions to the newest theories of relativity and the quanta. Much has been said about the reception of such theories in different cultural, philosophical and scientific geographies but more often than not, these have been presented in terms of the consistency of the theories and their philosophical implications. Earlier "reception" studies prioritized mostly professionals in the field, physicists and to some degree mathematicians and philosophers, each with their own professional language and conceptual apparatus. We want to explore a broader problem by expanding the focus to other types of media, linguistic as well as non-verbal, visual and material, while also shifting attention to the general public and to various other groups of intellectuals beyond physics per se, in science, medicine, humanities, religious thinkers, artists, etc. In this session we will thus pay attention to the “visual, material, and mathematical cultures of physics” in the twentieth century, to paraphrase the general topic of the conference, and analyse a variety of representation technologies and visual models employed to represent, but more often to misrepresent the new theories and cultures in physics: from cartoons to Gedankenexperiments, from public exhibits to mathematical technologies, from journalistic reports to artistic imagination, and from practical future promises to contextual political interpretations.

Chair: **Jaume Navarro** (University of the Basque Country, Spain)

1 - **Klaus Hentschel** (University of Stuttgart, Germany)

Philosophical (Mis-) Interpretations of the Theory of Relativity - Historiographic Considerations of How They Arise and How to Analyze Them

Philosophical (mis)interpretations of the special and general theories of relativity were quite frequent during Einstein's lifetime. Even today interpretative statements about relativity theory are frequently false or highly misleading. In my Ph.D. dissertation (Hentschel 1990), I analyzed interpretations by 10 different philosophical schools active in the early 20th century which widely differed in their approaches, emphasis and blind spots. Many of these interpreters had studied the theory intensely and had close contact with Einstein himself or with one of the members of the "protective belt" of close friends and allies of Einstein. Rather than declaring all of these thinkers – including philosophers of high standing such as Ernst Cassirer, Moritz Schlick or Joseph Petzoldt – as either luminaries or idiots (which would be implausible, if not downright silly), I show structurally how these misunderstandings arose and why they were kind of unavoidable even for highly qualified and very well-informed interpreters. More popular texts were often second-order interpretations of these firstorder accounts, thus multiplying the first-order misinterpretations. In my talk I will give a few characteristic examples but focus on the structural characteristics of these misinterpretations and discuss how to analyze them historically.

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2 **- Jaume Navarro** (University of the Basque Country, Spain)

Edmund T. Whittaker, Einstein and anti-Semitism

In the early 1950s, Edmund T. Whittaker published a second edition, in two volumes, of his classical 1910 A History of the Theories of Aether and Electricity. A third volume was promised but an aging Whittaker could not finish his intended plan. The second volume appeared in 1953 and caused much surprise since it played down, more than in the previous edition, Einstein's role in the formulation of special relativity, attributing it mainly to Poincaré. Ever since, the accusation of anti-Semitism has dawned upon Whittaker. In this paper I shall present my research at the Whittaker papers, in the University of Toronto, where the lifelong correspondence between Edmund T. and John W., father and son, is kept. Indeed, some expressions such as the warning "I shouldn't be surprised if the German Jews set up a howl at my treatment of Einstein's claims to be the discoverer of Relativity" (22.09.1953), have an anti-Semitic flavour. However, setting this sentence in the context of his opinions on other people (the familiar correspondence with his son is full of judgements of other physicists and mathematicians) may give a more complex picture. Also, in 1953, he was convinced of the challenge posed to General Relativity by the German Jews and émigrés, Erwin Finlay-Freundlich and Max Born, both good friends of Whittaker. Born, like Whittaker, was professor in Edinburgh and Freundlich in nearby St Andrews. This proximity was instrumental in having Whittaker, not a practitioner of general relativity himself, share in the doubts that many theoretical physicists and astronomers had about the theory at that time and, indirectly, about the genius of Einstein.

3 - **Hiroto Kono** (Tokyo Institute of Technology, Japan)

The Formation of a Science of Matter in Wartime Japan and the Role of a Visual

During World War II, some Japanese physicists established a subdiscipline of physics called "Busseiron (物性論)." This field literally studied the properties of matter –"Butsu (物)" means substance or matter, "Sei (性)" means property or character, and "Ron (論)" means theory, discourse, or study – and was

among the several branches of physical sciences that started to focus on the properties of substances following the advent of quantum mechanics, such as “solid-state physics,” “quantum chemistry,” and “chemical physics.” However, isolated from the international scientific communities due to the ongoing war, the Japanese physicists had to make this new field by building upon prewar scientific developments based on their own perspective, which gave the field a framework unique to Japan. Busseiron has evolved into one of the largest subdisciplines of physics but lacks a corresponding discipline outside Japan. In this talk, I will analyze how Busseiron physicists viewed the preceding developments of the sciences of matter to create their new field as well as how it differed from the stories abroad, especially in Germany, England, and the United States. It should be pointed out that a visual aspect of the scientific inquiry on matter played an essential role in the field’s emerging phase. Some Busseiron physicists had conceived that there was a divide in the microscopic approaches to properties of matter: they differentiated “bunshiron [molecular theory]” and “denshiron [electron theory]” in the sense of methodology—not of object. They used the former, which represented a particular and consistent visual model and methods, as the guiding principle in making their new discipline from the preexisting sciences of matter. This Japanese case might give us a new insight into how differently scientific thinking with images works in different cultures.

4 - **Emilie Skulberg** (University of Cambridge, UK)

Curved Space on a Flat Surface: The Event Horizon Telescope and Visual Representations of Black Holes

The first image of the shadow a black hole was released by the Event Horizon Telescope Collaboration (EHTC) on 10 April 2019. Speaking at one of the press conferences in which this image was presented, Prof Heino Falcke stated that ‘You have probably seen many, many images of black holes before, but they were all simulations or animations, and this is precious to all of us because this one is finally real’. Indeed, in the years leading up to the release of this image, members of the EHTC had themselves used such visual representations to communicate black holes. In the first part of this paper, I focus on the ways in which readers of Scientific American were encouraged to interpret visual representations of the surroundings of a black hole before the release of the EHTC image. Members of the EHTC often used visualisations from simulations from their research in their communication to nonspecialists. Rather than isolated visual cultures for research and science communication, there were exchanges in a period when researchers learned how to produce images of black holes, while also communicating to audiences how to read potential images. The release of the black hole image cleared front pages around the world, became the topic of discussion on social media, and was soon used in a variety of memes, some of which compared various types of visual representations to the EHTC image. In the second part of the paper, I present the reception of the image with an emphasis on how audiences thought of it in relation to other types of visual representations, and how members of the EHTC felt about this reception.

Room 6: **S46 - Material culture in the positioning of national science in Ibero-America: natural history museums, scientific cabinets and educational institutions - 1**

Conveners: **Carolina Valenzuela Matus** (Autonomous University of Chile, Chile), **María Gabriela Mayoni** (University of Buenos Aires, Argentina)

The proposal of this Symposium is focused on the material and visual culture of science and its role in the scientific positioning of the Ibero-American countries. The study period includes the latest decades of the XIX century and the first half of the XX century. The symposium is divided in two sessions: in session 1, the main objective will reflect about the collaborative scientific networks whom made possible the development of Museums and Science in Ibero-America; in session 2, topics related to

scientific learning and material and visual culture will be discussed from the perspective of cabinets and scientific learning at schools and the different theories that sustained the learning science process. In both sessions we seek to highlight the active participation of local actors in global science (K. Raj 2007, C. Sanhueza 2008). By doing so, we consider the importance to build a history from a scientific culture around the objects, institutions and collections (Jardin, Secord and Spary 1996; Secord, 2004) and the relevance of the circulation of objects of scientific interest between Europe and the Americas (Köhl, Podgorny y Gänger 2014). The collaborative view in the Ibero American space is essential to understand the developing of science and scientific learning which is connected with common proposals to teach sciences during the end of XIX century and the first half of XX centuries. On the other hand, we hope to strengthen a regional researcher network about the studies of history of Science and its projection to different topics like the productions, circulation and exchange of collections, artifacts and knowledge around cabinets, natural history museums, educative and scientific institutions in Latin America and the Iberian Peninsula.

Chair: **María Gabriela Mayoni** (University of Buenos Aires, Argentina)

1 - **Carolina Valenzuela Matus Autonomous University of Chile, Chile**)
Scientific culture in Chile and Latin America. Tendencies and perspectives (XIX-XX centuries)

Nowadays, we can look Latin America as an active participant in the global scientific knowledge thanks to the advancement of the History of Science. This discipline proposed wider focus considering diverse themes like the culture of natural history around the objects, institutions, collections and scientific exchange, promoting a global history beyond the traditional differences between center and periphery, where the Metropolis located in western country owned the privilege of controlling and diffusing knowledge. In this context, we look for a deep reflection about the role of Chile and Spanish America in the scientific culture during XIX and XX century. Through different aspects like scientific explorations, natural histories, collections in cabinets and museums, and the relation with natives, we try to position the role of the Spanish American countries in the production and diffusion in scientific knowledge during XIX and XX centuries.

2 - Maria de Fátima Nunes (University of Évora, Portugal)
The XII International Congress of Zoology - Lisbon, 1935 - Approaches to Visual and Scientific Culture

The new agenda of History of Science covers new historical sources, new methodologies and new approaches to the national / international narratives focused on scientific culture, as in visual and material culture. The recent mainstream literature on History of Science and Scientific Museology uses new archives and new historical sources in order to get new approaches: see e.g. Maria Paula Diogo and Dirk van Laak, Europeans Globalizing: Mapping, Exploiting, Exchanging, Nova Iorque, Ed. Plagrave Macmillan, 2016; or the Caribieen network HOSLAC. It's possible to develop a biography of material and visual objects, e.g. the Congress «souvenirs» offered to the participants, the exhibitions inside the Congress, the scientific tours and documental guides, or even the artistic caricatures on the most important keynote speakers. All these examples of visual and scientific culture can be found at the XII International Congress of Zoology, 1935. Held in Lisbon, this congress was attended by three hundred and six participants / communicants from Europe, Asia (especially Japan), America (North and South), and African colonies, beyond the representatives of scientific institutions from around the world who attended the week of the International Congress of Zoology. The event mobilized the high spheres of the Portuguese State that reproduced the reutilization of the power of science – political and nationalist power - ideological projection and forms of cultural diplomacy translated into material objects or organized events. Let us remember that since the 19th century, Europe and the New World have participated in these ritualized and mobile scientific parliaments. Based on the archival resources of the

Lisbon of the National Natural History of Science Museum, compared with other sources, we propose to analyse the material, artistic caricatures, and other visual supports of the International Zoology in order to have a global overlook on the thematic Oceans inside the Zoological Congress. We know how important the Oceans agenda was to the two Iberian States between the World Wars – historical memory, political and ideological frameworks as science policy to build national identities based on the importance of the Seas and Early Modern Discoveries.

3- **Francisco Garrido** (National Museum of Natural History, Chile)
Museum falsifications and the debate of Precolumbian writing in the ancient Andes

Museum falsifications have been an important topic in the construction of archaeological knowledge and narratives about the past. They can provide useful information about intellectual debates, the paradigms that they might support or challenge, and the fallibility of experts who certify and interpret the artifacts. This presentation discusses the case of a set of pottery with painted glyphs that were sold to the National Natural History Museum of Chile, which sparked an important debate about the existence of writing in the Precolumbian Andes. In 1929, a couple of antiquarians offered this set of pottery to Richard Latcham, the museum director, which they claimed came from Ica in Peru and belonged to a pre-Nazca period. Fascinated by this story, Latcham decided to exchange them for a generous collection of ancient silverware from the museum collection, a deal that the antiquarians happily accepted. In between 1929 to 1934, he published several articles based on the analysis of these pots, aiming to prove his discovery of ideographic writing in Precolumbian pottery. Simultaneously, he tried to establish contact with other archaeologists abroad in order to promote and validate his theory. However, Latcham's efforts to achieve international recognition were not successful, which discouraged him from continuing his pursuit. During the 1950s, years after Latcham's death, when the infamous Ica pottery collection was identified as a fake, the museum chose not to publicly dismiss their authenticity, and preferred to preserve Latcham's reputation and legacy instead. Given the likelihood that Latcham eventually realized that the artifacts were falsified, this case demonstrates how the reputation of persons and institutions can influence the construction of scientific knowledge and even contributing to the persistence of unsustainable paradigms.

4 - **Víctor Guijarro** (University Rey Juan Carlos, Spain), commentator

Room 7: S79 - Secretaries of Knowledge: Scribal Helpers and Social Visibility in the Worlds of Scholarship, sixteenth-nineteenth centuries

Conveners: **Francesca Antonelli** (University of Bologna), **José Beltrán** (Centre Alexandre-Koyré, France)

In sharp contrast to the image of the "great men of science," intellectual work was an overwhelmingly collective enterprise, as the studies of Steven Shapin have made clear. Most recently, Ann Blair's research on amanuenses has demonstrated that this was particularly true for the world of record making and keeping: for carrying out not only perfunctory work, but also thoughtful activities such as notetaking, archiving, drawing, writing, and even reading, savants sought the assistance of helpers whose labor tended to vanish both in their contemporaries' eyes and from the historical sources. Only in rare cases did scholarly scribes become visible—and these often manifest exceptional circumstances (controversies, blunders, men and women who achieved intellectual careers of their own, etc.). From the sixteenth to the nineteenth centuries, scholarly scribes reveal both the social and gender unequal structures of the time and a hard-dying split between mechanical and liberal work— but also the limits of historians' work to account for social practices in the making of knowledge. This symposium aims at

addressing the slippery reality of scribal labor through specific cases studies. We would like to focus on fields of knowledge where compilation through paperwork was of the essence, from erudition and antiquarianism to natural history and natural philosophy. In doing so, we hope not only to account for a phenomenon that has left few historical traces, but also to interrogate an essential tension that runs through the history of early modern knowledge, and echoes the fetishism of the author's hand: that between the emerging figure of the savant as a reclusive, masculine genius and the reality of collaborative scholarly work.

Chair: **José Beltrán** (Centre Alexandre-Koyré, France)

1 - **Paola Molino (University of Padua, Italy**), *The Power of a Mistake: Library Scribes, with Too Much Ink and Never Enough Wood*

Who were the library scribes in late Renaissance Europe? Were they men or women, young or old, did they live in the library or could go home in the evening? What kind of skills were they expected to have? But even more important: what has been the impact of their mistakes in the history of scholarship? If we believe what the Imperial librarian of Vienna Peter Lambeck wrote in 1665 the mistake of an amanuensis could let an author, or a book disappear for the time to be or one other be created out of a misspell. In my presentation, I will not only present a set of these "mistakes" but will also try to investigate the reasons why some mistakes happened, such as the lack of wood to warm up the rooms, the noise coming from the streets. I will introduce a selected group of library helpers, active in Central Europe, between roughly 1570 and 1650, and thanks to the letters that they have written to the librarians and to their relatives, and also thanks to the evaluation of their work by future scholars, I will, first, spatialize and contextualize their contribution, dwelling upon the intellectual and physical space they occupied in a library and, second, I will present the various duties they had, from cleaning the shelves of the library until reframing titles and writing subject catalogues, in fact very similar to encyclopaedias.

2 - **Hülya Çelik & Chiara Petrolini** (University of Vienna, Austria)
Court librarian Sebastian Tengnagel's "Oriental" Copyists and Their Role in Fostering Knowledge of the Orient in the Seventeenth century

Sebastian Tengnagel, the imperial librarian in Vienna (1608–1636) and a scholar of Arabic, Turkish and Persian, was one of the leading figures of the "Republic of Arabic Letters". His many interests included history, poetry, cosmology and his correspondents ranged from giants of philology like Casaubon, Gruter and Erpenius to unknown, mist-shrouded figures from a shifting ecosystem: missionaries, adventurers, interpreters, slaves and prisoners of war, from the borders of the Ottoman Empire and the shores of the Mediterranean. These were the people who conveyed information, who sold or copied the texts that would then be studied in the cities of Europe. It was thanks to them, therefore, that a more precise knowledge of the Near East and of Islam was formed, which not only fed into the extraordinary intellectual endeavours of the time but in Europe served more generally "to shake things up, to provoke, to shame, to galvanise", as Noel Malcolm has recently written. These people often belonged to a marginalised, almost invisible humanity: we know of at least one captive scribe, Ibrahim Dervish, and a second scribe, named ash-Shuwaykh ʿAli ad-Daqqaq. In our paper we use letters, manuscripts and notebooks to raise and answer the following questions: How did Tengnagel work together with the (captive) scribes he hired? How did he communicate with them? And how can we describe a kind of daily routine? Two of Tengnagel's notebooks in particular, which contain at least three different Arabic handwritings (one being Tengnagel's), show traces of collaborative work and mutual support. What was the role of these "hidden helpers" in the making of knowledge about the Orient between 1600 and 1636?

3 - **José Beltrán** (Centre Alexandre-Koyré, France)

Secretaries of Nature: Scribes, Scholars, and the Archive of Nature in Eighteenth-Century Paris

The history of natural history in eighteenth-century France has been portrayed, more often than not, as that of a glorious succession of great men. From Buffon to Cuvier, such a history appeared as a string of some sort of talented mongrels, halfway between hermits and a men-about-town; hailing from the upper reaches of French society, and able to thrust forward their fields of knowledge by the sheer force of their lonesome intellects. A history of collective work and largely unknown individuals seethes under the surface of this narrative. During the eighteenth century, natural history largely came down to paper accumulation on a large scale, the amassing of sweeping archives of nature in the form of manuscripts artefacts such as inventories and catalogs, indexes, collections of drawings, and herbaria. In this ambitious enterprise, naturalists largely relied on a large range of collaborators, from slaves in the colonies to young apprentices, from servants to family members. Evidence is scant for these crucial, yet largely unremarked secretaries of nature. Some of them were virtually erased from the historical record, as the unknown slave who assisted naturalist Charles Plumier in his expeditions through the Antilles in 1680s. Few others went on having scholarly careers on their own, as Sébastien Vaillant in the early eighteenth century. And others became known due to exceptional circumstances, as Jean Barret, who accompanied Philibert Commerson to the South Seas in the 1760s. In this presentation, I would like to look at several cases of scribal collaboration in natural history around the Paris Jardin du roi, later the Muséum d'histoire naturelle. Several questions will guide my exploration. Who were these secretaries of nature? What were their roles, and how was their work perceived and portrayed at the time? How was the reality of these collective scribal work relate to the emerging persona of the naturalist as an auctorial figure?

4 - **Francesca Antonelli** (University of Bologna, Italy)

A Visible Assistant? Marie-Anne Paulze-Lavoisier (1758-1836) as a Secrétaire

In an insightful article on the moral œconomy of seventeenth-century laboratories, published in 1989, Steven Shapin raised some crucial questions on the reasons why the work of technicians was often made invisible within scientific circles of the time. Since then, an increasing number of studies have been devoted to various kinds of assistants who never took credit for their contribution to knowledge production in early-modern era. In this paper I will try to approach this topic from a slightly different angle and I will explore, in particular, how eighteenth-century representations of gender differences influenced the social visibility of historical actors. I will focus on the case of Marie-Anne Paulze-Lavoisier (1758-1836), a woman of the French haute bourgeoisie who, for more than twenty years, worked as a secrétaire for her husband in a domestic laboratory. As a first step, I will analyse some of the scribal practices in which she engaged and which cover a significant part of Antoine-Laurent Lavoisier's unpublished Registres de laboratoire. I will then examine how these practices were presented to the public, through the means of domestic sociability, spectacles, and public or semi-public experiments. As I will show, on these occasions PaulzeLavoisier's abilities as a secrétaire could easily be admired and commented on by the audience. But what were the cultural meanings of these public displays? And to what extent they challenged eighteenth-century gender norms? I will thus propose some tentative answers to these questions, basing on a set of textual and visual sources.

Room 8: **S19 - Sensory and Material Economies in early Fossil Capitalism**

Convener: **Simon Schaffer** (University of Cambridge, UK)

Much recent attention has been devoted to the decades around 1800 as the moment when human agency achieved the scale and intensity of a geological agent of environmental change. The argument has focused on the construction of a system of fossil capital through large-scale steam-driven industrial production and massive rise in carbon fuel consumption (Bonneuil & Fressoz 2013). Textile trades have hitherto been principal concerns, where separation of labour from ownership of means of production and concentration of available workforces in industrializing cities decisively aided displacement of water by steam to power manufacture (Malm 2016). The symposium complements and revises this approach with studies of social conflicts around workforce rights in land and labour alongside accounts of their uneven development in sectors such as transportation and mining from Britain to Central Europe. Labour discipline aimed at a new kind of working body, with sensibilities and skills ultimately fitted into the new fossil economy. The papers highlight what was at stake in this reorganisation, charting how resistance, exploitation and exhaustion were incorporated into an economy of powers situated in the working body. The sensory economy of the material body was therefore a field of major social conflict, not least around the very notion of economy, with its older sense of a prudently conservative system (Roberts & Werrett 2017). In the transition to fossil capital, artisans and managers developed radically antagonistic accounts of how the material and sensitive body should be understood, managed and situated within the working world.

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Chair: **Simon Schaffer** (University of Cambridge, UK)

1 - **Eoin Carter** (University of Cambridge, UK)

Political Sensation: Artisan Radicalism and Materialism in 1820s Britain

"Man is brought into the world weak and helpless [...] He is no sooner born than the idea of want is impressed upon him. The surrounding area strikes a chill upon his organs of feeling." So wrote the editors of the Newgate Monthly Magazine during their mid-1820s confinement in London's most infamous prison, on charges of blasphemy. In so doing, they were giving voice to a new radical philosophy of mind, one that fused a British empiricist tradition with eighteenth-century French materialism newly available after decades of wartime suppression. For these 'zetetic' radicals, modern science was collapsing the imagined gap between sensation and impression, unmasking both as nothing but the deterministic action of matter-in-motion. 'Mind' was nothing but the accumulation of such interactions, and human intelligence, far from being unique, differed only in degree from that found in other species. These defiantly workingclass agitators embraced their identity as "mere maggots" who, like all animal life, owed their existence not to God but to the indifferent mechanical operations of "the hotbed of change and corruption which exists on the whole surface of the earth". The biological and the political were inextricably linked in this new radical anti-hierarchy: a knowledge politics, I argue, that can only be understood as the production of thinkers at the bottom end of the great chain of social being.

2 - **Patrick Anthony** (Vanderbilt University, USA)

Oeconomizing Matter and Mind: Mining and the "Psychological Policy" behind Alexander von Humboldt's Sustainability

In recent years, both scholarly and popular writers have found in Alexander von Humboldt's holistic scientific enterprise the seeds of modern environmentalism. But what may appear in the Prussian savant's writings as a "proto-ecology" can, I argue, be reappraised under the rubric of "Oeconomy," an early modern conception of domestic thrift and balance extended to nature as to the body politic. This talk relocates Humboldt's ecological sensibilities in Central European mining, where he served as an official in the 1790s, to explore the politics of social order embedded within sustainability's early history as a set of industrial practices. I focus specifically on the "Free Mining School" that Humboldt established in 1794 for the children of common miners in Prussian Franconia. A microcosm of broader trends, the School illustrates how the language with which state officials understood resource use was the same language with which they administered life and labour in the mine. Its curricula were designed to curb the "Raubbau," or rash over-exploitation of mineral resources, carried out by investors and their self-appointed foremen. Humboldt and his ilk thus set out on a civilising mission: their so-called "psychological policy" was to create a new generation of foremen, agents of sustainability answerable to state administrators alone. Indeed, Humboldt hoped to imbue the sensory experience of underground labour with an oeconomizing ethos. Blasting, boring, masonry, and timber framing were to embody "moderation," "regularity," "rationality," and "the miner's sense of honour"—a lexicon that registered a polemic against the "ignorance" of the investors and the "superstition" of the miners. This study thus extends recent work by Lissa Roberts, Joppe van Driel, and Simon Werrett on "Oeconomy" to environmental questions, showing how eighteenth-century actors understood material concerns about resource exploitation chiefly as a set of moral concerns about social order.

3 - **Jenny Bulstrode** (University of Cambridge, UK)

The Sensation of Surplus Extraction: Fossil-fatigue and the Naturalisation of Capital in the Industrial Origins of Climate Change

In the early decades of the nineteenth century Cornish mine surveys provided crucial observations and techniques for international efforts to establish the earth's central heat. Yet the credibility of such observations was widely challenged as unable to distinguish between heat that was native to the earth, and that which was the waste output of human labour. The debate saw claims for the peculiarly dulled senses and radiant heat of miner's bodies pitched against arguments that the earth itself was a heat engine. This contest within subterranean sciences of mining, minerals, and abstract mathematics, surfaced in the late 1810s through 1830s. In the same years the same principles at stake in the deep heat debate were deployed as resources for the reform of the science of work above ground in Britain. Reformed work was to be distinguished from the physical effects of labour by reconceiving bodily fatigue as a function of temperature, registered by the thermometer rather than reported from experience. Meanwhile time discipline itself was, for the first time, systematically calibrated against temperature, as a measure of the material effects of use on the components of the chronometric body. In this way, at a critical moment in the development of modern physics in Britain, the culturation of the earth as heat engine and the naturalisation of steam power specific and fundamental to the Cornish mine economy was extended above ground. As the factories filled with steam, the fatigue-wasted bodies of workers were dosed into laudanum fevers, and air and experience got hotter. This paper is concerned with the moment work became a function of heat, the naturalisation of this lived and reported experience as necessary and inevitable, and what the mine gave to the extension of fossil-fuel capital in the fevered birth of anthropogenic crisis.

4 - **Eoin Phillips** (Ramon Llull University Barcelona, Spain)

Inland Empire: Canals, Waterways and Oceanic Labour in the Industrial Revolution

This paper aims to explore the changing and ambiguous responses to the role and value of canal and river workers who were central to the functioning of Britain's navigable waterways in the late eighteenth century. Histories of the transition to the carbon economy in Britain have not taken as seriously as they might the importance of the role of inland navigation in defining attitudes towards the improvement of trade and manufacture, population control and strategies to discipline skilled and unskilled workforces and, therefore, have not paid sufficient attention to the construction of the idealised river worker in this period. Advocates of the expansion of inland navigation projects – significantly engineers, astronomers and East India Company officers - often drew upon the experience of work and surveillance of labour in the British colonies to inform the designs and arguments for undertaking such large-scale projects. Central to the arguments of these figures was that if inland navigation was made more like the British system of long-distance oceanic navigation and colonial production, then the solution to wider-felt domestic problems of the period concerning high unemployment, 'unmanageable' workforces, and unstable manufacture would be found. Crucially, this paper will attempt to show that such views rested on claims of the pre-existing skill and habits of the people who could be relied upon to move goods securely and reliably along rivers: the boat and bargemen. Such workers, became important, therefore, in redefining what a trusted skilled worker might behave like at the very moment when advocates of canal building (and enclosure more generally) mobilised arguments of the general ill-discipline and unmanageability of labour. The body of the worker on inland waterways, became then, a contested site in which broader debates around industrialisation, the management of empire and the capabilities of labour were played out.

Room 9: **S84 - Visual and Material Cultures in the Mathematics of the Ancient World - 1**

Conveners: **Karine Chemla** (CNRS / University of Paris, France), **Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)

This symposium draws on the rich traditions of research that have taken shape in the last decades on material practices, diagrammatic practices and practices of diagrammatization in the mathematical writings of the ancient world. It aims at bringing into conversation the various threads of research that have been developed in these directions, as well as at allowing researchers working on various geographical parts of the planet to discuss with one another. Diagrammatic and material practices will be considered broadly. In a first part of the symposium, we will deal with material practices of quantification and computation and the types of visualization that actors have shaped in this respect. A second part will be devoted to the diagrammatical features of texts (the use of lines, columns, tables and other specific layouts) and the ways in which diagrams were inserted into texts, addressing the issues of what actors did with these various dispositifs and how observers should interpret them. In a third part, we will turn to the nature and diversity of geometrical diagrams in the ancient world, raising new issues about their specific content, their material production, and the reasons that might account for their specific outlook. Finally, the fourth part of the symposium will focus on how actors put various kinds of diagrams into play in different contexts and how they expressed or developed reasoning using these diagrams.

Chair: **Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)

1 - **Zhu Yiwen** (Sun Yat-sen University, China)

Visual Aspects of Mathematical Operations Carried Out With Counting Rods

As we know, counting rods were the main mathematical instrument in ancient China. Almost all procedures written down in mathematical texts, such as The Nine Chapters on Mathematical Procedures (Jiuzhang suanshu 九章算術), were carried out with counting rods. The main sources we have relied on to recover the mathematical operations of counting rods are two documents: Mathematical Procedures by Master Sun (Sunzi suanjing 孫子算經) completed in ca. 4th to 5th centuries and Mathematical Book in Nine Chapters (Shushu jiuzhang 數書九章) completed by Qin Jiushao (秦九韶, 1208-1261) in 1247. Based on a new seventeenth century handwritten copy of the latter source, I am going to further analyze the operations of counting rods from the visual aspects, and to reveal the key role of this instrument in the mathematical practice in ancient China. Moreover, I will compare the operations of counting rods with those of counting diagrams in the Mathematical Book in Nine Chapters, and those of abacus in the later Ming dynasty (1368-1644). From this perspective, I am going to argue we can understand the history of Chinese mathematics in a new way.

2 - **Christine Proust** (CNRS / University of Paris, France)

Semantics of layouts and alignments. The case of mathematical cuneiform texts

Lists, tables or informal vertical alignments are omnipresent in mathematical cuneiform texts. What is the mathematical meaning of such alignments? What do they tell us about mathematical reasoning or calculation practices? How did ancient scribes work with lists of numbers? Such questions will be addressed to some mathematical cuneiform texts dated to different periods (3rd, 2nd and 1st millenia BCE).

3- **Guillaume Loizelet** (University of Tolouse, France)

Diagrams as computational tools?

In his Treatise on the Distances and Sizes of the Celestial Bodies, when he deals with the determination of the diameter of planets, Kūshyār ibn Labbān (circa 1025) refers to a diagram [(1) p. 88] of which no physical interpretation seems to apply, as the commentators pointed out : "the geometrical figure is confusing because DE does not represent a celestial body at distance AE" [(1) p. 99]. Given that Kūshyār explicitly writes his treatise for people who are not familiar with the mathematical tools of Ptolemy's Almagest, I will examine the possibility that this diagram could have been proposed by Kūshyār as a visual help for computations like Rule of Three. As a matter of comparison, I will eventually produce physically loaded diagrams from AlBīrūnī's Al-Qānūn al-Mas`ūdīX.6 (circa 1030) dealing with the same topic [(2) p. 1312].

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4 - **Zhou Xiaohan** (Chinese Academy of Sciences, China)

A comparative study on the representations of abacus as visual aids appearing in mathematical writings of the 16th century

The representation of a layout with dots which modern historians clearly recognized as that of an abacus firstly appeared in a painting completed at the beginning of the 14th century. However, the extant earliest mathematical writings including representations of abacus were completed centuries later. They are Mathematical Methods Using Beads in Abacus (1573 C.E.), Thoroughfare of Mathematics (1578 C.E.) and The Guide to Mathematical Methods (1604 C.E.). Other historical documents and antiques support the thesis that by the end of the 16th century, practitioners of a certain milieu used abacus as their main

calculation device, even though their layouts show small differences. When images of the material calculation tool were included in mathematical writings, the representations of the abacus became one of the key visual elements of the writings. The mathematical practices using the material abacus, the visual representations of the abacus, and the verbal texts (usually in the form of pithy formulas) together construct a scientific culture in the context of which we can interpret the ancient mathematical writings. Alexei Volkov (2018) and Chen Yifu (2013) had researched on these earliest representations of abacus in mathematical writings. In this paper, on the basis of my comparative study on the visual representations in the writings mentioned before, I would like to inquire into the following questions. What are the relationships between the representations of abacus and the verbal texts placed around them? Did these representations affect in turn the layout of placing texts, and further, the readers' way of reading the texts? How did these arrangements of visual aids facilitate the readers to gain the reason and the practice of using an abacus? At last, what are the similarities of and differences between the representations of abacus in the three writings in terms of the aspects I inquired before? And what could these similarities and differences tell us about the writings?

5 - **Eleonora Sammarchi** (ETH Zurich, Switzerland)
Ordinary language and the construction of tables in the Arabic arithmetical-algebraic tradition

Between the 10th and the 13th century, a group of mathematicians of the eastern part of the Arab muslim empire chose to investigate the interaction between arithmetic and algebra, and began to create a coherent and exhaustive system of rules for calculating with algebraic entities, as well as with the arithmetical ones. The algebraic treatises of this tradition are written in ordinary language. Moreover, in these texts symbols are not yet conceived, diagrams have a marginal role, and numbers are most of the time written in full letters. The use of such a rhetorical style deeply influences these authors' way of understanding their mathematical objects. In these texts we can sometimes find tables. These tables are constructed in order to illustrate a procedure for some specific computations, such as the multiplication of ranks, the division of two algebraic expressions, or the extraction of the square root. Does the use of such tables modify the mathematical features of the objects involved in the computation? And if so, how does this shift take place? In this talk, we will uncover evidence to answer to this sort of questions. More precisely, we will consider some examples taken from the book al-Bāhir fī'l-jabr (The Marvellous in algebra), written by the arithmetician-algebraist al-Samaw'al (d. 1175 ca.).

Room 10: S58 - Visual, Material and Political Cultures of Zoological Gardens - 3

Conveners: **Oliver Hochadel** (Spanish National Research Council - CSIC, Spain), **Miquel Carandell-Baruzzi** (Autonomous University of Barcelona, Spain)

Chair: **Juliana Adelman** (Dublin City University, Ireland)

1 - **Ilja Nieuwland** (Vrije University Amsterdam, Netherlands)
"A primeval world, conjured into the present". Carl Hagenbeck's Urzeitpark in Stellingen

In the early 1900s, zoological gardens throughout Europe began to incorporate images from extinct life to link it to extant nature. The most prominent of those was probably Carl Hagenbeck's Urzeitpark, which became part of his revolutionary zoo in Stellingen near Hamburg shortly after its opening, in 1909. Until well into the 1910s this attraction garnered publicity all over the world, and Hagenbeck's example was followed up in various other locations. 10 The discovery of multiple sensational dinosaurs, and the subsequent proliferation of their remains throughout natural history museums both in America and Europe, created a popular hunger for more information about these animals. The influence of this

"dinomania" on public culture was profound and did not escape zoo authorities who were increasingly engaged in competition with natural history museums that now seemed to hold a unique trump card. At roughly the same time, scientists started to adapt their relationship to zoological gardens, partly because of the changes in orientation of the latter, but also because their idea about the relationship between extinct and extant life started to shift. Rather than focus on systematics and anatomy, it became common for scholars to look at these animals in the light of ecology and development. This made it all the more valuable to explicitly show existing life, and existing ecosystems, in relationship to ancient ones. This is clearly shown both in the reactions to Hagenbeck's park and in subsequent, similar efforts that were undertaken under more stringent scientific supervision. In my contribution, I shall contextualize Hagenbeck's park within the context of both the public interest in past life and changing scientific ideas about the relation of past worlds to present nature.

2 - **Shai Ben-Ami** (The Hebrew University in Jerusalem, Israel)

Zoos and animal collections in Israel: from Biblical times to the Biblical Zoo

Around the world, zoos have developed in most urban spaces, and they serve as a unique and genuine reflection of the local culture. This study focuses on the national and civic role of zoos in Mandatory Palestine during the British mandate and the newly formed Israeli state. The study qualitatively examines and characterizes the processes which led to the establishment of city zoos and its founders. It aims to understand the role of key figures in the urban sphere, including capital, national and municipal politics, colonial power, immigration and immigrants, regulations, and networks. The analysis based on historical documents and publications through national, municipal and personal archives and manuscripts. Findings show that zoos have an essential role in the development of urban and national spaces and are a way to fulfil national and urban aspirations. Zoos were part of wider Zionist nation-building, as a reflection of the national and urban culture as well as the identity that is both a reflection of memories from Europe and the unique creation of new cities and a state. The founders of the various zoos saw themselves as active citizens who offer a great opportunity to the cities in which they live, by creating an important symbolic urban space – the zoo. These perspectives 11 are evidence of the structure of power and politics in both the urban and national elites in Israel and the process of creating a new cultural institution.

3 - **Hugo Domínguez Razo** (National Autonomous University of Mexico)

Actualizations of the Moctezuma's Zoo's idea in Chapultepec Zoo's architectures

The Moctezuma's Zoo's (MZ) idea is an anachronism of the XX century that actualizes the animal and human collections of Moctezuma Xocoyotzin, ruler of Mexico Tenochtitlan, which were reported by Hernán Cortés and Fray Bernardino de Sahugún since the XVI century. This anachronism allows to identify the historical development of the post-revolutionary Mexico City's zoo gardens system, because the different ways to recall the MZ shows its power by creating or renovating architectures and justifying rhetoric for the public exhibition of wildlife in the city. This case can be traced out in the almost centenary history of the Chapultepec Zoo Alfonso L. Herrera (CZ), opened in 1923, led by an evolutionary model with a design that evoked the collections of water birds –from salted and fresh water– of MZ's, leaving in oblivion the nineteenth century zoos of the positivist regime before the Mexican Revolution. The professionalization of the CZ was strengthened by the patronage of Ernesto P. Uruchurtu –Mexico City's ruler (1952-1966)–, whom inspired by the MZ's idea, made deals with the German Herman Ruhe House to acquire animals from all latitudes, with the consequent new facilities of the CZ and the administrative incorporation of the Swiss zootechnician Jean Schoch, among his achievements, he collaborated with the veterinary medic Juan Téllez Girón in the captivity reproduction of Tohui in 1982, the first panda (Ailuropoda melanoleuca) born outside of China. By the end of the XX century the project "Ecologic Rescue of the Chapultepec Zoo" (1992-1994) planned the remodeling of CZ with the objectives of recreation, education, research and conservation of wild fauna with a bioclimatic zones museography

–in force nowadays–, among which, stands out the immersive passage of the "Moctezuma aviary" where visitors can walk between parrots, swans, ducks and pelicans as if Mesoamerican rulers.

4 - **Mitchell G. Ash** (University of Vienna, Austria), commentator

Room 11: S28 -The nature of scientific discovery in the chemical sciences - 1

Conveners: **Brigitte Van Tiggelen** (Mémosciences, Belgium), **Annette Lykknes** (Norwegian University of Science and Technology, Norway)

History of science is full of examples of scientific discoveries, priority disputes related to such discoveries, and discussions on what aspects of a discovery that qualify for credit. In textbooks and popular accounts, however, discoveries are often presented as clear-cut and a point for sudden change of thought (or even as decisive for paradigm shifts), while insight into the context in which the discovery took place, the time involved in developing new knowledge, and the contributions by a range of actors of different rank, is often omitted. This tension appeared especially clearly in the course of the International Year of the Periodic Table (IYPT) in 2019: popular accounts often celebrated the Russian chemist Dmitri Mendeleev as the sole discoverer of the periodic system, and presented his discovery as an eureka moment, while historians of science insisted on the multifaceted and collaborative character of the work related to the development of the periodic system and discoveries of elements. This symposium considers nature of scientific discovery in the chemical sciences and technology, broadly construed, and considers the discovery, including its narrative, as a process. The case-studies presented allow to problematize and explore the unfolding of discoveries, how they are reported and what stage is considered as "the" discovery as well as how predictions and assumptions on what could exist shape these processes in scientific and historical practice. The papers in the first session focus on the context, and how discoveries are assigned and credited, while the second session investigates how anticipation shapes discoveries and their historical narratives by actors, historians and philosophers.

Chair: **Brigitte Van Tiggelen** (Mémosciences, Belgium)

1 - **Charlotte A. Abney Salomon** (Science History Institute, USA)
Element Discovery in Eighteenth-Century Sweden

Swedish mineralogists of the eighteenth and early nineteenth centuries are routinely credited with the discovery of up to a dozen elements. Historians have only recently begun to enumerate the factors that allowed for this rate of chemical discovery wildly disproportionate to the kingdom's population or political power, in particular the unique institutional structures and industrial focus of the eighteenth-century Swedish chemical community. In this talk I look specifically at the collaborative nature of research in this community. Textbook tables customarily assign credit for each of these findings to a single researcher. On closer inspection, however, it is clear that the term "discovery" is largely arbitrarily used to describe either the first prediction, identification, isolation, or synthesis of a new substance that either was recognized as, or was later recognized as containing, one of the elements on the current periodic table. In this talk I demonstrate that while each of these phases of the discovery process was typically completed by a different researcher, the unique features of Swedish mineralogical research in the eighteenth century enabled and encouraged the community's own members to continue or assist with the projects of their predecessors and contemporaries. Thus, credit for each discovery remained within the community regardless of the researcher and project phase to which it was assigned.

2 - **Pierandrea Lo Nostro & Duccio Tatini** (University of Florence, Italy)
Hugo Schiff and his bases, a story begun in the XIX century

Hugo Josef Schiff discovered his bases by reacting aniline (the simplest aromatic amine) with an aldehyde while working in Pisa and later in Florence (Tidwell). The experiments began in 1863 and the first paper was published in 1864 (Schiff). The title of this first publication "Eine neue Reihe organischer Basen" (A new series of organic bases) suggests that he was already well aware of his discovery and of the basic nature of these compounds. In the following decades Schiff continued his work with an intense activity and the discovery of new compounds. Furthermore, he developed the so-called fuchsin Schiff test, that allows the detection of an aldehyde through the formation of an intense magenta color, which is still used for various biological tissue staining methods (Schreiner, Puchtler). The synthesis and correct structure assignment of the first bases made by Schiff in his 1864 article are definitely a milestone at the beginning of modern age of chemistry, and paved the way to a plethora of different chemicals, including dyes, antibiotics and coordination ligands for metal ions. This contribution will outline different historical aspects related to the discovery of Schiff bases: the originality, timing and relevance to the advancement of chemistry, the recognition he received from his contemporary colleagues, and how this research was part of the chemical research carried out in Europe at that time. This presentation will take advantage also of the material conserved in the chemistry section of the University Museum of Natural History in Florence, with a collection of books, papers, instruments and chemicals synthesized by Schiff.

References:
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3 - **Annette Lykknes** (Norwegian University of Science and Technology, Norway)
The chemistry of the imponderable? Radium, polonium and the discovery of elements in the era of radioactivity

In the 19th century, atomic weight came to be considered the crucial feature that distinguished one chemical element from another. When, in the 1860s and onwards, elements were detected by means of spectroscopy or other physical methods, the next step would always be to separate sufficient amounts of the elements to determine their atomic weights to fully establish the discovery of the new elements. When in 1898, Marie and Pierre Curie announced the discovery of polonium and radium it was based on their characteristic radioactivity. Only four years later, sufficient amounts of radium were produced and its atomic weight determined, and it took much longer for polonium. In 1898 thus, the methods used to detect both elements relied on the "invisible" and not on the material such as weight -which is why Marie Curie, in her Nobel speech 13 years later, referred to this kind of chemistry as "the chemistry of the imponderable". Indeed, radioactive elements were first identified and characterized by other characteristics, such as the type of radiation or the half-life, and these characteristics provided them with a status of existence before full determination of atomic weight. The latter however remained key for acknowledgment by the community, be it national or international commissions such as IUPAC's. Obviously, what stage in the discovery process that constituted "the discovery" is not clear-cut. In this paper, I will discuss the specific challenges in "discovering" elements associated with radioactivity research in the early 20th century and whether this new means of interacting with matter challenged the traditional condition of acceptance for discovery.

4 - **Soňa Štrbáňová** (Czech Academy of Sciences, Czech Republic)
Early discovery of sexuality in yeast

Discovery of mating in microorganisms belongs to those crucial findings which demonstrated sexuality in microorganisms and in its consequences stimulated the rise of genetic engineering, molecular biology and molecular genetics. This breakthrough has been generally attributed to the Danish geneticist Øjvind

Winge (1886-1964) who in the 1930s investigated yeast on a genetic level. In reality, as early as in 1918, two Czech chemists and fermentation specialists from the Prague Technical University, Karel Kruis (1851-1917) and Jan Šatava (1878-1938), published a paper based on microphotographs of yeast which demonstrated an entirely new phenomenon, namely sexual mating in yeast. The discovery represented culmination of Kruis's life-long investigations of microorganisms including introduction of pioneering methods in scientific microphotography. It is noteworthy that Kruis was encouraged to turn to microphotography by his passion for art photography, which is a good example of a crossfertilisation between art and science. The paper unfolds the path to Kruis's and Šatava's discovery which led from innovations in fermentation technology, through studies in biochemistry and morphology of yeast and bacteria to the unearthing of yeast sexuality. The paper also aims to discuss the specific circumstances which have determined that this outstanding discovery remained generally unknown and unacknowledged.

Pause from 15.45 to 16.00

Tuesday 1 September, 16.00 - 18.00

Room 1: S32 - Hybrid ontologies: the circulation of visual cultures, gender, and expert communities - 1

Convener: **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)

Many materials in the history of contemporary science have circulated between the industry, the clinic and the laboratory. This session proposal aims at studying hybrid ontologies, whose histories are composed of shared styles of representations such as drawings, devices, concepts and facilities that belonged to a material culture of science and technology in which gender participates. Images and many biomedical technologies are examples of hybrid ontologies, among many others. Provided by the conceptual framework of the histories of scientific objects, this session proposal aims at focusing on the circulation of knowledge and objects between different places; between the invention setting and those where they were used, between the laboratory and the clinic, the consulting room, the pilot plant, the factory, the environment, the school room. In so doing, the history of the sciences would include those who, by adopting and using experiments, knowledge and devices, produced expertise and expert communities. Hybrid ontologies are regarded as scientific objects that belonged to a diversity of professional spaces. By historizing their shifts and travels, a collective of people and materials would be involved: women, men, medical and scientific institutions, gender as well as knowledge represented in images, materials and new dispositifs – apparatuses, procedures, methods. We offer a set of contributions that take into consideration two or more of such agents so as to provide stories of the circulation of knowledge between political geographies, professional spaces and domains of authority in the contemporary era.

Chair: **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)

1 - **Soraya de Chadarevian** (University of California Los Angeles, USA)
Intangible yet all pervasive

Strontium-90, a radioactive isotope produced by atomic fission, is not accessible to our senses yet once released into the environment its threatening effects linger for decades. Its presence in the air, soil and in organic tissues is registered through the crackling sound of Geiger counters, the blackening of photographic plates and measurement in scintillation counters. Its distribution and effects are captured in numbers, graphs and maps and in clinical pictures. Since the 1940s, these have become the object of research and politics, fear, protestation and regulation. This paper will consider how the history of this all-present yet elusive substance could be written and what it might reveal.

2 - **Ana Romero de Pablos** (Spanish National Research Council - CSIC, Spain)
Uranium ore: Materiality and meaning of a hybrid object

In 1966, 137 tons of Spanish uranium arrived at the port of New Orleans from the port of Cádiz (Spain). In my presentation I want to use this trip that involved political, industrial and business agents as well as technical capabilities, to explore the uranium ore as hybrid object -physical, technical and diplomatic. This material connected the interests of the Francoist authorities, scientists and businessmen from the electrical industry. It served Franco's regime in training researchers, to buy and import technologies, methods and experimental practices, and also to introduce ways of popularising atomic policies and ideologies from the United States. While powering nuclear reactors, uranium was a fuel that also fed new disciplinary spaces, modified landscapes and outlined new industrial and administrative cartographies. In addition to being a key piece in the Franco regime's foreign policy – it was useful for the Spanish regime to align itself with prevailing Western thought on the civil uses of nuclear energy – internally it served to effectively abandon autarchic discourses and strengthen the power of the technocrats, who used atomic energy to transform Spanish electrical production, up to then dependent on water and coal. The materiality of uranium ores changed with travel and also their meanings.

3 **- Gina Surita** (Princeton University, USA)
Mildred Cohn, metabolism and the mass spectrometer

The mass spectrometer is a multifaceted object. From its origins in the final years of the nineteenth century, to its uses in the petroleum industry, to its implementation in the Manhattan Project, the mass spectrometer underwent various changes in design and was put to a diverse set of uses. Prior to World War II, only a handful of useable mass spectrometers existed worldwide. Before they became commercially available in the 1940s, mass spectrometers were often built by their prospective user(s). Among the earliest academic users of mass spectrometers were biochemists, who sought to study intermediary metabolism using stable isotopes as tracers. In fact, the detection of stable isotopes required the use of a mass spectrometer, which provided information about isotope abundance in a given sample. (Radioisotope detection, by contrast, did not require a mass spectrometer.) The deployment of a mass spectrometer in research first required someone with the knowledge, networks, and skills necessary to build and operate it. Biophysicist Mildred Cohn was this person in two biochemical laboratories following the completion of her doctoral work with the stable isotope 18O in Harold Urey's Columbia University laboratory. This paper follows the travels and transformations of the mass spectrometer—and thus of Cohn, its builder and user—through the laboratories of Vincent du Vigneaud (Cornell University Medical College, New York City) and Carl and Gerty Cori (Washington University School of Medicine, St. Louis) in order to understand the gendered dynamics and transfers of knowledge, skill, and apparatus within 1930s and 1940s biochemistry. By tracking Cohn's attempts to construct two different mass spectrometers in two different laboratory settings, this paper argues that person and instrument were intertwined in the building of scientific career and identity, an effort that faced various roadblocks due to the fact that Mildred Cohn was a Jewish woman scientist.

4 - **Miguel A. Rego Robles** (Spanish National Research Council - CSIC Spain)
Brain's digital images in the 1970s: Inventing a hybrid technology

In 1972, in a hospital in London, a suspect brain tumor in a middle age female patient led to an exploration by the new computerized tomography (CT), a technology based on the combination of radiology and computation. The patient's head – with a water-filled rubber cap - was introduced in a scanner made EMI, the leading British firm for music records production. The device rotated itself degree by degree emitting X-Rays to the patient's head during nine hours. On the emitters opposite side there were receptors accumulating numeric information related to the amount of X-rays absorbed by the brain. Therefore, each lecture concentrated the information of a brain sectional plane. This information was processed through an algebraic algorithm in a different laboratory in London. Each value was interpreted to a different black and white tonal intensity. The resulting digital matrix obtained from this process was formalized into press paper, a cathodic rays tube and a Polaroid photography. The brain was abstracted into numeric values through the influence of an ionizing process. This source of data transited from the study object after being treated with X-rays to its final representation in an image. Unlike photography, which requires luminous stimulus reacting with silver nitrates, this kind of representation was made with the algorithmic interpretation of numeric inputs. The knowledge that led to the construction of the device circulated between the clinic, the industry and the laboratory. In the construction of CT a diversity of agents were involved, including the computer, X-ray expertise, electronic engineers, neuroradiologists from Atkinson Marley´s Hospital and EMI Company's X-ray scanner. I will analyze CT digital image production regime of what became a usual imaging technology for the neurosciences from the 1970s on.

Room 2: **S6 - Neither "Lowly," nor "Soft": How Taste Produces Knowledge, Makes Expertise, and Forms Identities**

Convener: **Ardeta Gjikola** (Columbia University, USA)

Taste has not fared well in the history of science. There are many reasons for its neglect, but two might be singled out: its depreciation as one of the lower senses for most of the pre-modern period, and its emergence as a tool for social distinction since the seventeenth century. Taste as a perceptual sense and taste as aesthetic judgment have over centuries often constituted some of the markers for delineating the epistemic space of objective knowledge, the "low" and the "soft" outer boundaries of "hard" science. Inadvertently or not, historical analyses have duplicated such stances. A number of historians of science and cultural historians have re-evaluated the place of taste in recent years, whether by examining its shifting representations and knowledge produced about it, or by identifying the conditions for such developments. Our panel builds upon this work, but proposes to put some new accents on the study of taste. Specifically, we identify cases in which gustatory or aesthetic taste played a constitutive role in knowledge-making and in the establishment of expertise. Moreover, we show that taste proved socially and culturally consequential in ways that cannot be accounted for by the usual sociological analyses. If one of our aims is to expand our understanding of forms of knowledge, expertise, and intersubjectivity, the other is to make the case that taste is a productive analytical tool, for its very ambiguities enable us to crisscross past cultural territories in yet unscripted itineraries.

Chair: **Ardeta Gjikola** (Columbia University, USA)

1 - **Laura Eliza Enriquez** (Concordia University, Canada)

Taste before Taste: Gustation as Knowledge in the Early Modern Collection

In his Critique of Judgment, the German philosopher Immanuel Kant distinguished between two meanings of taste, where the first one belongs to the sensuous realm, while the second one to the domain of rationality and knowledge. Thus, according the Kantian definition, taste denotes the faculty of aesthetic judgment. How did the polysemic concept of taste lost its original sensory connotation, and turned into a metaphor for desensitized contemplation? The aim of this paper is to explore the first literal meaning of taste, that is, taste as sensation, by looking at the gustatory experiences performed in the early modern collection as valid means to make knowledge. These experiences include: 1) the selection and display of objects with a gustatory dimension; 2) the pictorial representation of these objects, and their inclusion in the collection as celebrations of mercantile success, and objects of scientific inquiry; and 3) sensory engagement with the exhibited goods via a series of practices that comprise observation, eating and drinking, and, in certain cases, their factual tasting and consumption. What information of the world can we gain via taste? What cognitive faculties are at stake? This paper also intends to expand the classical definition of knowledge, by questioning the hegemony of scientific observation, and considering practices in other domains of human experience. Instead of restraining observation to the limits of the eye, I suggest it should be understood as a multi-sensory mode of inquiry and appreciation. Finally, this represents an attempt to reflect upon the genealogy of taste as a metaphor for aesthetic discrimination.

References:

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2 - **Alexander Wragge-Morley** (New York University, USA)

Intersubjective Experience and Medical Expertise in the 18th Century

Although scholars are increasingly aware that medics of the early 18th century were closely involved with the arts, little attention has so far been paid to the role of aesthetic judgment in medical practices and the constitution of medical expertise. In this paper, focusing on Britain from around 1700-1750, I will show that the characteristically “aesthetic” problem of finding ways to agree about supposedly subjective feelings had a far bigger role in medicine than has so far been recognized. In an intellectual and cultural setting that increasingly saw securing agreement about the meanings of sensory experience as the solution to a wide range of social problems, practitioners framed the ability to share the feelings of their patients as a core component of medical expertise. In addition, I will argue that recognizing how important it was for eighteenth-century medics and their patients to enter into one another’s feelings may lead us to new, more pluralistic understandings of medical expertise and the kinds of actors who were supposed to have it. Focusing on medical correspondence exchanged between Selina, Countess of Huntington (1707-1791) and Susan Keck (1706-1755), I will show how both women and men identified expertise by seeking out people who appeared to share their feelings of pain and suffering. This case study demonstrates the importance of embodied experience to 18th-century understandings of expertise and intersubjective agreement. The paper, therefore, will not only shed new light on the interconnections between the arts, emotions, and sciences, but also propose a new, more pluralistic framework for understanding early modern medical expertise.

3 - **Ardeta Gjikola** (Columbia University, USA)

The Judgment of a Connoisseur

What is connoisseurial authority and how is it similar to or different from scientific authority? This talk will address this question by focusing on a case study: a connoisseur’s aesthetic judgment of the Parthenon sculptures in early 19thcentury London. The first Parthenon sculptures arrived in London in

1802. Initial remarks about them were few, far between, and inconsequential. It was a different matter when in 1806 Richard Payne Knight pronounced a judgment on them. A wealthy connoisseur and a member of the Society of Dilettanti, Knight judged the sculptures as aesthetically worthless. For Lord Elgin, who had brought them from Athens and sought to sell them to the British government, this assessment proved to be one of the greatest obstacles. To understand why, I consider connoisseurial practices and the kind of judgment they were understood to develop, and the ways in which such judgments circulated in early 19thcentury London. Rather than taking connoisseurial authority as an automatic attribute of social or institutional positions, I examine how it was produced in situations whose dynamic was shaped by lack of knowledge as much as by demonstrable competence.

4 - **Marieke M.A. Hendriksen** (Royal Netherlands Academy of Arts and Sciences, Netherlands)
Taste Identities: How a Cough Medicine Became Interwoven with National Identity

Both gustatory and cultural tastes play an important role in the formation and experience of national identities. Drop (a pharmaceutical preparation based on liquorice root) was first mentioned as a cough medicine in a Dutch apothecary handbook in 1683; today drop takes up a substantial part of the candy aisle in every Dutch supermarket. The Dutch eat the greatest variety and quantity of drop in the world, and many consider it a typical Dutch delicacy. Why? How was this new pharmaceutical product tailored to and how did it alter Dutch tastes? How did it transform from a pharmaceutical preparation into popular candy? How did drop shape and become part of the collective identity of an emerging nation state? This paper explores the history of the interlinked development of (understandings of) the taste of drop through medicine and pharmacy in the Low Countries, and its influences on individual and collective bodies. Tasting included of course.

Room 3: **S30 - Vegetal inferences: A sociology of plant science**

Convener: **Ariane Dröscher** (University of Trento, Italy)

Plants and humans interact in many different ways. Recent scholarship endows agential qualities to both. Therefore, plants are vectors of knowledge that reaches far beyond the material object itself. This is not an exclusive characteristic of the epistemology of botany, yet plants, due to their broad and varied usage, are particularly suited for inquiries into the multifaceted contexts and the multidirectional in-between spaces. We encounter them as complex products of sociality and consumption: food, medicine, clothing, housing, environment, recreation, contemplation, inspiration, and many others. Non-scientific interactions have an impact on the scientific understanding of botanical research objects, whilst scientific discourses convey (consciously or unconsciously) more than strictly naturalistic types of information. Our session will address both, plants as scientific objects and plant science as carriers of a broad range of political, sociological, psychological, historical, esthetical, and symbolic meanings. The four talks will investigate the mutual interplay in four different dimensions of knowledge production and knowledge display: arrangement in collections (herbaria, xyloteques), in semipublic spaces (parks), and in literature. The focus is on the 18th and 19th centuries. The common bond regards the questions of how these forms express and/or question the social and scientific conventions of their time, which specific sets of explicit and hidden signs they adopt, and what kind of visual, verbal and sensitive messages they transport.

Chair: **Ariane Dröscher** (University of Trento, Italy)

1 - **Maura C. Flannery** (St. John's University, USA)
Making Plants into Status Symbols

One of the ways that plants communicate with us indirectly is through the contexts in which we place them. A herbarium is one such context: a collection of pressed plant specimens, each labeled with the species name and often used as a reference for identification. At Oak Spring Garden Foundation Library, there is a bound herbarium from about 1720, probably created in Verona, Italy. Curiously, its creator's name has been erased, but has been identified by one antiquarian as Carlo Sembertini, described on the title page as an apothecary. This is followed by an elaborate watercolor frontispiece and a dedication page to the physician Angelo Barberio, and laudatory poetry. The volume is in the manuscript tradition with fine calligraphy in black ink with red embellishments. The context here almost overwhelms the plants and suggests that Barbario was Sembertini's patron or being courted as his patron. It also suggests that a plant collection could be considered as a status symbol if given the proper environment: how the specimens were arranged on a page, elaborate lettering, ribbons across the stems, and a tooled-leather book cover. A reference work thus doubles as an aesthetic object, with art and botany wedded on each page. This collection harkens back to the age of manuscripts and indicates that in the 18th century natural history was considered an important area of study for the elite, and its artifacts were a way to display erudition and at the same time, status.

2 - Anna Svensson (Independent Scholar, Sweden)
"Specimens of Woods:" A natural history of the pianoforte

Tucked away in the archives of the Botanical Section of the Natural History Museum, University of Florence, is a little slip of paper with the following note:
Mrs L G Alexander
Specimens of Woods
from G H Chickering
To go to Florence, Italy.

_____
To be left at the store of F. K. Simonds
51 Federal St.
In this paper, the donation to a botanical museum in Florence of a selection of wood samples from George H Chickering of Chickering and Sons piano manufacturers in Boston, via the family of Mrs Lucia Grey Swett Alexander (wife of portrait painter Francis Alexander and mother of author and poet Francesca Alexander) provides a prism through which to explore the public role of the museum during the height of its success. Why was a member of a prominent American industry donating a selection of wood to this Italian institution, and what was the role of the artist family the Alexanders? What did it mean to donate to a botanical institution? How was the role of the wood itself perceived in the industrial production of high end pianos in the wider culture – domestic and public – during the second half of the nineteenth century? Today these woods are an unremarkable set of slabs among thousands, with nothing to tell them apart from the other specimens except for the numbers whose corresponding references in the xyloteque catalogue confirm the Alexander family's Boston connection. However, a century and a half ago, they were part of the public pedagogy of the museum. The story of their inclusion in this botanical collection is part of what we might call the nineteenth-century natural history of the pianoforte: forging a link between the natural resource (wood), the industrially produced commodity (the piano), and the refined and edifying practice of playing music.

3 - **Ariane Dröscher** (University of Trento, Italy)
Romantic gardens as spaces of knowledge

The eighteenth century was the "century of the garden". Numerous private and public gardens and parks were installed as places of leisure and consumption, of silence, private retreat and social representation. Yet these gardens were also hybrids of nature and artifice, and objects of manifold and multi-layered natural, historical, social, aesthetic, scientific, practical, and symbolic meanings. Several studies have promoted visions of gardens as implements of political, social and religious ideas, even as battlefields of international diplomacy. History of science, however, has rarely brought into focus the role of gardens as spaces of scientific knowledge. My talk will focus on romantic gardens and its influence on the Paduan botanist Giuseppe Meneghini. Whereas the French design corresponded to a concept of nature as expression of a superior and precise mathematical plan, we may think of the prevailing romantic concept of nature as that of a dynamic, organic and historical entity, composed of developing and transforming organisms. In its anti-reductionist new style it was accompanying the emergence of biology as a science defined by the basic dialectic between abstraction and singularity, the hopeful search of laws and the resigned admission of an almost endless diversity of forms and functions.

4 - **Joela Jacobs** (University of Arizona, USA)
Dangerous Entanglements: Writing Plants, or Phytopoetic Agency in the German Literary Imagination

In this talk, I propose the notion of phytopoetics, which parallels the term "zoopoetics" for animals, to describe what it means when plants take on literary, cultural, or social agency. Often thought of as passive and static, plants are not usually endowed with agential qualities, yet throughout history, art, and literature, they have been depicted as active participants in the human world. This vegetal impact has reached beyond the page or the canvas whenever the imagination surrounding plants became a socially or culturally significant factor, so for instance in the context of art nouveau imagery and writing that attributed sensual, erotic qualities to plants (Panizza, Ewers). The ensuing institutional fear of vegetal eroticism resulted in several decades of literary and curricular censorship of plant reproductive processes in Germany, ultimately prohibiting the teaching of rudimentary botany to school children, which is an example of phytopoetics, or the literary and cultural effects of plant agency. While the notion of vegetal eroticism locates a threat in the sensually charged parallels between the vegetal and the human in the context of the emergence of early sexology, the same time period also saw the beginnings of science fiction in response to the emergent Anthropocene. Some of these texts feature vegetal violence, such as trees suffocating human trespassers in their forest community instead of supplying them with air, and monstrous plant-animal hybrids that prompt everyone they touch to develop organic growths that ultimately strangle them (Döblin). These literary depictions of violent and erotic plant agency threaten the illusory sense of human superiority over nature and show that phytopoetics are at the core of some of the most central anxieties of modernity, which highlights the power of plants in sustaining the human species and affecting their imagination.

Room 4: **S67 - Media of Science**

Conveners: **Sigrid Leyssen** (Bauhaus University Weimar, Germany), **Henning Schmidgen** (Bauhaus University Weimar, Germany)

Science and media are coming together in new ways – and confront us with urgent political and social questions. In this symposium we look at how scientists in the past have used and reflected on media in their different fields. How have scientists used media in their various scientific practices? How have they reflected on their use of media, and how has this media literacy impacted their practices? Furthermore,

how are the relations between science and media changing today, when scientific best practice is being redefined with new developments in the domains of digitality, ecology, and inclusivity. 2 The focus in recent decades on material, visual and auditory cultures of science has brought an increasing number of historians of science to include the role of media in their accounts, as factors without which neither the production, nor the circulation of knowledge can be fully understood. This symposium brings together historians of science and media scholars who are studying the media of science. They explore the history of how scientists have reflected on the media they were using, ranging from philosophical toys, films, and books to neuronal media, through a variety of both natural and human sciences. The Media of Science symposium takes place in the context of the new Science Media Network, launched in Weimar in June 2019 as a platform for critical collaborations between Media Studies and History of Science. By bringing together Historians of Science and Media scholars it hopes to create a basis for broadening our understanding of the variety of ways in which media and scientific practices intersect.

1 - **Benoît Turquety** (University of Lausanne, Switzerland)
"Philosophical Toys": Science and the Invention of Media in the 19th Century

In 1827, Charles Wheatstone published a paper titled "Description of the Kaleidophone, or Phonic Kaleidoscope; a new Philosophical Toy, for the Illustration of several Interesting and Amusing Acoustical and Optical Phenomena". The notion of "philosophical toy" is exemplary of the 19th century context. Wheatstone inscribes his invention in a genealogy including the Kaleidoscope; he would go on to invent other such apparatuses, like the "Wave Machine" in the 1840s. That object would still be built and sold through the 1880s, as made notably by John Newman, "Philosophical Instrument Maker". Throughout the century, many other such toys of "experimental philosophy" – the name of Wheatstone's chair at King's College – would circulate widely within Western culture: the stereoscope – invented by Wheatstone (1838) but made commercially more efficient by David Brewster (1852), Jules Duboscq, Oliver Wendell Holmes, etc. –, the Phenakisticope or Stroboscope (1832), many variants of the Newton colour tops, etc. 4 These toys are defined as both "interesting and amusing"; they are experimental apparatuses, producing new phenomena for the scientist's reflection, for pedagogical use by the teacher, or for the curiosity of the amateur. They are also entertaining, therefore conceived to be produced and sold in great numbers. They were used in scientific contexts – by James Clerk Maxwell or Charles Cros –, but simultaneously organized the diffusion of the most recent scientific problems within general culture. They are a form of what we now call "media", joining mass production with scientific novelty. They created a specific mode of connection between the scientific community and the wider cultural concerns and debates, and drew the attention to intriguing visual and sound phenomena, thus participating in the creation of a media-oriented epistemological framework that would permeate all of the 20th century.

2 - **Sigrid Leyssen** (Bauhaus University Weimar, Germany)
How Scientists Understand Film. Filmology and Scientist's Media Theories

Filmology was the "new science of film". Just after the Second World War, a large interdisciplinary group of scientists joined efforts to create this new science. The war had demonstrated the pervasive effects of film as a propaganda tool, and these scientists recognized that film could no longer be studied just as an aesthetic phenomenon: it had to be studied as a psychological and social phenomenon as well. Filmology mobilised the methods and contributions of all existing human sciences on an international scale. Only in this way, they argued, would it be possible to broach the complex topic of the effects of cinema on man and society. The Filmology journal, the Revue international de filmologie, offers a still little 5 perused source to understand how scientists were thinking about media in the early Post-War years. Often the 'media theories' of scientists remain largely implicit. The filmology journal shows us how hundreds of scientists theorized about the medium of film. It reveals how many of them, in their different fields, had been working with film and reflected on possible uses of the medium. Others showed how they could apply their research methods to film. In this paper, I study the filmology

movement (1946 -1963) as a collection of multi- and interdisciplinary work that allows us to understand the variety of media understandings that existed among scientists during these two decades. I will also show how different media understandings of psychologists, sociologists, philosophers, anthropologists, linguists, ethnographers, mathematicians and art historians could interact.

3 - **Hannah Wiemer** (Humboldt-University, Germany)

Store and retrieve: Hans Scharoun's Staatsbibliothek and the library as a scientific medium in post-war Berlin

In 1978, West Berlin opened its impressive new State Library, the Staatsbibliothek at Potsdamer Strasse. Designed by Hans Scharoun, it was built around an open, 600-seat reading 6 space. The 3 million books and the librarian services accompanying them required a complex and often noisy infrastructure for acquisition, classification, storage, and retrieval. Yet reading is conceived of as a practice that requires undisturbed silence, even solitude. How were these two potentially conflicting functions of the library, handling books and reading them, organized within the Staatsbibliothek's architecture and urban setting? This paper examines the library's acoustics as an example for the reflection about books and its buildings as scientific media. As I show, the books—with the silence they demanded and the noises they created—formed part of a multilayered media infrastructure in post-war Berlin. A central figure is the physician Lothar Cremer, who acted as an acoustic advisor for the building of the library. Scharoun and Cremer had already collaborated for the building of the Berlin Philharmonic (opening 1963), where their collaboration and the acoustics of the concert hall got a lot of public attention. His acoustical measures for the library were designed to create a reading room as silent as possible, using sound absorbing materials and separating more noisy activities like the transport of books from the reading room. A conflict arose when students within the advisory committee suggested to create spaces for group working where talking should be allowed. What does this conflict reveal about scientific practices of the time? And how were scientific media and the practices to use them conceived of?

4 - **Chris Salter** (Concordia University, Canada)

Neuronal Media

When thinking about the relationship between science and media there is a peculiar object which takes different forms and increasingly seems to cross genres, cultures and practices: none other than the neuron. From live artistic performances that utilize the electrical spikes of biologically cultured neurons to control the action of robots or sound synthesis to the mathematical behaviour of artificial neural networks that provide the basis for our contemporary "4th revolution" in AI, the neuron as symbol, model and agent is certainly alive and well across the arts, neuroscience, and cultural studies. But strangely enough there is another kind of performativity that the neuron implies – that of economic markets. In 1952, the Austrian economist Friedrich Hayek published The Sensory Order which put forwards a neuronal theory of the mind arguing that all sense making, learning and memory is a product of the dynamic connections that emerge from neuronal links that take place over time. According to Hayek, the sensory order is constructed from the neuronal connections classifying information – objects external to the mind have no intrinsic properties except how the nervous system classifies these properties. Memory – i.e., past connections – is what gives meaning to sensory properties. In other words, "we live in a sensory order that is created by the central nervous system." This talk tries to understand this neuronal media and its resultant performativity - asking what work the concept of performance can do in attempting to describe "living technologies" (Takashi Ikegami) or lively systems like neurons that act across different scales (brains, machines, economies) and whose ontological and operational order is one that challenges a basic epistemological assumption: that we can actually know the world.

5 - **Orit Halpern** (Concordia University, Canada), commentator

Room 5: **S55 - Popular Representation / Misrepresentation of Modern Physical Theories - 2**

Sponsored by IUHPS / DHST Commission on the History of Physics

Conveners: **Jaume Navarro** (University of the Basque Country, Spain), **Alexei Kojevnikov** (University of British Columbia, Canada)

Chair: **Alexei Kojevnikov** (University of British Columbia, Canada)

1 - **Xavier Roqué** (Autonomous University of Barcelona, Spain)
The visual and material culture of small physics

I seek to explore the representation/misrepresentation of modern physics not just in terms of theories, but in terms of scale too. By the mid-20th century, the phenomenal growth of the discipline prompted the introduction of the term "Big Science". In the emerging visual culture of modern physics, high-energy accelerators, rockets and nuclear reactors were linked to cathedrals and pyramids (Weinberg, 1961). But Big Physics was not just seen as "new and shining and all-powerful" (Price, 1963), it was also perceived as detrimental of imaginative basic research: "It is the unadorned mind of man, and not the fanciful instruments man conceives, that produces all of the beautiful in science" (Tuve, 1959). Small-scale research has arguably remained relevant to contemporary scientific practice, and it might be gaining new visibility in the 21st century (Fortin and Currie, 2013; Werrett, 2018). How has small physics been depicted? And how should we approach the visual and material culture of small-scale physical research?

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Fortin, Jean-Michel; Currie, David J. (2013). *Big Science vs. Little Science: How Scientific Impact Scales with Funding*. PLoS ONE, 8(6), e65263. Price, Derek J. de Solla (1963). *Little Science, Big Science . . . and Beyond.* New York: Oxford University Press. Tuve, Merle A. (1959*). Is science too big for the scientist?* "The Saturday Review": 49–52.

2 - **Connemara Doran** (Harvard University, USA)
Imaginings and Icons: Imaging the Cosmic First Light, 1974-2014

Throughout human history, light has been instrument, messenger, and the yet unknown in observations of the cosmos. The co-evolving empirical, theoretical, and mathematical sciences entangled with intuitions and imaginings of a spatial-relational nature and deep aesthetic sensitivities, ever interrogating, visualizing, and representing what lies just beyond the horizon of understanding. Compelled by a conjunction of accelerating theoretical, material, and technological advances, 20th-century physicists came to interrogate a dynamic universe expanding from an initial singularity. By turnof-the-21st-century, the NASA missions COBE and WMAP and the ESA Planck space probe made visible the universe's very first light – the cosmic microwave background (CMB) radiation. Astrophysicists used the data collected from instruments on these satellites to produce iconic images mapping the universe's embryonic structure, including theoretically anchored imagery modeling the evolution of cosmic structure from the big bang to today. Creative aesthetic concerns appeared at all stages in these missions, from instrument design to image production to public outreach. To prefigure the pending twodimensional visual (digital) data-based icons, the science teams at the space agencies designed and curated publicly available three-dimensional physical models, computer simulations, cartoons on postcards, and interactive digital media that have been engaged in diverse ways by various overlapping communities – scientific and mathematical, publishing, educational, religious, and artistic. Rather than a simple move from "production" to "reception," these visualizations of the cosmos were co-created by

various practitioners and users. Throughout, tensions existed regarding meanings, visualizations, and mathematical and relativistic understandings, between ways of representing the first moments of cosmic expansion and our knowledge of that history, and between the epistemic and the ontic: as precision measurements have narrowed the uncertainty in our periodization and cataloging of cosmic evolution, the nature of the basic constituents of our universe remains under contention.

3 - **Pavel Yushin** (National Research University Higher School of Economics, Russia)
Inverted Space-Time in Pavel Florensky's Scientific Imagination: A Commentary on the Cover of the Journal Makovets (№3, 1923)

Pavel Florensky (1882-1937), a renowned Russian polymath and religious thinker, entertained a variety of bizarre ideas. One of the most perplexing of them, formulated in the notorious last paragraph of The Imaginaries in Geometry (1922), involved an attempt to use Einsteinian physics as a proof of the possibility to access the transcendental "other world" (identified with the realm of Platonic Forms, the Empyrean, and the Kingdom of God) by "turning oneself inside out." Alluding to the special theory of relativity, Florensky described how at a speed faster than the speed of light, the physical body could "fall through the surface […] and turn inside out." "So far, — he added, — we imagine the increase of velocities as the only means for this process […] but we have no evidence of the impossibility of any other means." That same year, at the beginning of Iconostasis (1922), he briefly tried to conceptualize the same process while analyzing the temporal structure of dreams. As I will attempt to show, these speculations were underpinned by Florensky's views on the meaning of religious conversion and ultimately rooted in a specific 19th -century interpretation of the biblical story of the fall of man. A year later, this entanglement of (psycho-)physical and religious ideas came to be depicted in a remarkable yet almost unexplored visual image — Vladimir Favorsky's woodcut on the cover of the journal Makovets (№3, 1923) — which will serve as a starting point of my presentation.

4 - **Alexei Kojevnikov** (University of British Columbia, Canada)
Space-Time, Death-Resurrection, and the Russian Revolution

The special theory of relativity was well received in Russia already prior to WWI, but Einstein's general relativity of 1915 arrived there with a five-year delay caused by the breakdown of communications during wars and revolutions. But once arrived, it triggered an enormous cultural reaction, multiplied by the acute hunger for European news after several years of informational isolation. Responses to Einstein in various genres and in a practically inexhaustible spectrum of sources, including professional, popular, pseudoscientific, literary, artistic, mystical, poetic, and others, included many such interpretations and misperceptions that were similar to cultural reactions to relativity elsewhere. Yet some of the commentaries were more idiosyncratic, reflecting the specific realities and experiences of a society in the whirlwind of the revolutionary change. The extraordinary excitement and trauma experienced by the Russian public during violent and catastrophic events of the early 20th century – the Great War, revolutions, civil wars, mass epidemics and hunger – engendered dramatic changes in cultural perceptions of space and time. Einstein's radical ideas, when reinterpreted within the new revolutionary experiences, triggered an outburst of even more wildly speculative hypotheses by avantgarde poets Vladimir Mayakovky and Velimir Khlebnikov, physiologist Alexei Ukhtomsky, painter Pavel Filonov, religious thinkers Pavel Florensky and Pyotr Ouspensky, historian of science Alexandre Koyre. Some linked the concept of space-time to the hope for biological resurrection, others to astronomical and historical catastrophism, the eternal return, or to fundamental periodicities at different time scales, organismic, historical, and cosmological. Among that family of unconventional theories, one finds the first proposal of the Big Bang Theory of the Universe: Alexander Friedman's relativistic cosmological model of 1922.

5 - **Jaume Navarro** (University of the Basque Country, Spain), commentator

Room 6: **S87 - Cultures of expeditionary science: Exploring the role of scientific expeditions in scientific knowledge production, (geo)political struggles and popular imaginaries in the 20th and 21st centuries**

Convener: **Kristian Hvidtfelt Nielsen** (Aarhus University, Denmark)

Scientific expeditions today have a somewhat tarnished reputation in the sciences and in science history. Scientific expeditions were once heroic achievements aimed at exploring and understanding all kinds of white spots on the maps of the sciences. Intimately connected to the colonial enterprise, scientific expeditions in the age of decolonization turned into objects of critique due to their "complicity in the imperial project of conquest, extraction and settlement" (Leshem and Pinkerton 2019, 496). Moreover, the historiography of scientific expeditions have struggled with hagiography, but also with scientists' own narratives of methodological progress depicting expeditionary methods as crude and ill-suited for careful and systematic observations. Many anthropologists, for example, prefer participant observation to expeditions, while biologists generally have incorporated laboratory-like methods and techniques in their attempt to develop a (often stationary) field science proper (Kohler and Vetter 2016). Still, scientific expeditions seem to have endured as method of scientific knowledge production, instrument of (geo)political power and popular imaginary of science, and therefore also as valid objects of historical inquiry. The objective of this panel is to engage conceptually and empirically with scientific expeditions in the 20th and 21st centuries. We seek papers that approach scientific expeditions from diverse historiographical perspectives. We aim to explore expeditionary science in relation to topics such as visual, material and sensory practices, civic and political epistemologies, science diplomacy, popular science, interdisciplinary collaboration, circulation of knowledge, and commemoration of past expeditions.

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Chair: **Matthias Heymann** (Aarhus University, Denmark)

1 - **Sofia Viegas** (University of Lisbon, Portugal)

Two of a kind: two collecting opportunities; the same purpose? Colonial botany in Portuguese Africa at the University of Porto herbarium

During the First World War, Américo Pires de Lima, assistant professor at the University of Porto went to Mozambique in 1916 as part of the Portuguese military force Corpo Expedicionário Português. As a trained medical doctor, he was Chief of the Hygiene and Bacteriology Section of the corps. Although this was a military assignment, Pires de Lima also had instructions to study local flora, fauna, and anthropology, and collected accordingly. Among other investigations, he gathered a significant lichens collection, which formed the internationally recognised set Lichenes Mozambici. During the Estado Novo regime in Portugal, Arnaldo Rozeira, professor at the Faculty of Sciences of the University of Porto, went to S. Tomé and Príncipe in 1954, 1957 and 1958. He was Mission assistant and Botanical Sociology Brigade Chief at Missão Científica de S. Tomé. This Scientific Mission was created to study various aspects of S. Tomé and Príncipe's natural history, ethno-sociology and economics to provide data for the International Conference of West Africanists (Conferência Internacional dos Africanistas Ocidentais - C.I.A.O.) held in 1956 in S. Tomé. At C.I.A.O. Rozeira gave two papers, one of which together with Arthur Exell, providing descriptions of local flora of S. Tomé and Príncipe, updating the knowledge on the archipelago. This paper compares these two collectors and their specific scientific agendas. Spanning through two political regimes, the First Republic and the Estado Novo dictatorship, this paper

contributes to the study of co-construction of science and empire. Working under distinct collecting contexts both Pires de Lima and Rozeira enriched the herbarium of the University of Porto. Simultaneously, they both contributed to expand the botanical knowledge of Portugal's overseas possessions.

2 - **Catarina Fontoura** (Falmouth University, UK)

Photography, science-making and wild animals in the Royal Society-Royal Geographical Society Xavantina-Cachimbo expedition to Mato Grosso, Brazil 1967-69

This paper addresses the ways in which a critical study of visual materials on expeditionary science in the 20th century has the potential to unlock new ways of engaging with existing narratives of expeditions, produced by scientists and science institutions themselves. Focusing on the XavantinaCachimbo expedition to Mato Grosso, Brazil, in 1967-69, a venture organized by the Royal Society and the Royal Geographic Society, I consider how the visual archive can help frame questions around photography's role in scientific knowledge production within the context of expeditions, with the camera embodying a range of functions, from scientific note-taking tool to an inscription-making device. I then turn to the photographs of wild animals, investigating the extent to which they portray particular encounters and interactions between animals and scientists in the field, considering animal welfare ethics, a poetics of vulnerability (Anat Pick, 2011) and uneven power structures between human and non-human participants in science in the field (Tsing, 2014).

3 - **Kristian Hvidtfelt Nielsen** (Aarhus University, Denmark)

Entangled expeditionary culture in the 21st century: The many meanings of the Danish Galathea Expedition from August 2006 to April 2007

This paper investigates the Galathea 3 Expedition, first envisioned by Henrik Thomsen, the editor of the Danish newspaper Jyllands-Posten, in year 2000. Thomsen wanted to continue and update the historical tradition of Galathea expeditions going back to the corvette Galathea's circumnavigation of the globe, 1845-57. The second Galathea Expedition, which really invented the tradition, took place from 1950 to 1952. Thomsen wanted organize an expedition encompassing science, media, business and culture. He managed to secure financial support from the Danish Government. However, the Danish research councils emphasized the scientific aspects over the other three. Throughout the expedition, interpretations of what it means to conduct a scientific expedition around the globe in the 21st century wrestled with each other. The Galathea 3 built on the historiography, sometimes hagiography, of Danish scientific expeditions, but also tried to a make a case for scientific expeditions today. This paper surveys the many meanings attached to the Galathea 3 expedition, arguing that the entanglements of different expeditionary cultures enabled the expedition in the first place, but at the same time, it was one of its main weaknesses.

4 - **Matthias Heymann** (Aarhus University, Denmark), commentator

Room 7: S35 - Visual Culture of Amateurs in Science (1850-1950)

Convener: **Laurence Guignard** (University Paris Est Créteil, France)

The ANR research project AmateurS – Amateurs in Science (France, 1850–1950): A History from Below proposes a session entitled Visual Culture of Amateurs in Science (1850–1950). The aim is to examine the place of visual productions in amateur worlds, through a wide scope of media: drawing, painting,

photography, stereoscopy, engraving, but also tree-dimensional productions, such as models or casts. The following points will be addressed:

1) The corpora produced by amateurs and how they contribute to new forms of science-induced visualization of the world. We will be interested, for example, in the techniques, the supports, the places of production, or the types of objects represented, possibly topical, etc.
2) Pictorial and iconographic practices mobilized by amateurs. These raise the question of the material conditions of these productions but also of the training and careers of amateurs and the transfers of skills they generate. It may include, for instance, the collaborative roles held by artists within science projects, the productions created at the boundaries of the arts and sciences, but also the links between different types of amateurism, such as photography/excursionism/geology, likely to favour certain amateur visual productions.
3) The methods of compilation, reproduction and circulation of these amateur productions, such as collections, exhibitions, publications of periodicals or books, public lectures using lanterns, etc. These can make it possible to identify close contact with the scientific popularization community or with the world of professionals, but also visual cultures that are specific to amateurs, as alternative visions to professional science.

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Florent Serina, *The Botanical Collection of a Psychotherapist: Pierre Janet's Herbarium*. Maria Esmeral Henriquez, *To Press, Dry, Organize and Represent. From a Herbarium to Botanical Illustration.* Verónica Ramírez, *Professionals and Amateurs under the Scrutiny of Magazines. Satirical Media and Astronoin Chile (Late 19th and Early 20th Centuries).* Nathalie Richard and Hadrien Viraben, *The Amateur and the Transmedia Drift of Archaeological Images: James Miln (1819–1881) at Carnac.* Florian Mathieu, *The Observation of Sunspots and Their Representations in Societies of Amateur Astronomers in France at the Beginning of the 20th Century*

Chair: **Laurence Guignard** (University Paris Est Créteil, France)

1 - **Florent Serina** (University of Strasbourg, France)

The Botanical Collection of a Psychotherapist: Pierre Janet's Herbarium

The French philosopher and psychotherapist Pierre Janet (1859–1947) is generally remembered as one of the pioneers of the psychology of the unconscious, and as a theorist whose ideas once competed with those of Sigmund Freud. It is less well known that Janet was also an amateur botanist. During his teenage years, Janet went through an existential crisis and was able to regain his mental balance thanks to gardening and the study of botany. In fact, he never stopped collecting and preserving many plant specimens until his old age. The discovery of his herbarium (kept nowadays at the Société d'Histoire Naturelle des Ardennes in Charleville-Mézières) reveals his love for flowers and his extensive knowledge of plant science. This unique collection also appears as a souvenir book, and as a travel book. His 28-volume herbarium contains about 3,000 plates of plants and flowers, collected between the 1870s and 1941 all over Western Europe and the American continent. My paper aims to introduce the main issues raised by this unique collection, Janet's botanical knowledge, as well as his science and art of composing plates. At last, I will show how Janet connected his amateur practice with his professional practice.

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2 - **Maria Esmeral Henriquez** (EHESS Paris, Fance)

To Press, Dry, Organize and Represent. From a Herbarium to Botanical Illustration

This paper is based on a comparison between two types of graphic and scientific documents produced during the Royal Botanical Expedition to the Kingdom of New Granada (1783–1816): herbarium sheets and botanical drawings. Between 1783 and 1816, the expedition of the Spanish Crown to the Viceroyalty of New Granada resulted in an exceptional corpus of botanical illustrations and herbaria. It gathers slightly more than six thousand botanical species, with about seven thousand drawings and twenty thousand herbarium sheets. In this regard, the expedition was one of the most significant in the history of science during the 19th century.[1] The collection, never published, was made by "Creole apprentices" under the direction of the Spanish doctor, botanist, mathematician and theologian Jose Celestino Mutis.[2] Indeed, about thirty draftsmen, mestizos, mostly sons of peasants, all born in America, acquired technical and iconographic knowledge in a school of drawing created by Mutis for this purpose. Their images keep the trace of the particularities. The iconographic analysis of these documents allows me to identify not only Carl von Linné classification principles,[3] but also a new way of seeing plants under the universal mathematical paradigms of Isaac Newton.[4]

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[3] Carl von Linée, *Systema Naturae sive regna tria naturae systematice proposita per classes, ordines, genera et species*, Leyde, Apud Theodorum Haak, Typographia Joannis Welhelmi de Groot, 1735.
[4] Victor Albis, Luis Carlos Arboleda, "Newton's Principa in Latin America", *Historia Matematica*, 1988, p. 376-379.

3 - **Verónica Ramírez** (University Adolfo Ibañez, Chile)

Professionals and Amateurs under the Scrutiny of Magazines. Satirical Media and Astronomy in Chile (Late 19th and Early 20th Centuries)

Between the end of the 19th century and the beginning of the 20th century, the publishing and journalistic industry experienced a relevant modernizing process. It produced newspapers and magazines giving way to commercial projects. In this context, while illustrated magazines of wide circulation and a lot of subscribers emerged, the visual medium became a main characteristic. Our proposal is to discuss how the illustrations of these magazines represented both professionals and amateurs of astronomy, as these categories were currently being defined. The "professional" and "amateur" status of science in the country were still diffuse and problematic, and these journals illustrated this situation with a sharp look. Specifically, we want to analyze the illustrations of a cartoonist for Zig-Zag publishing house, one of the most important at that time, with a heterogeneous audience, from middle to upper class. Through these representations, we are interested in examining the parallel process of development of the professional and amateur field of astronomy in Chile.

4 - **Nathalie Richard & Hadrien Viraben** (Le Mans Université, France)

The Amateur and the Transmedia Drift of Archaeological Images: James Miln (1819-1881) at Carnac

During the second half of the 19th century, the vogue for megaliths gradually made Carnac in Brittany a highly appealing place to sightsee. Its archaeological sites attracted an audience of tourists, for whom scientific curiosity was combined with a taste for the picturesque. This international reputation led the Scottish antiquarian James Miln (1819–1881) to visit Carnac in his turn. A member of the Scottish Society of Antiquaries, Miln was an amateur archaeologist, but also a dilettante watercolour painter and photographer. From 1873 onwards, he undertook an uninterrupted series of excavations, for which he used his skills as a draughtsman and a photographer. During his excavations, he was assisted by a local

farm worker, Louis Cappé, who signed some of the numerous illustrations published by Miln in his scientific publications, which appeared in Paris and Edinburgh between 1877 and 1881. Upon Miln's death, his collection was bequeathed to the city of Carnac and became the nucleus of the 'Musée Miln', dedicated to prehistory. Next to the objects, several models were also presented, commissioned by Miln and executed on the basis of his excavation records. James Miln's activity as an amateur archaeologist is thus at the centre of a rich visual production: sketches drawn in his digging diaries; landscapes transcribed into drawings, watercolours or photographs; engraved illustrations for his books; models sculpted from his archaeological sites surveys. This creativity can be particularly envisaged by following the transmedia declinations of certain images, from their manuscript and original copy to their diverse published forms. Our communication will highlight that while these images have close but distinct functions (memory aid, scientific accuracy, scholarly restoration, pedagogical reconstitution, aesthetic expression, tourist souvenir, etc.), they also 7 reflect an overlapping of scientific and artistic perspectives that we may consider as characteristic of amateur practice.

5 - **Florian Mathieu** (University of Paris-Saclay, France)

The Observation of Sunspots and Their Representations in Societies of Amateur Astronomers in France at the Beginning of the 20th Century

In the first decade of the 20th century, astronomical societies multiplied in France. All these societies became local environments allowing amateurs to practice science and to share their productions within communities. One of the phenomena most studied by these societies was undoubtedly sunspots, which were almost daily observed over several months, and generally monitored over several years. The phenomenon being quite easy to observe surely explains this interest, or at least partly: a small telescope fitted with a filter already makes possible to clearly observe these spots, and a slightly more sophisticated instrument would allow perceiving their details. The appearance of the spots and their numbers are thus recorded through numerous drawings and graphics, the aim of which was to help in the understanding of the phenomenon and the study of its periodicity. If, at that time, astronomical photography techniques were already widely used in professional observatories, mastery of drawing remained an essential quality for amateur astronomers who wished to share their observations. The regularity of these observations as well as the precision of the drawings testify to a desire for scientific seriousness. These graphical representations of sunspots could also be used to illustrate lectures – especially when projected – or popular articles. Science or serious hobby? Elitist activity or dissemination to a wide audience? The study of these productions will also lead us to question the special role played by amateur astronomers in the history of this science.

6 - **Hadrien Viraben** (Le Mans Université, France), commentator

Room 8: **S37 - Paper, Metal, Glass: Material Reproduction in Pre-Modern Science**

Conveners: **Katherine M. Reinhart** (University of Wisconsin, USA), **Megan Piorko** (Georgia State University, USA)

This panel explores the materiality of science from antiquity to the early modern period. By focusing on three different materials – metal, glass, and paper – this panel tracks how objects of science were made, copied, reused, and circulated during the process of creating scientific knowledge. Through the exploration of the scientific techniques for production of objects including black bronzes, glass alchemical instruments, paper texts, and metal coins, this panel interrogates how pre-modern materials were sourced and composed by reusing material and copying older traditions. It will also examine how

these objects were physically circulated while simultaneously disseminating the ideas which they contained. This panel will address the questions: What do the distinct media of paper, metal, and glass tell us about commonalities of how scientific objects were produced and reproduced? How does the act of reproduction affect these objects and the knowledge which they transmit? In what ways do these material objects perpetuate new scientific ideas, and how do those ideas change when copied into new contexts? Combining methodologies from history of art, science, archaeology, material culture, and history of the book, this panel brings an interdisciplinary lens to the history of scientific objects and practices—making clear that the creation of scientific knowledge cannot be separated from the materials of its production.

Chair: **Felicity Henderson** (University of Exeter, UK)

1 **- Agnese Benzonelli** (University College London, UK)

Texts, experiments and artefacts, a combined approach to the study of black bronze alloys

This paper presents the final results of a research based on a combined historical, experimental, archaeometric and archaeological approach to the study of naturally and artificially patinated copper alloys. The focus was on “black bronzes”, a class of alloys used for high-status objects from ancient Egypt to modern Japan, and including among others the famous Corinthian bronzes and Japanese shakudo. These were copper alloys containing small amounts of gold that were treated with a variety of method to develop a fine and durable black patina. For the first time, we compiled all the scientific and historical information concerning black bronzes into a single database which highlighted research gaps: What were the technologies used to patinate these alloys? Can different patination technologies be recognised through analysis of ancient objects? Are the black bronze artefacts in different culture derive from a single invention or are the result of a multiple invention? We addressed these and other unsolved questions through a systematic experimental project reproducing four different procedures taken from ancient and modern texts: chemical patination by means of solutions that mimic those used in traditional methods, Chinese patination using perspiration, thermal patination and simulation of natural corrosion. The resulting patinas were examined with a range of analytical techniques providing an understanding of the relationship between production technology, alloy composition and their physical-chemical characteristics. The experimental data serve as a reference for the interpretation of archaeological black bronzes. Egyptian, Roman, Greek, Anglo-Saxon, Chinese and Japanese artefacts from a range of museums were analysed and compared with the experimental results providing insights into the procedures and ingredients used by the different cultures. The comparison of the experimental data and the results of legacy and new analysis on archaeological artefact gave interesting suggestions about different traditions in the East and the West.

2 - **Umberto Veronesi** (University College London, UK)

Of copying, mixing and recycling: The glass distillation apparatus of a 16th-century alchemical laboratory and its material history

Early modern alchemy was a complex and multifaceted phenomenon, practiced by a wide spectrum of individuals at different places and with very different aims. One aspect unifying such colourful mosaic is the need for specialised apparatus to perform the challenging laboratory operations. The importance of choosing the right equipment is often stressed in contemporary documents and examples of such equipment abound in written and iconographic sources. Assemblages of laboratory tools and apparatus have also been recovered from archaeological excavations of sites such as alchemical laboratories and artisanal workshops and provide us with the opportunity to investigate early modern alchemical practice through the lens of its material culture. Through the analysis of the distillation equipment from the 16th -century alchemical laboratory of Oberstockstall (Austria), this paper explores the history of the glass vessels, how they were made and where they come from. The study reveals that among the types of glass available in the period and area in question, laboratory practitioners tended to use high quality

material for their vials and distillation flasks, with cheaper glasses being chosen for objects that did not require specific characteristics. The former group belongs to a well-known manufacture tradition that in this period copied the hugely famous Venetian crystal in central and northern Europe. Alchemists wanted perfectly clear glass which would allow to see inside of the vessels during chemical operations and thus maintain a better control over the reactions going on. Using material culture as the starting point, this paper tells the story of how alchemists sourced their distillation vessels and how these went through processes of copying, mixing and recycling in order to become desirable and technically advanced tools to be used in laboratory activities all over Europe.

3 - **Megan Piorko** (Georgia State University, USA)

Transmutating Alchemical Knowledge on Paper: Using and reusing alchemical texts in the seventeenth-century

Seventeenth-century alchemical texts relied on careful curation by the authors and producers of hand-press books and manuscripts to communicate hermetic ideas to various audiences. The medium (manuscript or hand-press book) usually dictated the purpose of a text and elucidated its intended audience. In many cases alchemical compendia were directed at particular groups or individuals who were adept in the art of transmutation, and explicitly as well as implicitly demonstrate this to the reader. This paper examines the ways in which the materiality of seventeenth-century hand-press alchemical texts was manipulated to create new chemical and hermetic knowledge from canonical medieval alchemical tracts. This presentation focuses on manuscript versions of hand-press alchemical books Fasciculus Chemicus (1631) and Theatrum Chemicum Britannicum (1652) held by the Wellcome Collection. How do the manuscript copies of these texts physically manipulate the print copies on which they are based? What did the producers of these manuscripts include/exclude/change from the original printed text and how does this create new alchemical knowledge? What does the production and existence of manuscript versions of a printed text tell us about the relationship between scribal and print culture within seventeenth-century alchemy? How does a material analysis of text impact the historical understanding of early modern science?

4 - **Katherine M. Reinhart** (University of Wisconsin, USA)

Science in Circulation: Coins, Copying, and the Materiality of Scientific Imagery

In the late seventeenth century, a vibrant trade of coins and medallions was taking place across Europe. Cast in an assortment of metals and alloys, these medals depicted events of national significance such as the signing of a peace treaty or the marriage of a sovereign. These coins circulated throughout Europe where they were collected, traded, and sometimes satirized by rival nations. In France, medals were issued to amplify the glory of the King Louis XIV and his reign. Yet in addition to battles and monuments, coins were also cast to commemorate the triumphs of science. In particular, the activities and discoveries of the young Académie royale des sciences in Paris – from their discovery of new moons to the construction of the observatory – became immortalized in numerous medals. The materiality of the coins, in particular the value and durability of the metal, meant they had the ability to travel to a greater degree than other more delicate or ephemeral objects of the Academy. These medals had multiple functions as they circulated both within the walls of the Academy, and in philosophical and aristocratic circles abroad. The visual allegories and events depicted on the coins were also copied into different formats including printed books and other medals. This paper will explore the coins and medals created on behalf of the French Scientific Academy – what they depicted, how they were used, and why scientific activity became memorialized in metal. This paper will also consider the materiality and mobility of these objects, and how they were dispersed and replicated in service of science and the French state.

Room 9: **S85 - Visual and Material Cultures in the Mathematics of the Ancient World - 2**

Conveners: **Karine Chemla** (CNRS / University of Paris, France), **Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)

Chair: **Karine Chemla** (CNRS / University of Paris, France)

1 - **Eunsoo Lee** (Stanford University, USA)
Pointing out the Visual in Ancient Greek Science

A formulaic phrase, “as seen in the figure,” is a typical channel in modern science through which the text invites the reader to see the visual. This deictic phrase traces back through early modern science at least to the late Middle Ages when some authors pointed out the visual through a similar phrase, “sicut patet in hac figura.” Can we find a corresponding phrase in ancient scientific treatises? If so, to what extent did the phrase play a similar role as its modern correspondent? This paper explores how ancient Greek science convened the visual in the text. To this end, the paper analyzes some spots where ancient scientific texts incorporated the visual through the phrase, “δῆλον/φανερὸν ἐν τῷ σχήματι.” The case studies in this paper show various aspects of the relationship between the text and the visual in ancient science. Thus, the paper confirms different mindsets in using visuals between ancient and modern science but at the same time questions the simple dichotomy between mentalité par les yeux and par l'oreille.

2 **- Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)
A homogeneous culture of drawing diagrams in relation to mathematical procedures in Old-Babylonian southern Mesopotamia?

A few dozens of mathematical procedure texts written in cuneiform script on clay tablets produced in southern Mesopotamia during the Old-Babylonian period (corresponding approximately to the first half of the second millennium BCE) are accompanied by a diagram which represents a geometrical configuration and displays some inscriptions. Though the archaeological context of the involved tablets is most often unknown to us, it is likely that they come from different places in Babylonia, from different moments of the Old-Babylonian period and from different social and intellectual contexts. They furthermore testify to the coexistence of diverse ways of articulating visual aids to discursive texts in this documentation, as well as of using these visual aids in order to conduct mathematical reasonings. However, in spite of their great variety in these respects, the Old-Babylonian mathematical diagrams linked to procedure texts show a surprising homogeneity as to the objects they represent and the way in which they represent them: the geometrical figures and elements of these figures which we find depicted by them always belong to the same very restricted repertoire and are almost always displayed on the tablets with the same orientation, whereas the contents and positions of the inscriptions inserted onto them seem to follow very stable implicit conventions. In this paper, I would like to highlight this contrast between the diversity of contexts in which the Old-Babylonian diagrams linked to mathematical procedure texts were produced and the roles which have been attributed to them on the one hand, and the uniformity of the objects which they represent and the ways in which they depict them on the other hand. I will thereupon try to discuss to which extent it could be relevant to speak of a common culture of mathematical drawing linked to the Old-Babylonian mathematical procedure texts.

3 **- Reviel Netz** (Stanford University, USA)
Why were Greek Diagrams Schematic?

The empirical observation that mathematical diagrams transmitted through the Medieval manuscript tradition are schematic is by now commonplace. At the same time, it became non-controversial among philosophers that diagrams can be validly used, as long as their use meets certain conditions (met by schematic diagrams). As the two combine, two further pieces of historical interpretation became entrenched. (1) Greek mathematical diagrams indeed go back, in their current form, to antiquity, and this is understandable because (2) they were schematic so that they could be validly used. In this paper, I take the question of the transmission more directly and consider why we should believe that it is fundamentally faithful to ancient sources, and then try to provide an alternative account – independent of philosophical considerations, and based on ancient textual practices – for why Greek mathematical diagrams were originally the way they were.

4 - **Gregg De Young** (American University in Cairo, Egypt)
An excursion into the archaeology of mathematics: situating the manuscript BULAC ARA 606

An unknown manuscript copy of the Arabic translation of Euclid's Elements, titled Kitāb al-Arkān, has come to light in the collections of the Bibliothèque universitaire des langues et civilisations in Paris. This manuscript once belonged to Soliman al-Harairi, a Tunisian scholar who died in Paris and whose book collection was acquired by BULAC. The manuscript is both old and complete, and contains marginalia in a variety of hands. According to the catalogers, it represents the translation of Ishaq as revised by Thabit ibn Qurra, and so is unlikely to shed light on the elusive earlier translation attributed to al-Hajjaj. In this presentation, I will explore the internal evidence available in this manuscript (primarily diagrams and ordering of definitions and propositions, but with a few remarks on the text itself) in order to situate this manuscript more precisely in relation to other known copies of the Arabic primary transmission. The colophon dates the completion of the manuscript to 611 AH / 1214 CE. This date implies that the manuscript is nearly contemporaneous with the three major Taḥrīr of the Elements produced during the latter half of the sixth / thirteenth century by Naṣīr al-Dīn al-Ṭūsī, Muḥyi al-Dīn al-Maghribī, and the anonymous Pseudo-Ṭūsī. Hence the manuscript may also shed some light on this period of the secondary transmission of the Elements in Arabic.

Room 10: S29 - The nature of scientific discovery in the chemical sciences - 2

Conveners: **Brigitte Van Tiggelen** (Mémosciences, Belgium), **Annette Lykknes** (Norwegian University of Science and Technology, Norway)

Chair: **Annette Lykknes** (Norwegian University of Science and Technology, Norway)

1- **Helge Kragh** (University of Copenhagen, Denmark)
Can non-existing objects or laws be discovered?

According to the philosopher Peter Achinstein, the concepts of discovery and truth are intimately connected. Hence, something which does not exist cannot be discovered. However, although this may seem to common sense, it is problematic from a historical and sociological point of view, in part because it reserves the category of discovery for what is presently accepted as true. It does not take into account that in the future, some of our presents truths will transform into untruths. In any period of the history of science, there have been widely accepted discovery claims which turned out to be unfounded. It makes better historical sense to associate discovery with what the relevant scientific community

accepted as a discovery (and hence a truth) at any given time. Instead of saying that a discovery claim was proved wrong, we may say that it was dediscovered. There are other reasons to doubt the truth-discovery formula, among them that it presupposes discoverable objects to exist in nature prior to their discovery. An adequate understanding of the discovery concept needs to include a definition of concept of existence. The idea of the talk is to problematize the concept of discovery, not only with respect to truth but also with respect to the grey area which includes partial or temporary discoveries. This will be done primarily by means of historical examples from the chemical sciences. Among the examples may be the case of phlogiston, belonging to the 18th century, and the lesser known case of triatomic hydrogen. The latter case involved the discovery claim of H3 which was widely accepted from about 1915 to 1930, then dediscovered and eventually rediscovered in laboratory experiments in 1979. Still other examples may be antozone, helium, coronium, and nuclear electrons.

2 - **Sarah Hijmans** (University of Paris, France)

Analogy, Indecomposability and the Discovery of Aluminium

Throughout most of the 19th century, the chemical element was defined as an empirically indecomposable substance. Therefore, it might seem justified to equate 19th -century discoveries of elements to their first isolation: aluminium is said to be discovered either by Wöhler in 1827 or by Oersted in 1825, depending on how one views their success in producing the metal (Weeks, 1956, pp. 588–605). However, this view defines discovery without asking how chemists themselves viewed it at the time. Instead, this paper studies the attribution of elementary status in practice. Focusing on the case of aluminium, it will show the importance of analogy and classification for its acceptance as an element. Alumina (aluminium oxide) had long been suspected to contain a metal, but aluminium itself was identified and named by Davy (1808, 1810). He successfully isolated the alkaline earth metals, but failed to decompose alumina. Nevertheless, chemists widely accepted aluminium following Davy's work. Their conclusion relied on analogy: the strong resemblance between all the earths and alkalies meant that only a few of them had to be decomposed in order to view all of them – including those that were empirically indecomposable - as compounds. Thus, years before its production as a substance, aluminium was accepted as an element. The identification, isolation and acceptance of aluminium as an element were separate events. This complicates the attribution of its discovery to a single person. It also illustrates the need to look beyond definitions towards chemical practice.

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3 - **Gisela Boeck** (University of Rostock, Germany)

Germanium - discovered as the predicted eka-silicon?

It is well known that Dmitri Mendeleev successfully predicted the existence of several unknown elements. Some of these predictions were highly appreciated after the discovery of the relevant elements. This was the case for gallium, scandium and germanium. It is often assumed that the predictions gave rise to a purposive search for these elements. Even though Victor von Richter (1841-1891) saw a big interest in discovering the eka-silicon (Kaji et al.) there was no special program to find it. This paper will especially describe the discovery process of germanium in comparison with gallium and scandium. Clemens Winkler (1838–1904), who discovered it in 1886, was primarily interested in the composition of the new mineral argyrodite which was found near Freiberg (Haustein). After publication of the new element (Winkler, 1886), Mendeleev did not accept it as eka-silicon but letters of Lothar Meyer (1830-1895) and von Richter show that they recognized the link between germanium and eka-silicon (Winkler papers). A precise determination of the atomic weight of germanium finally convinced Mendeleev and he later celebrated Winkler as one of the "verifiers" of the periodic system.

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4 - **Brigitte Van Tiggelen** (Mémosciences, Belgium)

It's not elementary. The successive lives of ekamanganese aka element 43

Narratives devoted to the discovery of a chemical element usually trace back every occurrence of "precursors", that is alleged elements whose existence were eventually dismissed. It even happens that one such alleged element is recuperated as being another element than, or a homologue of, the one announced initially. These stories written from a presentist point of view often aim at fairness, but fail to do full justice to the actor's perspective, by ignoring the horizon of possibilities and the limits of prediction available to those who made these claims. This paper will focus on element 43, now known as technetium, and predicted by D.I. Mendeleev as an element yet to be discovered. In his 1871 table, he left a gap for an element with an estimated atomic weight of 100, for which, contrary to eka-boron, eka-aluminium and eka-silicium, he didn't provide detailed prediction of the physical properties and chemical behavior. Chemists struggled to isolate what was provisionally called eka-manganese. While Mendeleev is credited with making a successful prediction because the atomic weight of Tc is indeed close to 100, other unpredicted properties of the element 43, like its radioactivity or unstable character, do not feature in these narratives. Many claims were made for element 43, and names proposed (canadium, davyum, ilmenium, lucium, masurium, neo-molybdenum, nipponium), within the frame of the periodic system and outside of it, that were not met with acceptance by the chemical community. This paper will analyze such episodes, in the context of the knowledge of the time, shared or predicted, and the means of assessing a discovery. Special attention will be given to attempts of rehabilitation, endeavoring to demonstrate the predecessors had indeed "seen" the element though unable to reproduce the piece of evidence needed, or recycling, trying to assign the dismissed discovery to another element.

Tuesday 1 September, 16.00-18.00

Room 11: *The Decision. Edoardo Amaldi and science without borders*

Documentary directed by **Enrico Agapito** and written by **Adele La Rana**
Historical and scientific advisors: **Giovanni Battimelli** and **Adele La Rana**
Duration of the docufilm: **77 min.**
English subtitles

After its successful screening at CERN last December, the docufilm recounting the life of the physicist Edoardo Amaldi arrives in Bologna. Close collaborator of Enrico Fermi in Rome in the 1930s, Amaldi became a key figure in rebuilding Italian and European science after WWII: founding father of CERN and of ESA, pioneer in the search for gravitational waves, active supporter of nuclear desarmament. The docufilm describes Amaldi's life through many original interviews, archive repertoires and specially created historical reconstructions. It took over three years of work to collect around 30 illustrious interviews (for a total of over 30 hours of oral history) and a thorough study of archival materials, which are partly unpublished**.** The actions of Edoardo Amaldi (1908-1989), his vision of international scientific cooperation and his extraordinary far-sightedness marked the most important events in the development of Italian and European scientific institutions from the post-war period until the eighties. During the period of post-war reconstruction, he had a leading role in the establishment of the National Institute of Nuclear Physics and the first National Laboratories in Italy. At the international level, his contribution was decisive in the foundation of CERN, the great European laboratory for elementary particle physics - of which he was the first General Secretary - and in the design of ESA, the European Space Agency, institutions that constitute today the greatest monuments to Amaldi's work, according to the words of Nobel laureate Carlo Rubbia. Starting from Amaldi's education as a young scientist, in the group directed by Enrico Fermi at the Royal Physics Institute of via Panisperna in Rome, the documentary film ranges from the years of birth of nuclear physics up to the post-war research and to the following promotion of pioneering experimental activities, such as the search for gravitational waves. In parallel with his scientific activity, the docufilm describes how Edoardo Amaldi matured his sense of civil responsibility and his Europeanism during the dramatic period of World War II, becoming afterwards a statesman of science who put all his effort in promoting scientific cooperation among European countries and the peaceful use of nuclear physics. First Italian to participate in the Pugwash Movement, in 1962 he gave birth together with his young colleague Carlo Schaerf to the first international school devoted to nuclear disarmament topics: ISODARCO. Edoardo's ability in looking at the far future, his Europeanism and his civil committment, against any personal interest, are today more than ever a concrete example of how the will and clarity of intent can give good and lasting fruits, a precious message of optimism especially for young people who approach scientific, social and political studies. The documentary is a production of Enrico Agapito Realizzazioni AudioVisive, co-financed by Zanichelli publishing house and TERA Foundation, accomplished with the support of the INFN (Italian National Institute for Nuclear Physics), the contribution of the Department of Physics - Sapienza University of Rome, the patronage of the Edoardo Amaldi Foundation - ASI (Italian Space Agency) and Hypatia Consortium, and of the Italian Society for the History of Physics and Astronomy.

The documentary will be followed by a round table with **Ugo Amaldi** (CERN, TERA Foundation), **John Krige** (Georgia Institute of Technology, USA), **Luciano Maiani** (Emeritus Professor, Sapienza University of Rome, Italy), and **Adele La Rana** (University of California Riverside, USA)

Wednesday 2 September, 9.00 - 11.00

Room 1: S77 - Internationalism, Nationalism and Localism. Images and Places of Mathematics in Europe from Napoleon to the Wars of the Twentieth Century - 3

Sponsored by SISM - Società Italiana di Storia delle Matematiche (Italian Society for the History of Mathematics)

Conveners: **Maria Teresa Borgato** (University of Ferrara, Italy), **Erika Luciano** (University of Turin, Italy)

Chair: **Erika Luciano** (University of Turin, Italy)

1 **- Livia Giacardi** (University of Turin, Italy)

Geometric Models in Mathematics Teaching in Italy at the Turn of the Twentieth Century

The aim of my talk is to examine the intertwining of mathematical research with modelling activity in Italy in the period running from the mid nineteenth century to the early decades of the twentieth century. In particular, I intend to address the following questions: why Italy remained marginal in the activity of conceiving and constructing geometric models for university teaching; the triple function of Beltrami's cardboard model of pseudospherical surface in comparison with the use of abstract models by the geometers of the Italian School of algebraic geometry; and if and how visualisation and manipulation of concrete or abstract models contribute to the construction and transfer of the mathematical knowledge.

2 - **Salvatore Coen** (University of Bologna, Italy)

Cesare Razzaboni, his work and the renewal of engineering studies in Bologna

Cesare Razzaboni was a brilliant student in Modena where he graduated in Mathematics and Engineering. Professor of Hydraulics and Rational Mechanics at the Universities of Modena, Rome and Bologna. His personality, after the extensive essay of F. Cavani was almost ignored. His main field of interests was hydraulic engineering, but he also worked in Mathematics, Geodesy and he was also a politician. The lack of a good, capable, efficient Italian national leadership, respectful of the common good was one of the greatest problems of post-Risorgimento Italy. The purpose of this talk is to show that Cesare Razzaboni was such a manager, appreciated by Cremona and Sella. I will try to do this by briefly illustrating the main moments of Razzaboni's public and scientific life. Scientific interests. In his scientific studies of the early years Razzaboni showed several interests that ranged from parallax problems to History of Mathematics issues. It was during the period in Rome that his made the final choice to devote himself to hydraulics problems closely related to mathematical methods that he mastered. When Razzaboni finally had tools to perform experiments in Bologna, he turned decidedly towards problems of experimental hydraulics. The foundation and direction of the Application School for Engineers in Bologna was perhaps his greatest achievement.. Razzaboni was certainly an example of local personality, ignored outside of Italy. In the first years after the Risorgimento, the country needed high-level leaders who knew their country in depth locally. They had the task of creating the men and structures for the future of a great European country.

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3 - **Cinzia Cerroni** (University of Palermo, Italy)

The Mathematical Circle of Palermo: internationalism and local influences

With its almost 1.000 members, in 1914 the Circolo Matematico di Palermo was one of the most important mathematical association in the world and its journal Rendiconti included papers of great value by Hilbert, Klein, Borel, Picard, Fredholm, Moore, Volterra, Segre, Castelnuovo, Enriques, Bianchi, ... When the first world war broke out, the new director of the Rendiconti, Michele De Franchis, had to face a very awkward situation. While he intended to faithfully follow the ideals of scientific internationalism that had characterized the Circolo since its very beginnings, some members of the editorial board strongly demanded the exclusion of German associates. Between 1914 and 1928, the Circolo was perhaps the only European scientific society with German as well as French associates. During the '30s, the nationalist and localist politics of the fascism will severely damage the Circolo. We will use the rich correspondence in the Circolo's archives to shed some light on this evolution.

4 **- Aldo Brigaglia** (University of Palermo, Italy)

Le premier éclair d'un rétablissement des anciens liens qui unissaient les savants de toutes les peuples et de toutes les race, Edmund Landau and the Circolo Matematico di Palermo, 1919 - 1934

Edmund Landau was member of the editorial board of the Rendiconti del Circolo Matematico di Palermo since 1909 and had published here 11 papers before the first world war. In 1919, immediately after the world war, a correspondence began between Landau and Michele de Franchis, dealing with the necessity to restore international links among scientific scholars. In my talk, I will try to focus on this correspondence and the underlying problems in the mathematical community.

Room 2: **S52 - Sight, Touch and the Material Culture of Nineteenth-Century Medicine**

Convener: **Beatriz Pichel** (De Montfort University, UK)

This panel will explore how sensory engagements with bodies and objects such as photographs shaped nineteenth-century medical encounters. Through the examination of different medical disciplines, including pathology, psychiatry, dermatology and anatomy, this panel situates the senses, mainly vision and touch, as key practices in the making of medical knowledge. In particular, the four papers highlight the variety of ways in which practitioners used their senses to examine the living and dead body. Wynter and Wallis demonstrate that smelling, touching and seeing the dead body became key elements in understanding the cause of death, but while Wallis' paper focuses on the standardisation of sensory and material engagements in the postmortem examination, Wynter shows that science and fiction coexisted in the study of phenomena such as spontaneous human combustion. Rawling and Pichel offer new perspectives on medical photography, arguing that photographing patients disrupted visual observation by introducing several points of view and new tactile engagements with casebooks and other objects. All together, these four papers problematise the senses, bringing to light the many ways in which haptic engagements with the body and other objects formed the basis of nineteenth-century medical knowledge.

Chair: **Beatriz Pichel** (De Montfort University, UK)

1 - **Jennifer Wallis** (Imperial College London, UK)

'A good, firm, kitchen table and a piece of stout mackintosh': The sensory and material culture of postmortems in private houses, c.1850-1930

In 1882 the Students' Journal and Hospital Gazette reported with distaste that a postmortem had recently been performed in London 'in a room where five persons lived, ate, and slept'(1). Such events were not unheard of: postmortem manuals of the period often contained advice for practitioners who might find themselves conducting a postmortem in a district without a mortuary, or in a particularly remote area. This paper will explore the material and sensory culture of postmortems undertaken in these private, non-clinical, spaces. To undertake such a procedure in a domestic setting required innovation on the part of the practitioner. Kitchen tables, doors, and beds were put to use as tables; household rags and sheets were torn up to use as swabs; bowls and other utensils were employed to scoop out liquids and hold organs, and coffee grounds were thrown onto fires to mask unpleasant odours. Repurposing household objects in this way disrupted domestic space in a similar way to that described in Amy Bell's work on criminal abortions carried out in private houses during the twentieth century (2). Transforming the home into an ad hoc space of pathological examination necessitated both the subversion of domestic material culture and the careful masking of that subversion: choosing a nondescript bag large enough to carry instruments and specimens, cleaning blood from borrowed utensils, and ensuring that no odours lingered in the house after the procedure. By exploring such practices, I argue that the historiography of death in the nineteenth and early-twentieth century has so far overlooked the role of private postmortems in configuring contemporary attitudes towards, and knowledge about, pathological examination.

References

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(2). Amy Bell, 'Abortion Crime Scene Photography in Metropolitan London 1950–1968', *Social History of Medicine*, 30 (2017): 661–84.

2 - **Rebecca Wynter** (University of Birmingham, UK)

'The incinerated moustache' and 'Major Sewall's thumb-nail': Applying the Scientific Senses to Spontaneous Human Combustion

In Aberdeen, Scotland, in 1857, Dr J. MacKenzie Booth – physician to Aberdeen General Dispensary, and Lecturer on Diseases of the Ear and Larynx at the University of Aberdeen – attended 'a case which vividly recalled the old tales of spontaneous combustion, and more especially an article that I have read on the subject by … Professor Ogston'. These tensions between folklore and scientific study are found throughout the literature on spontaneous human combustion, yet reporting in both fact and fiction paid special attention to the sights, sounds, smells and textures of burning and burnt human material. This paper will explore how the senses have been engaged to evidence true-to-life incidents and scientifically to assess and experiment around spontaneous human combustion. Using examples from nineteenth and twentieth-century Britain, it will suggest that the phenomenon enabled an array of people to engage in a kind of materials science, though one that was firmly rooted in morality rather than method. The paper will demonstrate that whether in male fiction or scholarly writing, spontaneous human combustion was thought evidence of poor-quality human material – alcohol-soaked, corpulent, old, or female fabric.

References

J. MacKenzie Booth, 'Case of So-Called Spontaneous Combustion', *British Medical Journal*, 1 (1425), 21 April 1888, pp. 841-2.

3 **- Katherine Rawling** (University of Leeds, UK)

Making sense of insanity: photography in the nineteenthcentury asylum

Many surviving asylum casebooks from the second half of the nineteenth century contain photographs of patients. These images had several uses in both the institutions that produced them and in wider medico-psychiatric practice, from recording a 'true likeness' of an inmate to providing a visualisation of particular symptoms or pathologies. As images, casebook photographs are highly varied in style and content and are informed as much by artistic and photographic conventions as by scientific or medical priorities. As a result, patient photographs occupy an ambiguous space between scientific or clinical data and 'art' broadly defined. However, making, using and viewing patient photographs requires more than the engagement of sight and vision alone. In this paper I move beyond an analysis of patient photographs as only 'representations' and focus on the materiality of casebook photographs and their status as image-objects to consider the ways in which other senses like touch were involved in using and understanding patient photos. The photographs contained in the casebooks from institutions like Holloway Sanatorium, Surrey (c.1880- 1910) were cut and shaped, reprinted and annotated, manipulated and arranged in experimental and varying ways. These processes required the engagement of sight and touch and highlights that taking and viewing photographs, whether for an album or medical casebook, are embodied practices. By paying due attention to the role of touch as well as sight, and by viewing casebooks as photographic, as well as medical, records, we can consider asylum casebooks as creative and productive spaces, in which medical knowledge was produced, disseminated and understood.

4 - **Beatriz Pichel** (De Montfort University, UK)

Engaging the senses in medical photography

By the 1900s, medical photographs were 'mainstream' but this does not mean that they were standardised. Just as commercial photography, medical photography followed a variety of styles, formats and methods. This diversity responded to two factors: the specialisation of the medical field in different disciplines and the emergence of photographic innovations such as stereoscopic photography, chronophotography, the magnesium flash and artificial lighting, silver gelatine dry plates, film and halftone reproductions. In this presentation, I will argue that the application of photographic innovations to the medical field, did not stabilize the sense of sight, quite the contrary. With this aim, I will focus on two case studies: the photographic production at the Hôpital de Saint Louis (Paris) and the emergence of medical stereo photography. Sant Louis was a renowned centre for the treatment of skin and venereal diseases. Besides illustrations and wax models, it developed its own photographic production, characterised by hand-coloured prints that highlighted the skin lesions. For its part, stereoscopic photography promised three-dimensional vision and was mainly used in anatomy education as well as forensic medicine. While very different, both case studies share the same aspiration to use photography to enhance the sense of sight. Yet, the result was not the standardisation of vision but, at the contrary, the multiplication of visual engagements. The photographs taken in Saint Louis had to be compared with wax models and stereoscopic photography created different experiences in the viewer depending on whether they were looking at the cards or through the stereoscope. The application of photographic innovations to the medical field, therefore, problematized the sense of sight. It consolidated its power as a medical tool at the same time that challenged it, bringing to light the inherent multiplicity of points of view and their relation to the sense of touch.

Room 3: **T10 - Supernatural and Criminology**

Chair: **Monica Azzolini** (University of Bologna, Italy)

1 **- Eva Yampolsky** (University of Lausanne, Switzerland)

The materiality of the supernatural: the pharmacological function of relics in the miraculous healings at Saint-Médard in 18th century France

In this conference, I propose to present my current research in the history of medicine on the miraculous healings in the movement of the Convulsionaries of Saint-Médard, in early 18th - century France. More specifically, and on the basis of extensive archival research, I will present the porous relations between the natural medical therapeutic experiences of the Convulsionaries and their subsequent supernatural, miraculous healings. I will show that "patients" play an active role in the healing process (both natural and supernatural), particularly through their use of relics of the Jansenism deacon François de Pâris. Indeed, at Saint-Médard, relics acquire a pharmacological function, in continuation of other medical therapeutic approaches. They become the material, even medical, vehicle for the supernatural, which the patient can inscribe within the vaster healing process. Through a reading of first-person accounts of miraculous healings, I will show that the patients' use of relics resembles that of other natural remedies, allowing for "home-based miracles". According to my hypothesis, the patient's ability to trigger the supernatural convulsions through his or her contact with the relics, and which consequently bring on the miraculous healing, represents a new medicoreligious model of miracles. Thereby, the patient acquires an active function within the supernatural. More specifically, in this conference, I will analyze the different kinds of relics used by the Convulsionaries, their circulation, their precise uses, as well as their role in the healing process. Indeed, the miraculous healings of Saint-Médard are progressive and incomplete, challenging the ecclesiastical canon. As I will try to show, this specificity allows for a new role for the patient within his or her therapeutic process.

2 **- Francesco Paolo de Ceglia** (University of Bari, Italy)

Criminals, saints and some vampires. The natural, the preternatural and the supernatural in the different early modern European cultural contexts

According to a middle and north European tradition, the cadaver of a murdered person would start bleeding in the presence of his or her assassin: "Therefore, when you create a contact between the breath of the murderer and the spirit that has remained in the blood of the murdered, the blood boils and rages [ebullit effervescitque sanguis]". Reading such accounts, one may be struck by their similarities to the chronicles of the so-called "miracle of saint Januarius" in Naples, in which the verbs ebullire and effervescere were usually used to describe the behaviour of the blood of the martyr in the presence of his own head. In my talk, similarities and differences between the two ritual phenomena will be used as a litmus test to shed light on the relationships between the natural, the preternatural and the supernatural in, at least, two different early modern European cultural contexts. In other words, I will try to ascertain to what extent knowledge of what nature can or cannot do has been culturally (religiously, ethnographically, juridically etc.), but also "sensorially" (the perception of judicial rituals, processions etc.) determined or at least influenced.

3 - **Andrea Graus** (French National Centre for Scientific Research - CNRS, France)

Scientific demonstrations and the commodification of child prodigies in Paris

This presentation looks at the interplay between the scientific – especially psychological – interest in child prodigies and their commodification in the press and the popular cultural. In particular, it analyses the visual and material culture of child prodigies performing in Parisian scientific meetings and savant societies during the nineteenth and early twentieth centuries. At that time, the new entertainment industry was located in the cities, which became poles of attraction of gifted children on an international

scale. From 1850 onwards, child prodigies from all over the world invaded theatres and cafés in fields as diverse as mental calculation, the variétés, literature, chess and languages. Many of these children were examined in congresses and scientific societies, such as the Academy of Science, and competed against adults, for example in arithmetic and chess competitions. The visual and material sources I will take into account range from posters, press images, cartes de visite, short films and different commodities related to these children and their demonstrations. Particular attention will be given to cases such as Samuel Reshevsky (1911-1992). In 1920, this 8-year old chess prodigy undertook a tour around Europe, including Paris, beating some of the best professional players in simultaneous games. Just like other child prodigies, he became a "commodity" and psychologists and physicians took the opportunity to examine him while on tour.

4 - **Lara Bergers** (Utrecht University, Netherlands)

Smelling a Rat. The Use of the Senses in 20th Century Dutch Criminal Investigations and Trials

Dutch police reformer W.H. Schreuder, in his 1930 manual on the crime scene, enjoined investigators to use not only their eyes, but also their other senses. Solving a crime, for police officers, criminalists and forensic pathologists alike, required full engagement of the sensory apparatus. In practice, however, much of the evidence presented to the court in criminal cases hailed mainly from visual observation. Assisted by visual technologies such as schematic drawings, photographs and physical evidence, professional witnesses helped the court see how the facts had unfolded. In the last two decades, historians of forensic science have examined the powerful role played by visual investigative technologies, such as photography, and the visual representation of (scientific) evidence in criminal proceedings. Many such histories have placed the ability of jurors to visualise the facts — to be 'virtual witnesses' — front and center. The Dutch legal system, however, does not make use of juries. This paper therefore offers a different angle on the problem of visual evidence practices. In addition, I address the fact that the — apparently minimised — role played by the other senses has thus far received little attention. Exhortations such as Schreuder's should make us wonder: did smell, hearing and touch indeed play a negligible role in criminal investigations and trials? If yes, why? And since when? Thus, in this paper, I develop an understanding of the role of the senses in Dutch 20th century criminal investigations and trials. What was the status of evidence gathered by each of the senses in Dutch criminal investigations in the 20th century? And how did the use of the senses relate to conceptions of expertise held by police officers, lawyers and judges, and forensic experts? To answer these questions, I examine case files from homicide and sexual assault cases from the period 1930-1979.

5 **- Fabio Frisino** (University of Bari, Italy)

Tarantism: a Psychiatric Controversy in the Twentieth Century

In Southern Italy, Tarantism has attracted the medical interest from every corner of Europe for centuries. According to the tradition, the bite of the Apulian tarantula could provoke a dancing mania during the summer months. Despite the elimination of arachnidism as a causative factor during the eighteenth century, the problem of the real nature of tarantism was still strongly debated. This contribution seeks to reconstruct a psychiatric controversy that occurred, in the twentieth century, between the studies of Ernesto Giordano and those conducted by Giovanni Jervis and Letizia Jervis-Comba. Among the various problems, the methodological choice was crucial in order to conduct an adequate study. In this regard, the use of projective psychological tests, such as the Rorschach test, was central and denoted a particular sensory approach to tarantism. However, the modality in which the test was carried out and the lack of knowledge of the culture of the cases analysed posed several problems regarding the reliability of the results. The aim of this presentation is taking into account different issues of this debate, such as: the considerations and the use of the Rorschach test; the interpretations about the etiology of the phenomenon; the relationship with other mass hysterical phenomena; the nosographic status of tarantism.

Room 4: S62 - Diplomacy and Images in Science - 1. Scientific Images and International Rivalry

Sponsored by IUHPST/DHST Historical Commission on Science, Technology and Diplomacy

Conveners: **Simone Turchetti** (University of Manchester, UK), **Matthew Adamson** (McDaniel College, Hungary)

Recent scholarship has emphasized the visual aspects of public diplomacy in an effort to demonstrate that international negotiations are more than just a "logo-centric practice" (Constantinou, 2018). Given the growing emphasis on the interaction between science, technology and international affairs, there is scope for extending this inquiry on "visual diplomacy" to scientific images and/or images of scientists and diplomats. The relevance of scientific images in diplomatic practice has been recently captured by US President Trump's controversial statements, supported by a crudely assembled weather map, that Alabama lay in the path of Hurricane Dorian, a faux-pas that echoed around the globe. Visualized scientific data convey messages and meanings in international affairs, especially in connection with global challenges (Wormbs, 2013). This symposium aims to deepen our understanding of how scientific images and images of scientists, diplomats, and scientific practices shape diplomatic activities. In particular, our contributors consider images of science meetings with a diplomacy angle; on big science/technology artefacts shaping diplomatic relations (e.g. CERN), scientific images playing a substantive role in international diplomacy (e.g. climatology, forensic seismology); satirical cartoons/comics referring to international events with a science/technology element. This exploration encompasses different historical periods in the modern and contemporary eras, looking at the role of, for instance, cartographic images and press reports in the shaping of diplomatic practices. The symposium is divided into three sessions of ca. 25 minutes - presenters to start the talk with one image or set of images.

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Chair: **Simone Turchetti (**University of Manchester, UK)

1 - **Gordon Barrett** (University of Oxford, UK)

Competing Images of Chinese Science: Photography in the Communist-Nationalist Battle for International Legitimacy during the Second World War

This paper elucidates the complexities and competing agendas in 'visual diplomacy' about Chinese science during the Second World War. Reflecting China's fragmented and contested political landscape of the time, it discusses photographic collections of scientific research and education produced by multiple key actors: the internationally recognised government of the time led by the Nationalist Party (KMT); the Chinese Communist Party (CCP), the KMT's rivals for power in China's long-running civil war, which also controlled significant areas of the country; and the British biochemist Dr. Joseph Needham, who spent 1943-46 heading the British Council-sponsored Sino-British Science Co-operation Office and as Scientific Counsellor to the British Embassy. During these years, Needham undertook a range of activities to strengthen Sino-British scientific relations and support scientific research and education during China's war with Japan. Needham was himself a keen photographer and diarist, recording of his interactions with a staggering range of Chinese scientists and scientific organisations. These formed the basis for a series of reports he produced for the British government on the state of science, industry,

and natural resources in China as well as featured prominently in his public writings and presentations on these things. Needham also drew on and disseminated both the KMT and CCP's carefully staged images of science in the regions each controlled which provided competing visions of Chinese science, each tied to contested narratives of political legitimacy and ideology. These collections of images therefore provide an opportunity to understand visual science diplomacy in the context of intersecting domestic and international conflicts which would feed into the post-war science diplomacy of both CCP and KMT, as well as wider understandings of science in twentieth-century China.

2 - **Lif Lund Jacobsen** (Danish National Archives, Denmark)

Seismograph Diplomacy

When diplomatic negotiations for a Test Ban Treaty began in 1950s, the US and USSR had to agree on a mutual nuclear monitoring regime. Seismic surveillance could provide such a mechanism, but the negotiations were hampered due to the lack of standardized seismographs. Seismic stations around the world recorded signals on instruments with different frequencies and ranges, making it hard to compare data received at different stations around the world. Effective detection of nuclear explosions required the presence of modern standardized equipment at all seismic stations of international importance. At meeting in Genève in 1958 and 1959 seismologist from east and west discussed the different models of seismographs threshold capabilities for detecting nuclear explosions. By 1959, it became clear that the US and USSR's scientific arguments were influenced by political objectives. In response to the scientist's inability to reach a consensus, the US, under the VELA program, initiated the World-Wide Standard Seismographic Network (WWSSN) in 1960. The networks full surveillance purpose was not disclosed to the participating nations, but instead presented as an advancement of basic seismology. The first standardized seismograph was installed in 1961. By the next year, the US-team had installed 52 standardized systems around the globe. By 1964, 75 stations had been gifted with new, standardized instruments. At its peak, the WWSSN consisted of 120 stations worldwide. Although invited, organizations in Eastern Bloc countries did not participate in the WWSSN. Nor did China, France and French-speaking African countries. The progress of the WWSSN was presented in a global circulated newsletter propagating the benefits of the network. Each issue also featured a global map of WWSSN-station, showing the lack of stations in the USSR had none, illustrating how the USSR had chosen not contribute to the advancement of seismology.

3 - **Daniele Cozzoli** (Pompeu Fabra University, Spain)

American media and the Scientific and Technological Collaboration between the USA and USSR from Sputnik to détente

By analysing the visual representation in American media of Soviet science, this talk assesses the circulation of knowledge between the USA and USSR during the Cold War and its relation to scientific diplomacy. It focuses on the rational and the emotional factors that led the two superpowers to establish scientific and technological collaboration from the late 1950s through the 1970s. The 1957 launching of Sputnik led to the signing of the Lacy-Zaroubin agreement in the following year. Under this scheme, the US National Academy of Science and the Soviet Academy of Science promoted visits of medical investigators to laboratories and health facilities and lectures and seminars by researchers throughout the 1950s and the 1960s. By the end of the 1960s, during détente, the USA and USSR started a number of scientific and technological collaborative programs even in strategic sectors, the most important of which was the Apollo-Soyuz project. Space sciences and biomedicine were in fact the sectors in which most of the collaboration was concentrated. These projects were rooted in the scientific diplomatic work carried out in the previous decade. Historians have stressed the role of the de-Stalinization in the establishing of bilateral scientific collaboration. However, beyond the Cold War rhetoric of the peaceful coexistence initially and of the détente later, in this talk a number of other geopolitical and economic factors are taken into account. The creation of the European Economic Community and the

establishment of intra-European scientific institutions are considered as crucial factors in pushing Soviet Union both to look for multilateral scientific collaboration within the Comecon space and to promote scientific and technological collaboration with the USA. With the creation of the EEC, indeed, Eastern Europe industrial products lost competitiveness and could be hardly exported to Western Europe.

4 - **Pascal Griset & Anne de Floris** (Sorbonne Université, France)

Show, Not Tell? The Astronaut as Political Mascot or as an Ambassador?

On July 20, 1969, Neil Armstrong's first steps on the Moon were broadcasted live around the world. Hundreds of millions of people witnessed an astronaut accomplishing the greatest technological achievement ever presented on television as well as an undeniable expression of an American leadership - a leadership casting a long shadow on the definition of future space policies. Through the deployment of complex media system and highly symbolic imagery, this global mediatic event helped to define the range of visual strategies used afterwards by US agencies to communicate their space activities. Be it to establish the new cooperation (i.e. the 1975 ApolloSoyuz flight), to mourn the Challenger crew in 1986 or to make the ISS a paragon of future international collaboration. This imagery thus made it possible to connect, in a shared psychosocial place, scientific realities and foreign policy imperatives. Human spaceflight offers a layout for what is still to be explored as a "visual diplomacy", by associating the presence of a subject, the astronaut who physically embody political issues, with the cold object of communication. Techno-scientific images thus convey a wide variety of materials, uses and meanings. In this paper, we choose to focus on the astronaut as a media subject, arguing that this space protagonist is at the juncture of national imperatives and international global challenges. By studying photographic and filmic representations of European astronauts since the late 1970s, in the light of the iconographic codes developed since the beginning of the Space Age in the United States and the USSR, we propose to investigate the diplomatic effects produced by space images at a time when internationalization and coopetition blurred power relations in space endeavors. The paper will also address the issue of television coverage looking at what infrastructures and networks were mobilized and what speeches were broadcasted through live images.

Room 5: **T17 - Cartography**

Chair: **Matthieu Husson** (Paris Observatory, France)

1 - **Chiara D'Agostini** (University of Southern Denmark, Denmark)

A multisensory approach to cartography. The case of Planudes' rediscovery of Ptolemy's Geography

At the end of 13th century, the Byzantine polymath Planudes discovered a copy of the Geography, a treatise on cartography penned by the 2 nd -century AD mathematician and astronomer Claudius Ptolemy. Such a "rediscovery" has been regarded as a cultural turning point: unlike other geographical works read by the Byzantines, the Geography offered a mathematical view of the world, providing instructions and coordinates so as to draw maps. Scholarship has duly emphasized the scientific relevance of Planudes' enterprise and its impact on the way Byzantine elites looked at the world. And yet a focus on the mathematical dimension alone leads to a historiographical distortion, as it neglects the visual and performative impact of Ptolemy's cartography in Byzantium. My aim is to bring the materiality of the maps back into the picture, raising at the same time broader questions on the conceptualization of "science" in the pre-modern world and in a non-western European cultural context. To this end, I will analyze the epigrams devoted by Planudes to the Geography and specifically to its maps, as I argue. The epigrams' performativity creates a multisensory environment, which in turn affects the understanding of the cartographical objects through sight and hearing, indicating the appropriate way to approach the maps. I will also show that Planudes assumed a manuscript of the Geography to be

visually present before his audience. The materiality and visuality of both the Geography and its context of consumption contribute to define the nature of the work. Conceiving of the Geography as a disembodied scientific treatise equals to betraying it twice: not only does such an approach overlook the manifold (cultural, political, etc.) relationship between the object (the map) and its physical counterpart (the world), it also disregards the way science was undertaken in 13th-century Byzantium, that is through the materiality of books.

2 - **Friederike Frenzel** (Technical University of Dresden, Germany)

About the Sensuality and Sensibility of Charts Flattening the Earth while Circumnavigating the Globe with James Cook

On his first Voyage round the World (1768-1771), James Cook encountered the Polynesian navigator Tupaia and worked closely with him on several drawings. The most notable result of this "British-Tahitian collaboration" is known as "Tupaia's Chart" (Parsons 2015). The European charting of the globe at that time was a playing field for new and exciting scientific disciplines, techniques and instruments, and grounded deeply in a collaboration between scientific institutions and state, entrepreneurial and military ambitions. To break down an only partially and sensually perceived complex, multi-faceted world into codified presentation formats that are readable and comprehensible for instructed users makes up the inherent ambiguity of European 18th century maps and charts as well as the foundation of the modern concept of scientific objectivity (Daston; Galison 2007). The possibility of action in real time and space opens up, if the map user only finds and situates themselves inside of the aesthetic plainness of the map. Just like navigators and mapmakers, users of maps observe and participate alike, actively contributing to the "cartographic paradox" (Krämer 2012). Tupaia's Chart is a rare example of European and Polynesian concepts merging at a time, where European endeavours to map the world were still in their early, pre-colonial stages – a dynamic process with a focus on problem solving and thus an openness for contributions and other perspectives. Subjective world perception is indeed not a counterpart for mathematical cosmography, but lies at its core. In the act of accurately representing and depicting the perceived world, it is decidedly warped, which raises questions of truth, establishment of reality, perspectivity and intercultural communication anew.

3 - **Oyndrila Sarkar** (Presidency University Kolkata, India)

Maps & Manuals: Visual Cartography in the Indian subcontinent 1820-1890

The extension of Trigonometrical Surveys in late 19th c British India created a need to employ and educate all surveyors – those working both on field as well as in different survey offices. Field cartography and survey operations were impossible without the help of a specific genre of professional manuals and handbooks, outlining tips, hints, rules and methods for both the romantic explorer and the scientific surveyor. Visual culture in circulation did not remain restricted to the printed word alone. With the establishment of the map production department and the Photographic and Lithographic department in Calcutta, the print market saw the proliferation of maps and the Atlas of India, which were made, duplicated, copied and circulated to both libraries as well as the headquarters of the Survey of India. The printed cartographic material, which was published and circulated, was indispensable to army officers, indigo planters, ameens, residents and students alike. They not only supplied the survey department with information, they also were indispensable to civilians who came in contact with the survey operations. Both print and image found their way into the teaching curriculum and evaluation processes in the nascent Survey Schools, being set up all over India. It was a formative moment of the making of the discipline of surveying, quite different from the cartographic praxis, but deeply entwined. This paper deals with the printing and publishing of cartographic material – handbooks and manuals and maps and atlases - which would be of practical help to all surveyors and their assistants, caught in an uncertain era of no proper survey instructions, to help them to not falsify data and maintain uniformity, accuracy and keep the standards of surveying intact. This print culture would eventually lead to the building up of a rich cartographic archive in the Indian subcontinent.

4 - **Lachlan Fleetwood (**University College Dublin, Ireland)

'The Snow-line and the Arid-line': Attempts to Scientifically Define and Visualise the Limits of Habitability in Imperial Maps and Gazetteers of Central Asia

In a contribution to a 1930 special issue of The Geographical Journal on 'The Habitable Globe,' Albrecht Penck argued on the basis of Central Asia that 'the snow-line and the aridline are the most important border lines for human life on the land.' This claim followed more than a century of unprecedented imperial attempts to scientifically define the limits of habitability, even as it was increasingly recognised that these limits were not static and could change over both short and long timescales. In this paper, I examine the various ways that surveyors and naturalists, spurred by imperial insecurity around a key frontier of British India, attempted to measure and visually map data for climate, biogeography and hydrography in Central Asia. By considering a series of imperial maps and gazetteers of the Pamirs and the Hindu Kush (regions both elevated and dry) across the long nineteenth century, this paper considers how new scientific measurements fed into environmental imaginaries of these regions, and how these shaped imperial policies. Here, I show that in mapping the limits of habitability, imperial agents often described landscapes beyond as empty, uninhabited and uninhabitable, which served as justifications for appropriation. At the same time, however, I demonstrate that their ability to operate in these spaces (and often their very survival) relied on pre-existing networks. Throughout, I thus foreground the 'hidden histories' of expertise and labour on which these measuring and standardising projects relied. Ultimately, this approach allows me to reflect more broadly on the way nineteenth-century imperial attempts to impose universality on environmental and geographical categories were uneven, contested and incomplete.

Room 6: **S36 - New transnational perspectives on 20th-century organismic biology**

Convener: **Marco Tamborini** (Technical University Darmstadt, Germany), Jan Baedke (Ruhr University Bochum, Germany)

Over the past decades, we have broadened our understanding of 20th -century biology. The received view, according to which evolutionary biology was shaped by a hyper-selectionist and gene-oriented approach developed during the so-called Modern Synthesis of Evolution, has been considerably expanded and in part abandoned. Several so-far overlooked research traditions have been investigated in-depth, thus providing new insights into the development of 20th -century life sciences, like the history of evolutionary developmental biology or epigenetics. Although in recent years a significant positive trend is visible, more efforts are required before we can reach a comprehensive overview of how the various theoretical traditions, which featured the 19th and 20th centuries, impacted on and transformed 20th-century life sciences. This session aims to give a substantial contribution to such trend. It focuses on so-called organicist approaches to evolution. Organicism was characterized as a third way between vitalism and reductionist mechanicism. From four different geographic perspectives, the papers in this panel investigates central features of this holistic and organism-centered biology. By exploring four emblematic case studies across the German-speaking world, Anglophone biology, central American field research, and Italian biology, the papers will point out the practices of 20th -century organismic biology, situate its theoretical agenda, as well as analyze its visual dimension. Thus, new material will be provided for re-considering the history of 20th -century biology and its impact on the theory of evolution.

Chair: **Elena Canadelli** (University of Padua, Italy)

1 **- Jan Baedke & Abigail Nieves Delgado** (Ruhr University Bochum, Germany)
The endosymbiosis of the endosymbiotic theory: Meyer-Abich's and Böker's work on developmental evolution

In the historiography of the endosymbiotic theory, Lynn Margulis has been credited as one of the (maybe the) most central names, thanks to her work on the mechanisms by which once independent bacteria became integrated as cell organelles in eukaryotic cells. However, around 30 years before Margulis started her famous work in the late 1960s, German theoretical biologist Adolf Meyer-Abich, from the late 1930s onwards, developed a comprehensive theory of 'holobiosis' on the evolutionary change and origin of form through symbiotic processes that anticipated key elements of Margulis' theory. Meyer-Abich argued that in order to explain evolution, one has to focus on describing the processes of assemblage of independent organisms, first as symbiotic partners, then holobionts ('Holobionten'), and finally systems of organs that contribute to a larger integrated whole. At the crucial evolutionary stage of holobiosis, the originally independent units are so closely interlinked that they cannot develop, grow, nor reproduce independently of one another. This holistic theory was itself a product of an endosymbiotic process, albeit a scientific one. In order to describe how novel traits, that no individual organism could produce on its own, evolve during holobiosis, he integrated the Lamarckian theory of 'Umkonstruktion' (reconstructuring) of anatomist Hans Böker. This approach described how during development, functional changes in organ systems were introduced, which had evolutionary consequences. In this paper, we focus on three elements of Meyer-Abich's (today largely forgotten) biotheoretical work: (1) The origin of his theory during his and Böker's joint research stay at the German-Dominican Tropical Research Institute in 1937, (2) the central empirical and theoretical components integrated in Meyer-Abich's approach, and (3) its visual dimension, especially his so-called 'Typenkreise' (type circles) that should represent the correlations of 'primitive' and 'differentiated' characters across taxa – an indicator of previous holobiosis processes.

2 **- Flavia Fabris** (Konrad Lorenz Institute, Austria)
The Philosophical Impact of Cybernetics on Waddington's Epigenetics

The presentation analyses Conrad Hal Waddington's systemic and antireductionist approach to biology, and explains its development in the period between the 1930s and 1950s. It will be shown that: (i) much of Waddington's work on epigenetics was deeply influenced by a process ontology of living systems; (ii) Waddington's process philosophy offered a new rationale for evolutionary biology, distinctly different from the one proposed by the architects of the Modern Synthesis; (iii) and lead the foundation for the systems approach. This is a well-worked territory for historians and philosophers of biology, but the presentation will challenge relevant aspects of the received view. Drawing from the first-hand study of papers, books, and correspondence letters from the Waddington's archive housed in Edinburgh, the research establishes a link between Waddington's reasoning and Whitehead's organicism, and argues that it was mainly Waddington's cybernetic reasoning –rather than organicism–, to lead the foundation for his novel scientific approach. Waddington's theory of developmental systems was initially entrenched in the general cybernetic framework of communication and control. Waddington took the work of Ashby Ross and colleagues beyond their familiar boundaries, toward a cybernetics of biological development, that he called epigenetics. Building upon Whitehead and Thompson's cybernetic works, and then on Ross' feedback-control concept, Waddington adumbrated, and then fully presented, the process of genetic assimilation. It will be shown that this link is fundamental to understand the conceptual dimensions of Waddington's processual epigenetics and to clarify what contributions it made to contemporary theoretical biology.

3 - **Marco Tamborini** (Technical University Darmstadt, Germany)
Form, Organism, and Architecture

Several approaches to morphology were developed in the first half of the twentieth century. Among them, a meticulous empirical investigation of form structures was established. This methodology was arranged as an active international network of biologists, who investigated the notion of analogy, convergence, and parallel evolution to emphasize their significant powers in illustrating morphogenetic and evolutionary mechanisms. The point of departure for their analyses was threefold. First: a deep aversion to Mendel genetics, and a suggestion that it couldn't be understood as the sole explanatory framework for biology; second: rebellion against the absolute power of natural selection in elucidating the origin and transformation of organic forms; and third: a strict refusal to view morphology as a mere ancillary discipline to phylogenetics. Instead, they considered morphology to be an independent, autonomous, and important biological discipline. They grounded these three stances on painstaking empirical work on morphological data. This paper will explore this network of scientists that called attention to what they referred to as "the architecture of organisms". The bottom-up examinations of the inner structure of form were particularly promoted by Giuseppe Colosi (1892–1975), a prominent Italian biologist. This approach was widespread in Italy and was shared by several international biologists such as by the Russian zoologists Michael M. Nowikoff (1876– 1965) and Lev Semyonovich Berg (1876–1950). In this paper, I will illustrate the practices used to investigate organic form, their peculiar "organismic" approach to evolution as well as the visual tools they developed.

4 - **Alejandro Fábregas-Tejeda (Ruhr University Bochum, Germany**), *The 'Organism' in Post-war Biology: Paths, Boundaries, and Environments*

The 'return of the organism' to the life sciences has been signaled by scholars with renewed emphasis in the last lustrum. The 'organism' is being conceptualized as a causally efficacious, autonomous, and active ontogenetic unit that transcends the properties of its parts (e.g., genes), whilst standing in a deeply entangled relationship with its environment. Albeit 'organisms' feature prominently in contemporary explanatory endeavors, this was not the case for most of the latter half of the twentieth-century. Organism-centered perspectives like British Organicism, German Ganzheitbiologie, Dialectical Materialism and Holistic Biology broadly construed thrived during the Interwar period; however, for some historians, the 'organism' disappeared from the ontology of the biosciences after the end of World War II. A common historiographic narrative places the blame in the advent of molecular biology, which signaled new tides of change in the financial policies of biological research that thwarted organismal-holistic initiatives. This work delves into what happened to organism-centered perspectives after World War II. I will concentrate on searching for continuities and epistemic breaks in the itineraries of organicist knowledge and practices, especially in the immediate years after the war ended and later decades which harbored manifold, not-easily-classifiable approaches that placed 'organisms' and 'environments' as centerpieces of theorization. Moreover, in the second part of this talk, I will focus on how the conceptualizations of the organism-environment relationship changed in postwar biology, stressing different answers to the so-called 'boundary problem' (i.e., if we grant that organisms are inextricable linked with and fully embedded in their environments, how to draw meaningful boundaries between the two?). I shall explore how the 'organism-environment boundary' was reframed and renegotiated after 1945 (for instance, I will discuss German theoretical biologist Adolf Meyer-Abich's 'complementarity principle' concerning the internal-external relation of organisms and environments), and provide reflections on the 'visual epistemologies' of this problem.

Room 7: **T11 - Modern Biomedicine**

Chair: **Maria Conforti** (University of Rome La Sapienza, Italy)

1 - **Janina Wellmann** (Leuphana University Lüneburg, Germany)

Visualizing Morphogenesis: The Art of Moving in Biology

Since ancient times, self-propelled movement has been considered the distinguishing characteristic of the living, setting it apart from mere matter. Motion has always been observed, described and visualized: the hidden world inside our bodies, for example, has been brought to life most vividly by cells "dancing", "swimming", or "curling" to name only a few metaphors. In my talk, I will present different concepts and visual representations of early embryogenesis, ranging from 19th century tactile models to 21st century vector fields. I will show how morphogenesis was framed in terms of moving cells and argue that motion in the living world is not a simple given but the product of theories and practices of seeing and observing, of the spaces opened up by optical devices and experimental set-ups, of technologies and forms of representation that generate and capture movement.

2 **- Enrique Wulff** (Institute of Marine Sciences of Andalucía, Spain)

Visualizing data with professor Tsugita: a history within distinct macromolecular classes

Following the emphasis on Tobacco Mosaic Virus (TMV) to encourage further studies of the successive model systems and modes of experimentation that shaped the growth of molecular biology, this study searches to establish the standing of Akira Tsugita in the history of bioscience research. The analysis aims to provide an explanation for the spread of the main mechanism that he proposed for the visualization of biological information. In the mid twentieth century, to harness the information content of the coding problem of how is determined the order of nucleotides in ribo- or deoxyribonucleic acid, as a UC Berkeley virologist Tsugita denied its mathematical nature and gave an answer of biological significance. Together with Fraenkel-Conrat, and in line with Sanger's experiment on insulin, Tsugita determined the number of nucleotides per amino acid in the tobacco mosaic virus DNA, noting three amino acid differences. A triplet code was assumed. As a result Marshall W. Nirenberg coined the term 'codon', in a work also deserving credit to Tsugita and Fraenkel-Conrat. Upon returning to Japan in 1961, Tsugita researched a framework for visualizing mutations in cancer and he established a cooperation with Masayori Inouye (then a Postdoc at Osaka University) and George Streisinger, who begins working with the zebrafish in the late 1960's. By 1966, their studies of mutants and recombination defined the mechanism of frameshift mutations and the structure of the T4 phage genome. In a Cold Spring Harbor contribution dedicated to Theodosius Dobzhansky, Tsugita confirmed both the nature of frame-shift mutations and the assignment of amino acids to triplets of nucleotides; also the first DNA sequence of a specific gene ever determined was theirs, albeit a partial sequence, 11 years before the Sanger's DNA sequence. Tsugita suggested the mechanism of translation of multiple open reading frames on a single viral genomic RNA, and moved to Europe, as a visiting Lecturer on leave of absence from the Osaka University at the University of Basel (1972-78) at first, and then as part of the staff of the European Molecular Biology Laboratory in Heidelberg (1978-1985), to establish and promote standards in DNA sequencing. From the mid- 2 sixties, he had established a correspondence with Sydney Brenner in Cambridge (UK) and, in line with his programmatic vision, once back in Japan in 1985, this time at Tokyo University, Tsugita's main interests became directly involved in a bioinformatics program. In the decades since 1990, assuming various top positions within the International Council of Science (ICSU), the late Tsugita afforded with the crossdisciplinary challenges of visualizing data within genomics, proteomics and glycomics, as the only way to keep pace with the increasing data production among sequence databanks.

3 **- Anne van Veen** (Utrecht University, Netherlands)

Sensing Suffering

In 1984, the registration of experiments using nonhuman vertebrates became legally required in the Netherlands, including the registration of the level of animal suffering involved. Additionally, the law stipulated that an animal experiment is only allowed when the benefits outweigh the suffering and that experiments involving very severe suffering are only permitted when they are 'of interest for the essential needs of human or animal'. To comply with this new law, researchers thus had to think about questions such as: what is suffering? how can we objectively measure suffering? how can we quantify suffering? A governmental working group Grading Suffering was established to provide answers. This working group wrote an extensive report, including philosophical reflections on suffering, lists of indicators of suffering for different species (ranging from body weight to 'sad eyes') and a flow chart with ten variables leading to a suffering score between zero and ten. The report also states however, that no objective criteria can be defined and that grading suffering will always be a subjective judgement by an individual. Caring for the wellbeing of tested animals is a job that involves a lot of tacit, embodied knowledge involving sensory sensitivity and attunement towards other animals. This type of knowledge is difficult to articulate and capture in written indicators. In this paper, I analyze how Dutch researchers and animal technicians dealt with this tension between the demands of the law to quantify suffering on the one hand and the belief that this is an impossible task on the other hand. For this, I use archival material from the Animal Experimental Committee of the Dutch National Institute of Public Health and Environment. I also draw on two case studies of animal experimentation, one involving cynomolgus monkeys used for producing the polio vaccine and one involving transgenic mice.

4 - **Shiori Nosaka** (EHESS Paris, France)

An unification of the world by vaccination: a case of Germany and Japan at the turn of the 20th century

During the 20th century, vaccination has become one of the most crucial measures taken by national and international health organizations against the propagation of cholera. As its starting point, historians have emphasized the massive vaccination program, carried out by Waldemar Haffkine in British India in 1894. That demonstrated a preventive property of his vaccine against cholera, and convinced international medical communities interested in control of the disease. However, the effectiveness of this product was not taken for granted from the beginning: although Haffkine's experimentation was overwhelming, its result was still controversial at the end of the 19th century. One should thus question as follows: what let vaccination take an important place in cholera control measures? To answer this question, this paper aims to show how agreement on the vaccinal method was made at an international level, focusing on German and Japanese cases. Being skeptical about Haffkine's method, bacteriologists of these countries tried to improve the vaccine by modifying its preparing process and theoretical explanation. The process of reinvention of vaccine through circulation of knowledge on the product, which occurred at the turn of the century, allowed not only to facilitate an international agreement on the vaccine, but also to determine geographical and social conditions of different places by the applicability of cholera vaccination. This would help to understand how the unification of technical intervention reconfigured a vision of the world, made by cholera outbreaks during the 19th century.

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Room 8: **T18 - Earth Sciences and Geography**

Chair: **Ezio Vaccari** (University of Insubria, Italy)

1 - **Elena Zanoni** (University of Verona, Italy)

"The best triumph of our century": big alpine tunnels and popularisation

Following the national unification, Italy was in need of stability, not only of the political and cultural kind, but also economical and industrial which alone could help bring the country forward towards modernisation and material growth, essentials parts to its assimilation in Europe. A determining step for the industrial development of the Peninsula was the creation of infrastructures that would make communicating within the country and between Italy and the rest of Europe much easier and faster. Hence, after unification, the national government gave a big push to public work, first of all to the railway. The expansion of the rail network, following the growth of the international trade, made it necessary to guarantee the continuity of the system across mountain ranges and therefore the realization of big tunnels. The extensive debates and the in-depth studies which preceded the completion of the Moncenisio's tunnel, and of the following tunnels of San Gottardo and Sempione, brought to the publication of many articles and memoires, the study of which allows us to expand our knowledge of the technological and engineering progress made by the Italian and European scientific community during those decades. At the same time, the public and popularising nature of these issues is particularly important. My contribution intends to focus on the way these big technological endeavours were presented to the public through newspaper articles, posters, public conferences of great communicative impact, with the goal of declaring the necessity and the grandiosity of such ventures, thus contributing in a crucial way to the establishment of a scientific and technological mentality in ever bigger sectors of the population.

**Il Cenisio*, in *«Emporio pittoresco. Illustrazione universale»*, a. VIII, 1871, n. 335, 29 gen.-4 feb., pp. 51-52, p. 52.

2 - **Nikolai Dronin*** (Moscow State University, Russia), Nataliya Kalutskova, Vladimir Dekhnich & Elina Sheremet, ***History Of Scenery Studies in Russian Geography***

Landscape as a notion appeared in Russian geography at the very beginning of the 20th century. At its core, landscape theory presents the earth's surface as composed of landscapes, natural units or cells of highly interrelated natural and human components. The earliest interpretation of notion landscape was scenery, a visually fixed harmony whole of different natural and cultural elements [pejzazh]. Most modern geographers would experience difficulties to understand how scenery could be the subject of natural science. Despite of presenting of landscape and scenery as synonyms there was some nuanced difference between them. The both terms came from art and related to scenery and landscape paintings. The scenery art related to depiction surroundings in its individuality, uniqueness and never collocated with negative adjectives or used in an unfavourable context, while the landscape art depicts most characteristic visual features of a country ("Italian", "German", "Alpine" landscapes etc.). Russian geographers accepted this notion as a guidance for identification of typical landscapes of a territory. A.P. Nechaev in his Pictures of the Motherland (1905) defined landscape as formed by "all objects located on the Earth surface – stones, streams, plants, animals, and humans with diverse results of their activities" and depicted typical landscapes for six macro-regions of European Russia. In 1908 A.A. Borzov in his Pictures on Geography of Russia presented characteristic landscapes for 12 macro-regions of European Russia. The Borzov's book was more impressionistic in style ("On the picture month of May is caught. Greeneries are fresh and brighter being washed by recent rain"). In 1928 V.P. Semenov-Tyan-Shanskij in his fundamental (312 pages) book Region and Country proposed many original ideas how to classify and measure visual natural objects including their colors, smells, sounds, etc. He wrote: "an artists is subjective while a geographer is objective". After 1930 Soviet geographers associated landscape with a region itself but not its visual characteristics. Landscapes became colorless, silent, and

odorless. Only in the 1970s Soviet geographies returned to study of natural and anthropogenic landscapes in terms of their scenery values. A simple expert score system of esthetic evaluation of landscapes elaborated by Lithuanian geographers, K.I. Eringis and A.R. Budryunas (1975), gained most popularity among Soviet geographies. Technological revolution in modern geography provides new opportunities for digitizing many visual properties of landscapes, for example, by unmanned aerial vehicles.

3 - **Giancarlo Scalera** (INGV Rome, Italy)

Variable radius cartography - History and perspectives

The first really conscious attempts to represent the geography of Earth on globes of radius less than the current one occurred after the formulation of the concept of expanding Earth through geological time. In 1928 J.A.H. Kerkhoff (Under the pseudonym 'Aero-dilettant') published a series of paleogeographic globes on which the modern oceans disappeared. With the same artisan methods, in 1933 O.C. Hilgenberg represented three different geological epochs, and later for the first time mapped paleopoles with their site-pole segments of meridian. Even today the traditional method of Hilgenberg is followed by senior researchers (Vogel, 2003) and younger geologists (Maxlow). In England Hugh Owen applied the methods of traditional cartography to the variable radius one. His 'Atlas of Continental Displacement' was in the 70s and 80s, for this discipline, a real milestone. While in the field of constant radius paleogeography the adherents to plate tectonics created many computer codes of automatic mapping (Bullard et al., 1965; Smith & Hallam, 1970, Scotese et al., 1979, and many others), in the variable radius field few people tried to reach the same task. In 1972 in United States a first simple attempt (not furtherly developed) came from R.B. Perry, followed by the still not-computerized Atlas of Owen, and both them constituted inspiration for the construction of a variable radius mapping code at INGV, with which it is now possible to represent paleopoles, site-pole segments of meridian, and their uncertainty ellipses (Scalera, 1988, 1990). In all paleogeographic reconstructions of the various authors, cartography is used in a way more or less complex, more or less intertwined with other disciplines and databases, not as pure representation or in the spirit of the simple 'fits' that supported plate tectonics, but as experiments of greater complexity with a value of proof in favor of the planetary expansion.

4 - **Iraklis Katsaloulis** (National and Kapodistrian University of Athens, Greece)

Predicting earthquakes with electric signals: Experiment and Credibility

In 1981 a group of Greek scientists (Varotsos, Alexopoulos, Nomicos) proposed a method which they claimed to be capable of short- term earthquake prediction (i.e. a few days to a few weeks before an earthquake occurs), named the VAN method after the initials of these three scientists' surnames. Soon after the method's publication a fierce scientific controversy, which lasted more than three decades, broke out. On the one side were the members of the VAN group, who were solid state physicists, and on the other side the biggest part of the international seismological community. The VAN method, in broad outline, works like this: It is based on the detection of electric signals (SES: seismic electric signals) that are generated in the focal area of an earthquake, before the earthquake occurs, and travel all the way to the Earth's surface, where they are collected by electrodes that are inserted in Earth's surface. The physical quantity that is measured is the potential of Earth's electric field. Field variations that fulfil certain criteria are attributed to SES and they are used in order to predict the parameters (place, time, magnitude) of the impeding earthquake. The visualization of the VAN measurements is crucial since the amplitude of a SES is the key parameter for the estimation of the predicted earthquake's magnitude. But what is really visualized by the VAN apparatus? Is it a SES or is it just noise, as opponents of the method claim? How can this be decided? The credibility of the experimental procedure that provides these measurements and visualizations is a highly controversial issue. In the proposed paper we will follow the protagonists of this controversy and the arguments they use. This will help us to understand how the credibility of an experiment is (or is not) gained.

5 - **Sandra Rebok** (NCIS, Germany)

Humboldtian Science in the United States: Bridging the arts and the sciences

The Prussian explorer Alexander von Humboldt developed a successful scientific methodology, which is today known under the term Humboldtian Science. This concept stands for a global and holistic understanding of science and is characterized by a collaborative and comparative approach, which constantly drew connections among information elements created by others in different scholarly disciplines and regional areas. It was his need to obtain large bodies of knowledge, which Humboldt required for his comprehensive work, that led to the creation of his extensive networks. Another important characteristic of his work is the way how Humboldt bridged the arts and the sciences, by combining both textual and visual ways to present his knowledge. This can be observed in numerous detailed infographics and in the important cartographic material that he elaborated. This paper argues that Humboldtian Science was particularly successful in the young United States, because here he found the ideal ground for the implementation of his knowledge into society. The particular situation of a nation in the process of being built led to the formation of a specific knowledge culture that was very favourable for Humboldt's methodology. This general argument can be well explained with the example of his famous map Carte Générale du Royaume de la Nouvelle Espagne (1803) and its impact on cartography in the United States. Due to to the access he had to first-hand cartographic material in Spanish archives in both hemispheres, the map was unusually well documented for his time and had a considerable influence on the development of American cartography. It was therefore of key strategic interest for President Thomas Jefferson, as he initiated the exploration of the American West after the Louisiana Purchase in 1803.

Room 9: **T29 - Measurements**

Chair: **Ezio Mesini** (University of Bologna, Italy)

1 - **Emma Prevignano** (University of Cambridge, UK)

How to make the metre: materialising the new metrology in Revolutionary and early nineteenth century France

Early modern units of length were defined as the length of specific bars kept in centres of power (e.g. town hall and guilds) and varied across space and practices. These objects created multiple domains of measurement which had to be connected at the borders of trading spaces. In revolutionary France, the government decided to metrologically unify the country and defined the metre, a unit of length based upon a natural parameter (the length of the terrestrial meridian). Eighteenth-century astronomers claimed that the metric system would finally fulfil their century-old dream of emancipating units of measure from their physical representation. Instead, no metrological reform had ever required such a large-scale production and movement of objects. Metre bars played a large part in the process of persuasion and uptake of the new unit. These artefacts were disseminated over space in order to transform space itself. The objects displaced prior regimes of measurement practices and measuring devices, moving between the abstract and the pragmatic. This paper analyses physical representations of the metre both as symbols and as essential components of the reform. The first part focuses on the marble metres installed across Paris in 1797, on the wooden metres gifted to the students of the École Normale Supérieure, and on the platinum metre officially representing the new unit. How could an object symbolise emancipation from materiality? The second part focuses on the large-scale production of metric rods as requirement for the success of the reform. This was an unprecedented project of economic interest, involving negotiations between the state and manufactures, and between the central government and provincial administrations. The unavailability of raw material and the lack of satisfying

technology for mass scale production of metre rods were chief obstacles to the implementation of the metric system during the French revolutionary decade.

2 - **Fabio Bevilacqua, Lidia Falomo Bernarduzzi & Maurizio Licchelli** (University of Pavia, Italy)
"À tous les temps, à tous les peuples!" Towards a Biography of the Pavia University Platinum kg (1800-2020)

In the Museum for the History of Pavia University shines a precious, small cylinder of platinum (weight 1 kg; ca 3,9 cm (d) x 3,9 cm (h)), with its original box signed by Jean Nicolas Fortin (1750-1831) and inscribed: *KILOGRAMME Conforme à la Loi du 18 Germinal an 3 présenté le 4 Messi an 7. Fortin*. The reference is to April the 7th 1795 and June the 22nd 1799. In 2019 the cylinder underwent a careful X-ray fluorescence analysis confirming that it is composed of platinum (only very small traces of iridium) and thus its 18th (or very early 19th) century origin. How did the platinum kilogram get to Pavia? In 1876 Giovanni Schiaparelli (1835-1910) director of the Brera Observatory in Milan and professor at Pavia, transferred it officially from Brera to the Pavia Physics Institute directed by Giovanni Cantoni (1818-1897). This followed the establishment in 1875 of the *Bureau International des Poids et Mesures* (BIPM) that led to 1889's new prototype made of 90% platinum and 10% iridium. The transfer from Paris to the Brera observatory is more obscure. It might involve three scientists who had personal links with Napoleon: Lorenzo Mascheroni (1750-1800), Alessandro Volta (1745-1827), and Barnaba Oriani (1752-1832). At the beginning of the 19th century three official kilograms were in Milano, one of them in Brera. In 2019 also the "new" Paris prototype had to retire. Pavia's platinum kilogram is now a grandfather and stands in all its beauty as a witness to the usefulness of the ever more precise but never definitive search for a 'stable' unit of measurement.

3 - **Jan Potters** (University of Antwerp, Belgium)
Disputing measurements: on the German materialtheoretical culture of charge-to-mass ratio measurements

This paper focuses on Walter Kaufmann's experimental investigations of the electron's charge-to-mass ratio (1897 - 1906) and the reception these investigations received. In the historicalphilosophical literature on the electron (e.g. Arabatzis 2006), Kaufmann's measurements are often grouped together with the results of Thomson, Wiechert and Zeeman as providing evidence for the electron's existence: the agreement between the results, it is claimed, led to a consensus that what was responsible was a negatively charged, sub-atomic particle. My starting point will be a three-fold observation: 1) Kaufmann himself eventually accepted the possibility that his results were produced by the electron, but he did not infer this possibility from the charge-to-mass ratio values he obtained; 2) many scientists at the time emphasized not the agreement between the different values obtained, but rather their differences, which gave rise to significant disputes; and 3) these disputes occurred primarily in the German context. I will then argue that the way in which these disputes were carried out is very similar to how Olesko (1996) characterization of a German precision measurement culture: the aim was to obtain, through individual, competitive investigations focusing primarily on formal error analysis, as precise a value as possible. Once such a value obtained, it then became an 'ideal observation' from which the set-up and the observer that produced it were partially erased. I will then argue that this culture manifested itself specifally well in the evaluation of the photographic clarity of the experimental materials produced, and that this allows us to study the standards of objectivity at play. If time permits, I will then conclude with what this case could learn us about the benefits and limitations of speaking about national cultures of precision measurement.

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4 - **Roberto Lalli & Dirk Wintergrün** (Max Planck Institute for the History of Science, Germany)
Understanding scientific texts with machine learning: A computational approach to the history of exoplanet exploration

The talk presents a new computational method for investigating the history of recent science elaborated within the framework of the Berlin Center for Machine Learning. Recent advances in machine learning within the field of Natural Language Processing (NLP) allow, in principle, for more nuanced and complex distant-reading analyses than those provided by more established methods such as topic modeling and keyword extractions. It remains challenging, however, to clearly interpret the historical insights obtained using computational approaches. This is even more so as the nonlinear machine learning methods, such Deep Neural Networks (DNNs), lack sufficient transparency to make the results easily interpretable. Analytical processes remain largely black boxes, which make it difficult to build reliable historical narratives out of these kinds of analysis (Samek et al. 2019). A mixed approach that closely intersects quantitative and qualitative methods might be crucial to overcome this shortcoming toward the development of more robust computational methods in the history of science (Laubichler et al. 2019). The method presented here is a step in this direction by, first, comparing the results obtained using three different computational methods and, then, interpreting them with close reading analyses of the documents of the corpus that appear as particularly relevant in the computational analyses. This method allows for an interpretability of findings retrieved with machine learning algorithms based on the historians' expertise. This method is applied to a corpus composed of full-texts of about 17000 articles, published between 1995 and 2019, in the field of exoplanet exploration. The approach allows to figure out and visually represent the dynamical changing of research agendas, and to make historical hypotheses about how theoretical models and experimental explorations have interacted in shaping the dynamics of the field.

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Room 10: S43 - A Visual Story of the Invisible. Toxicants Revealed

Conveners: **Alexandre Elsig** (University of Lausanne, Switzerland), **Ximo Guillem-Llobat** (University of València, Spain)

Distorted nature, physical defects, dead animals, protective clothing and gas masks, scientific instruments like Geiger counters, gigantic fumes… How to represent what cannot be seen and felt immediately, but only chronically and in a diffuse way? This symposium would like to explore the visual history of long-term toxic contamination. Studies about pollution and toxicity are now a dynamic field of research, as shown in a recent global synthesis (Le Roux, Jarrige, 2017). But if the main efforts have been made on the social, economic, scientific and environmental processes implied by toxic activities, a large field remains to be investigated on the cultural history of contamination (Deadly Dreams, ongoing). By considering the various representations of toxicants and toxic sites, we can analyze the way by which scientists and science communicators, as well as other historical actors, visibilized or invisibilized toxicity. This specific approach to visual history can shed new light on outstanding topics in the recent historiography of science such as that on Agnotology (Proctor, Schiebinger 2008) and the role of communication in the establishment of selective ignorance (Elliot, 2015 and Hilgartner, 1990). And, moreover, it can also shed new light on the sociomateriality of toxicants (Roberts, Werret, 2017). 2 What main images, representations and metaphors were mobilized to picture the harm (or the supposed unharmed) done by toxicants? How did scientists, engineers or environmental activists deal with the

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figuration of this “slow violence” (Nixon, 2011)? What were the dominant media and arts used? Do we find particular topoi related to specific toxicants (radioactivity, heavy metals, persistent organic pollutants)? Were the same images used in order to represent acute poisoning and chronic contamination by low doses? How did occupational and public health visually interfere with environmental concerns? And in the opposite way, what do representations about the supposed safety of a controlled toxicity tell us about the implied harmfulness of pollution phenomena and about what has to remain invisible? Another area of research may be the tensions arising between the artistic representations of contaminated sites (often with aestheticization) and the social disasters caused by this toxicity (Peeples, 2011).

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Chair: **Alexandre Elsig** (University of Lausanne, Switzerland)

1 **- Ximo Guillem-Llobat (University of València, Spain) & José Ramón Bertomeu Sánchez** (InterUniversity Institute López Piñero, Spain),

Toxic Pesticides in Spanish Rural Films during the First Half of the 20th century

In the early 20th century, new and important initiatives were implemented in Spain in pest control. A new general pest act was passed in 1908 and research stations focusing on plant pathology were established in the 1910s and 1920s. Among the new methods for pest control, agriculture engineers supported the intensive usage of chemical pesticides of well-known toxicity such as hydrogen cyanides and arsenic compounds. Cyanides were acknowledged as particularly dangerous in acute intoxications affecting workers while arsenic compounds were also known as risky products for both acute poisoning in criminal or suicide cases and their neurological effects in low-doses and long-term exposures. 3 The popularization of the new pest control methods involved many different communicative practices, including rural campaigns, leaflets, courses, radio and movies. The paper is focused on the rural films produced in early 20th-century Spain and employed in both the training of engineers and other agricultural workers and in the courses and other popularization activities aimed at farmers, landowners and other members of the rural communities. One of the first movies, shot in 1914 by the agriculture engineer Leandro Navarro, focused on cyanide fumigations in olive fields. And during the following years new and more ambitious projects produced an increasing number of rural films dealing with cyanide and arsenical compounds in pest control. The movies were promoted in the 1930s by the Servicio Central de Cinematografía Agrícola linked to the Directorate-General for Agriculture and the Sección de Publicidad y Publicaciones del Instituto de Reforma Agraria. In the first years of the Francoist dictatorship, a Servicio de Cinematografía was created in connection to the new Ministry of Agriculture. In this paper we will focus on the documentaries produced in three different institutional and political contexts: The Bourbon Restoration, the Second Republic and the Francoist dictatorship. We shall analyze how the practices related to arsenic and cyanide fumigations were portrayed in different ways and how their associated risks were described, misrepresented or silenced. We will discuss whether these documentaries paid or not attention to toxicity, the issues molding the different imaginaries of toxicity

included in the movies, and the visual and textual resources employed to present toxicity and safety. We shall conclude with a general overview about the practices of visibilization/invisibilization of toxic risks in these documentaries and other campaigns promoting pesticide usage in the first half of 20th-century Spain.

2 - **Bas Blaasse, Gayatri Kodikal, Marta Macedo, Analeah Rosen, Svenja Schennach, M. Luísa Sousa & Jaume Valentines-Álvarez*** (Nova University of Lisbon, Portugal)
Hydrocarbon Toxics in Lisbon EXPO 98: Memory, Environment and Visual Politics

In 1940, while Europe was at war, the Exhibition on the Portuguese World took place in Lisbon in its western riverside area of Belém. It was part of the official commemorations celebrating the Portuguese nation, its imperial past, and the Estado Novo dictatorship. The same year, the first oil refinery in Portugal was built in the eastern riverside area, in Cabo Ruivo, as a representation of the autarkic policies and fascist modernization of the regime. Fifty-eight years later, the world fair Expo'98 was inaugurated in this eastern area, celebrating again the times of the Portuguese discoveries. The theme was “oceans, a heritage for the future”, and the mascot, a smiling blue drop of water. Despite this popular image, the Expo was literally built on (invisibilized) hydrocarbon toxics. As part of a larger urban project, the area around the oil refinery 4 was transformed into a new high-middle class neighbourhood and a business hub, and toxic soils were deposited and sealed in a wasteland near there, which became a public park. However, in 2017, the digging works to expand a private hospital revealed hydrocarbon toxics, and triggered news on associated health problems such as cancers and breathing problems. As the history of the public and scientific debate on this issue is therefore very recent, we will not focus on the images by neighbours, journalists and scientists to depict (or unveil) the environmental and social harm produced by hydrocarbon toxicants. In this session, we aim at crossing the environmental history, the history of technology and visual arts in order to explore a visual historical narrative of the hydrocarbon contamination in the waters and soils of Lisbon. Taking and remaking past representations of the oil refinery and its surroundings, our visual narrative seeks to participate in the current politics of visibility of toxics in Tejo river (a very contaminated river with many sources of pollution). This starting and experimental research takes advantage of the different disciplinary backgrounds of the authors and of former collaborative experiences of the authors historians with artists. It draws on the preliminary works produced in the seminars of the Anthropocene Campus Lisboa: Parallax in January 2020.

3 - **Alexandre Elsig** (University of Lausanne, Switzerland)
Video Shooting to Denounce Industrial Pollution: Swiss Television and the Environment in the 1970s

In the beginning of the 1970s, long hidden industrial contaminations became visible in Switzerland. Mercury leaks by the chlorine industry in the Lake Geneva and fluoride releases from the aluminium plants in the Alps were under the spotlight. The institutional "environmental turn" is not sufficient to understand why electrochemical pollution that dated back to the beginning of the 20th century was then tackled down (even if partially) by the autorities. Social movements around farmers or students, critical scientists and engineers but also mass media played a big role for the awareness of these environmental and health problems. One of these media was a relative new comer in the mass culture: the television. And at the same time, the national TV was opening its scope from more or less official communications to critical and investigative journalism (with programme like Temps présent, created in 1969 and still screening today). This paper thus wants to explore how and why the Swiss national TV helped to give voice to the anti-pollution movements, by looking closely at which visual grammar it mobilized to picture the toxic substances and their multiple effects on humans and non-humans. Did the images representing these slow and mainly unspectacular contaminations diverge from what was used in case of acute industrial disasters? How did they diverge from the purified and technical images produced as backfire by the implicated companies? Which role played the translations between

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environmental and (occupational) health issues? This paper will take advantage of a database newly made available for researchers which permits to generate an audiovisual corpus of approximatively fifty newsreel subjects and longer investigation programmes. The main topoi are related to environmental impacts (dead fish and dry forest, colored waste water and heavy fumes, foam lines and algae) and to the legitimization of knowledge by science (water or air samples and geological cores, lab coats and experts at work, graphics on treshold limit values…), but let mainly aside the insidious impacts on workers and on human bodies.

4 - **Joshua McMullan** (University of Leicester, UK)

Making the Invisible, Visible: Radioactive Contamination and UK Government Response to Sheep Farmers in North Wales after Chernobyl

In response to the Chernobyl incident the British government embarked on an extensive campaign of public relations, stressing that an incident like Chernobyl could not happen in the UK due to 'superior' safety standards, different technical specifications and better managed reactors. Scholars have been critical of these efforts, highlighting the minor radioactive leaks that occurred and the lack of public consultation over the siting of new plants. Brian Wynne in particular has drawn attention to the failure of government planners to appreciate the expertise of farmers, and to accommodate their local, contextual knowledge into containment plans. Like Wynne, this paper focuses its attention on the impact of the Chernobyl fallout on sheep farmers, but enriches our understanding of the interactions between farmers and the state by looking at North Wales and considering how officials navigated a complex situation where on one hand they had to ensure consumer confidence in foodstuffs, through what became known as the mark and release scheme. Where overly contaminated animals were marked to be made visible to the public as they grazed in the open air and to the wider population through media reporting. Changes in color over time 6 marked the decline in contamination and served as constant reminder of the system in place to prevent contaminated sheep meat entering the human food chain. While also ensuring the viability of the North Wales economy that was heavily dependent on sheep farming, through a compensation policy. Together, these government initiatives sought to bolster public confidence in the future of nuclear energy. By examining this case study, this paper contributes to our understanding of how state bodies communicate science through government policy, and how radioactive contamination has been experienced. Whether the source of that contamination is a powerplant visible on the horizon or from 1400 miles.

Room 11: **T14 - Chemistry**

Sponsored by *GNFSC - Gruppo Nazionale Fondamenti e Storia della Chimica* (Italian Group on the History of Chemistry)

Chair: **Brigitte Van Tiggelen** (Mémosciences, Belgium)

1 - **Paolo Zani** (University of Bologna, Italy)

Chemistry As A New Science Of XVIII Century: How Was Its Visual Communication In The Printed Texts Present In Bologna?

The Bolognese Senate awarded in 1738 the Chair of Chemistry (lector ad CHYMICAM) to the physician Jacopo Bartolomeo Beccari (1682 -1766), one among the most important scientists active in Bologna. Beccari, who was already teaching ANATOMIA, taught Chemistry until 1766. After his death, lecturae Chymicae went on at the Bolognese Studium thanks to a few cooperators and this will be investigated in this study. With this respect, the University of Bologna was at the forefront through Italian universities

for lecturing chemistry. The name CHYMICA is unambiguous, but the contents much less, since chemistry, as a scientia nova, was in the process to detach from traditional alchemic beliefs, rooted in magia naturalis, to pursue the methods and goals of Galilaeian and Newtonian mechanics. However, this goal could be reached only later, mainly through the achievements of A.L. Lavoisier (after 1775). The aim of this communication is to consider the way Chemistry was presented in the period 1740 – 70 in Bologna: at the Studium, the teaching was addressed mainly to physicians. The visual message was conveyed particularly by engravings and images showing the places of chemistry (i.e. laboratories), the operations, the apparatuses and the symbolic language, identifying chemical substances. The symbols were still the same of the alchemical tradition and, for this reason, were sending a message where chemistry appeared as a science for "iniziati"only. These aspects will be discussed on the basis of original documents of the period.

2 - **Marco Taddia** (University of Bologna, Italy)

Nernst's controversial contribution to the theory of electrochemical cells

This year marks the 100th anniversary of the award of Nobel Prize in Chemistry to Walther Nernst "in recognition of his work in thermochemistry". The Nernst's success had a somewhat troubled history. Walther Nernst (1864-1941) was nominated for the first time in 1905 but the scientific community was long divided about motivations [1]. The winner's interest in the field of physical chemistry had been encouraged by Wilhelm Ostwald (1853-1932) who met Nernst in Graz in 1889. He accepted the Ostwald proposal to become his assistant in Leipzig. Nernst's mind, original and versatile, was attracted by some unresolved problems of classical thermodynamics. In Leipzig he came to formulate that "heat theorem" which, with the contribution of Max Planck (1858-1947), became the Third Principle of Thermodynamics. The present communication does not deal with Nernst's achievements recognized with the Nobel Prize but rather with earlier studies of great relevance in electrochemistry and analytical chemistry [2]. A few months after the Nobel Prize 2019 to the inventors of lithium batteries, such Nernst's fundamental results deserve a special mention. It will be shown how they had led him to define a theory of the electromotive force of galvanic cells, previously initiated by Hermann von Helmholtz, Josiah Willard Gibbs and Jacobus H. van't Hoff. It was van't Hoff's theory of osmotic pressure who suggested Nernst an equation from which, with a few steps [3], we arrive to that still bearing his name despite some controversy.

3 - **Antonio Martino* & Gaia Naponiello** (University of Roma Tre, Italy)

A sensory and a mimesis approach in the history of chemistry education: Ostwald's Conversations on chemistry

Wilhelm Ostwald's (1853-1932) Die Schule der Chemie (School of chemistry, Brunswick 1903-04) was published in the midst of harsh controversies arising from his wide cultural project of development of a modern philosophy of nature and of energetics – that came out of his views on the reconstruction of physical theory from the notion of energy from 1895 on (Görs et al 2005). As Marcel Brillouin (1854-1948) pointed out Ostwald's avoiding of images and sensorial representations to build physical theory, the question arises of his conceptual approach and literary strategies when addressing the general public, as a key reference for the diffusion of his views (Bensaude, Kounelis 1991). Moreover, how can his approach be characterized considering the 19th century tradition of vulgarization chemistry books (some of them read by Oliver Sacks as a child)? First, Ostwald develops a dialog between disciple and master – a resource common in arithmetics training books – but of a philosophical kind, a modern conversation (the title in the English translation) encouraging by mimesis the identification of the reader in the disciple. Second, Ostwald provides a brief theoretical introduction for each topic followed by an experiment: sight and touch helps understanding. A comparison will be explored with George Darzen's (1867-1954) Initiation chimique (Initation to chemistry, Paris 1909), addressed to young children.

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4 - **Elena A. Baum** (Moscow State University, Russia)

Educational innovations of the Chemical Faculty of Moscow State University (MSU): the using of museum funds for a practice-oriented teaching of history of chemistry

Today the teaching practice requires a permanent update of educational methods, the formation of new models of interaction between students and teachers. In my proposal, I discuss the results of insertion of the new educational project "To the History of Chemical Instruments and Chemical Technological Processes" implemented at the Chemical Faculty of MSU with the assistance of the Moscow Museum of Science (Polytechnical Museum) in the course of history of chemistry teaching in 2018-2019 years, as well as the effectiveness of the usage of visual content (educational film) for the same purposes. As part of abovementioned research educational project, students studied artifacts from the funds of Polytechnical Museum, assisting museum's staff in attributing a number of exhibits. In the course of research all participants using a variety of historiographical and visual sources try to answer on the questions: who created the object of their study, which technical parameters are peculiar to them, what role did this objects play in the development of chemistry, etc.? Even deeper the students plunge into the context of the corresponding historical eras when watching the educational film "Towards the History of Chemical Laboratory Equipment" that I created in 2017. Its material is methodologically divided into several sections, each of which is devoted to the evolution of a certain line of chemical tools. Graphic and pictorial illustrations are separated by footages of exhibits from the funds of the Polytechnic Museum. The use of such diverse material in teaching chemistry contributes to a deeper, more holistic, and most importantly, reflective students' perception of the studied discipline.

5 - **Stylianos Kampouridis** (National and Kapodistrian University of Athens, Greece)

Modeling molecules, making reliable predictions: John A. Pople and Theoretical Model Chemistry

Despite the fact that computational quantum chemistry was established, during the 1970s, as a legitimate practice in chemistry, few historical works about this process exist. Almost none of them explain the way computational models were constructed and how they were incorporated into chemical practice. In this talk, I will focus on John A. Pople, Nobel Laureate in chemistry in 1998 and one of the major figures of computational quantum chemistry. In the 1960s most practitioners in the field were applying the best model for every particular case and hence it was difficult to assess the results of different computations. In the early 1970s, Pople introduced "Theoretical Model Chemistry" which meant that every well-defined approximate computational model was creating a virtual chemistry that could acquire some predictive power if tested successfully against known experimental facts. I will argue that Pople's models brought systematization and standardization and they had the advantage of portability, as his models were incorporated in the GAUSSIAN™ software, created in 1970 and initially distributed freely. However, it will be pointed out that there were practitioners who thought that uninitiated scientists could not evaluate properly the data produced by Pople's models. In my talk I will also discuss that most chemists were initially reluctant to use computational methods. For this reason, Pople tried to collaborate with organic chemists. In this regard, visualization of quantum chemical principles on molecules proved decisive, because abstract equations were almost incomprehensible by most organic chemists. Finally it will be argued that this process involved the establishment of new criteria of accuracy and extensive evaluation strategies of models that could provide reliable predictions of molecular properties, autonomous and distinct from experimental sources of data.

Pause from 11.00 to 11.15

Wednesday 2 September, 11.15 - 13.15

Room 1: S47 - Material culture in the positioning of national science in Ibero-America: natural history museums, scientific cabinets and educational institutions - 2

Conveners: **Carolina Valenzuela Matus** (Autonomous University of Chile, Chile), **María Gabriela Mayoni** (University of Buenos Aires, Argentina)

Chair: **Carolina Valenzuela Matus** (Autonomous University of Chile, Chile)

1 - **María Gabriela Mayoni** (University of Buenos Aires, Argentina)
Studying the material culture of science education in Argentina: consumer market, transnational circulation, local application and teaching practices

During the second half of the nineteenth century in Argentina, a process of reorganization of public education began and the teaching of natural sciences expanded at different levels. This favored the creation of natural history cabinets and museums and the introduction of a wide variety of scientific instruments and collections in educational institutions. On the other hand, in that period there was an expansion of the industry and the cultural and consumership market of sciences at a global level. This generated a transnational circulation of objects that led to similar contents and practices in different cities of the world. In Argentina, the mechanisms for the acquisition of materials and the conformation of scientific teaching spaces were varied in different educational fields. However, some methodological tools are useful to analyze, in the different cases, the complex network of relationships between objects, associated scientific knowledge and pedagogical practices promoted for study. In particular, the cross between perspectives linked to the cultural "biography" of objects (Appadurai, 1986; Dannehl, 2009), the spatial turn (Livingstone, 2003) and the notion of circulation of knowledge and scientific instruments (Secord, 2004; Heering, 2011). Through objects, it is possible to inquire about the different forms of circulation of knowledge and how certain ideas crystallize into concrete things. With these tools, it has also been possible to identify mechanisms of appropriation and local application of objects and knowledge by observing the teaching performance, the pedagogical debates in which they were involved, the teaching methods implemented and the material supports that they demanded for in- class use. In this paper, we will show some examples about cases studied in Argentinian secondary and university education and natural history teaching during the last decades of the 19th century and the beginning of the 20th century.

2 - **Víctor Guijarro** (University Rey Juan Carlos, Spain)
The representation of science, body and objects in construction kits and in the active education movement: Tensions between industrialists and teachers in the interwar years

After World War I, modular methods for educational purposes received a significant boost. These procedures were based on the provision of simple, standardized and interchangeable parts for the assembly of experimental devices. As it was thought, they were an ideal tool for the assimilation of scientific contents. One consequence of the adoption of these new systems was the partial abandonment of the old styles based on expensive and unmanageable devices. Besides, these renovating approaches reproduced the aspirations of the supporters of both active education principles and the discovery methods. Both –industrialists and educators– promoted a new way of relating the body to the basic materials that were part of the learning process. In this context, the acquisition of

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knowledge should take place through the mastery of mechanical skills, and by the search for suitable or novel combinations of the pieces available. However, there were differences between industrial approaches and those coming from teaching professionals. One of the objectives of scientific construction toys manufacturers was to distance themselves from the methods of official education. As Rebecca Onion states (Innocent Experiments) “In the United Kingdom during the interwar years, the manufacture of Constructions kits, which allowed children to make their own scientific instruments, sold the toys as a stopgap meant to fill in holes in the education system.” The communication is intended to point out the values pursued by the promotion of modular methods, the differences between industrialists and educators, and the results of the analysis of the advertising discourse associated to the firms of scientific kits in the Second Spanish Republic period. This will help us to see that slogans were used by companies to emphasize the playful, imaginative, creative and liberating possibilities of their designs in response to the supposedly boring, rote learning and authoritative instruction of official education.

3 **- Katya Braghini** (Pontifícal Catolic University of São Paulo, Brazil)
Scientific toys: male dominance in representations about Science

This work discusses material culture, especially scientific toys, their registers, and functions in the creation of social gender roles. Scientific toys were organized in the following categories: scientific objects used pedagogically that, through playing, stimulate knowledge of natural sciences; items produced by scientific or didactic material companies with amusing characteristics, such as trains, cars, and tramways built in small scale; games and laboratories that simulate chemical experiences, natural phenomena, or the assembling of models, connecting entertainment and knowledge. The work presents a set of visual registries that organized an aesthetic connected to the processes of identification, formation, valid and socially accepted practices to boys, marking their spaces of socialization and dominance. Scientific toys, their graphic representation, and advertising guide the senses, creating patterns of behaviour that stipulate what is socially determined and accepted as attitude, pointing, even, to a possible professional vocation: to become a scientist. This work discusses the relations among science, childhood, and gender, through the studies of material cultural, aiming to understand the net of meanings that institute and highlights the presence of man as a subject able, by gestures and cognitive action, to produce science. In order to do so, we studied toys and scientific games from Great Britain, United States, Spain, Portugal, and Brazil. The temporal cut points out to the presence of scientific toys as a useful good to demonstrate natural phenomena from the second half of the 19th century to the 1950s, when girls are recognized by the same representations. We analyze what Scott (1995) calls social organization of sexual difference through the analysis of this document set that, in this case, formalizes the idea that the laboratory and scientific research do not belong to women.

4 - **Oliver Hochadel** (Spanish National Research Council - CSIC, Spain), commentator

Room 2: **S81 - Rare diseases and visual practices: from medical collections to self-representation**

Convener: **Juan Antonio Rodríguez-Sánchez** (University of Salamanca, Spain)

At the end of the 20th century, low-prevalence diseases constituted an emerging new category called “Rare diseases”. Even they are a consequence of the molecularization and genetization of the biomedical sciences, the construction of the new group did not respond to scientific of clinical criteria and surpassed the merely statistical. The affected, organized in social movements, found their own definition in some

common social and healthcare problems and, in this order, they implemented strategies that involved interaction with health professionals, researchers and the media. Therefore, the image of rare diseases has been created by a historical relationship between different producers. The classic scientific and collector interest in "the monster" was transformed with photography and the evolution of heredopathology. Progressively, the affected were displaced from the scope of the spectacle to that of research objects, with an additional function of prestige of the professionals with the capacity of registering greater number of cases. The iconic representation of "difference" acted powerfully in the definition of each new rare entity. During the construction of the category, the affected people have produced also their own image in order to transmit a social identity beyond the pathologically typified. Prior to the emergence of the Internet and the creation of virtual social networks, the mass media acted as the only spokesperson, profiling agendas and framing, making visible the problem, but often perpetuating representations of stigmatization. This symposium will try to analyse all this representation with its main producers (physicians, scientists, media and the own affected) in the Iberian Peninsula and in Brazil in the period 1940-2015.

Chair: **Juan Antonio Rodríguez-Sánchez** (University of Salamanca, Spain)

1 - **Raúl Velasco-Morgado** (University of Salamanca, Spain)
Photography and collecting practices behind rare diseases in late modern Spain

Visual registering and collecting had been key practices in occidental science since modern times. In the case of «non-ownable» entities –such as diseases-, visual registering has been one of the most useful ways to collect and to store them. The irruption of photography in the medical sciences meant a revolution in this sense, not only by the changing of the material but also by a transformation of the objectivity and power of the images. In this epistemic tradition of collecting, rarities become valuable items, and recent works have pointed the relevance of rare diseases –that can be understood as the rare items in these collections - in the process of acquisition of medical authority. By analysing the Spanish case, we aim to explore the relation of low-prevalence diseases and photography as collecting practice in late modern world (1870-1970). We propose here to study the spaces (the medical office and the hospital ward), the actors (physicians, photographers, patients and their relatives when they are children), the material culture (photo collections, medical record files, books, albums, slides…) and the circulation of these images/objects in order to understand the relevance of these practices in the production of science and in the acquisition of authority.

2 - **María José Ruiz Somavilla** (University of Málaga, Spain)
The representation of people with Turner syndrome in the medical treatises (1940-2015)

The incorporation of photography into research, diagnosis and treatment in medicine has contributed to the professionals' aspirations to develop objective knowledge in the binary construction of normal and pathological. It is a construction based on the neutrality of the photographed image and the science that explains it. However, along with this interpretation, it is possible to provide new meanings to those images. It is interesting to place photography in a narrative process in order to incorporate what is not included in the frame of the image, and to analyse series that could provide information not contained in the photographs seen individually. From these approaches, this paper study the photographs of people affected with Turner syndrome that appear in medical treatises published in Spain and Portugal between 1940 and 2015.

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3 - **Mafalda Sousa** (Nova University of Lisbon, Portugal)

The construction of the category "rare diseases" in the daily press: the Portuguese case (2002-2015)

"Rare diseases" have been taken up by the European Union as a priority health problem. This social awareness has been promoted by the affected people through their associations and the strategies developed, including the use of the media. The recent Portuguese history, marked by an economic crisis, offers a context that allows to relate economy, health and special health needs. The aim is to analyse the evolution of the presence of rare diseases in the Portuguese media, their representation and the social construction of the concept. In order to this the Jornal de Notícias newspaper was analysed between 2002 and 2015. The analysis of contents has been carried out by means of the design of a Book of Codes (subject to intercoders), complemented with the creation of different indexes. A growing trend in information on rare diseases has been identified from 2010, with a greater presence in the months of February. The predominant approach is human/associationist, although associations are only present in one third of the units of analysis. There is a predominance of specific thematic areas and the preferred typology of the articles is the case, with a profile of a sick male child, with willpower, portrayed at home with his mother and requesting social and economic support for treatment. The agenda of the Jornal de Notícias has a turning point in 2010, coinciding with the Portuguese economic crisis. Public figures supporting the cause of rare diseases are nonexistent, health professionals have little appearance and only associations have limited visibility. The information does not come from the previous instances, but from patients and families to whom it is presented as in need of charity, in informative pieces of very defined typology and that transmit a stigmatization of the rare disease.

4 - **Danielle Souza Fialho da Silva** (University of Salamanca and Fiocruz, Spain)

Group images and associations of patients with postpolio syndrome in social media in Brazil

Post-polio syndrome (PPS) is a chronic disease that cause pain, weakness, fatigue in their patients, and may cause disability or degrees of disability. PPS is a condition that can affect 50% to 75% of individuals affected by poliovirus 15 or more years after acute illness. The main symptoms that affect these people are aches, weaknesses, fatigue and breathing problems. Many report symptoms in members not affected by polio. People with this illness often report social disbelief regarding their symptoms. Therefore the goal of this paper is to analyze the narratives about this disease through images in the posts published in social medias by patients with post polio syndrome, whose interactions in this technological environment enabled new configurations in the relationship with the disease. Moreover, through the Internet patients are more able to obtain informations related to their chronic conditions and the volume of sharing of this contents with the emergence of web 2.0 are receiving special attention by the scholars that are producing reflections about the category of the experts patients. Besides that the invention of mobile phones with advanced technologies has also expanded the access to medical knowledges, even though that individuals do not have a computer, notebook, tablet, Ipad , from a telephone connection or from wifi , they can search several subjects about health, disease and treatments. Furthermore, we point out that images -such as inscriptions (as Ludwick Fleck argued)- produce materiality in diseases that may be socially invisible.

Room 3: S61 - I Spy With My Little Eye: Visualizing Science in Early Modern Europe

Conveners: **Christoph Sander** (Max Planck Institute for Art History Rome Italy), **Pamela Mackenzie** (Max Planck Institute for Art History Rome, Italy)

Some objects in our world are too small to be seen by the naked eye, while others are hidden behind a surface and therefore excluded from our view. Some things are even inaccessible to human vision in general. Moreover, in the early modern period/in early modern Europe, the very functioning of human sight is far from evident and complicated the issue of representing what usually cannot be seen even further. Yet, scientific investigation often relies on sense data; many of its scientific objects, indeed, become visible only through experimentation via some technique or instrument. Some of the most important and groundbreaking of these methods were developed in the early modern period, when microscopes and telescopes were invented, when physicians opened dead bodies to systematically study their inner components and structures, or when physicists performed more elaborate experiments to account for visible effects of invisible forces in nature. These technological and methodological developments were accompanied by another tendency of early-modern scientific practice: the sciences increasingly employed visual aids in order to communicate the results of their research or even used visual strategies as proofs for their theories. This panel will address these developments by presenting some key fields in which new forms of visualization and of manipulative or observational techniques emerged, and will investigate how the practical and theoretical foundations and conditions of visualization were reflected on by scientific practitioners.

Chair: **Sietske Fransen** (Max Planck Institute for Art History Rome, Italy)

1 - **Delphine Bellis** (Paul Valéry University, France)
The Puzzle of the Retinal Picture for Gassendi's Theory of Vision

If Gassendi accepted the Keplerian conclusion that vision occurred through light, he had some problems accepting the function ascribed by Kepler to the retina in the process of vision. In 1634-1635, he conducted, together with Peiresc, several anatomical experiments in order to better understand the eye's structure and the function of each of its parts. Peiresc and Gassendi explored several possibilities to account for the way vision could occur on the basis of the retinal picture (one of which being that the choroid behind the retina served as a concave mirror that would reflect the picture toward the center of the eye and put it upright). The formation of two different pictures in both eyes was also a problem for Gassendi in order to account for binocular vision: how is it that we see one object and not two? How to explain the perception of one unified field of vision? Even if these questions were already addressed by ancient optics, it became all the more acute in that light rays substituted for visual rays and that the prominent bodily dimension represented by the retinal picture replaced the Scholastic visible or intentional species. I will follow how Gassendi elaborated his solution (vision is performed alternately by each of the eyes and not by both eyes at the same time) through his correspondence with Peiresc and Boulliau. I will compare it to Mersenne's similar conclusion in L'optique et la catoptrique (I, prop. XXVI). My hypothesis is that this intense reflection on the topic was due to the threat to an empiricist theory of knowledge that was presented by the discovery of the two inversed and reversed retinal pictures.

2 - **Oscar Seip** (Max Planck Institute for Art History, Rome, Italy)
How the World Became a Stage: On the Theatricalisation of Scientific Practices

The 1502 Anatomice by the Italian physician Alessandro Benedetti (1450-1512) is one of the first printed sources, which promotes the idea of erecting a wooden theatre of anatomy (theatrum anatomicum) to facilitate the observation of dissections. But Benedetti also describes the dissection itself in highly

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theatrical terms as: 'a horrifying task, an object worthy of theatrical presentation'. In this paper, I will explore the impact of Benedetti's work and to what extent it is representative of a broader trend towards the theatricalisation of medical practices during the Early Modern Period; and a new vision of the natural world as a theatre. In order to trace this development, I will discuss how the image and language of theatre was used in the work of Benedetti and others like Andreas Vesalius, Giulio Camillo, and Jean Bodin to communicate the essentially visual (though secret or hidden) knowledge about the human body and the natural world. As I will argue, this is representative of a radical shift in scholarly discourses and practices towards the theatricalisation of knowledge, which led to a new genre of printed works that drove technical innovations in the printing press; a new tool and practice of observing the world; and a new way to record and transmit these observations.

3 - **Pamela Mackenzie** (Max Planck Institute for Art History Rome, Italy)
Nehemiah Grew and the comparative methodology and visual epistemology in his Anatomy of Plants

Nehemiah Grew's Anatomy of Plants, published in 1682, contended with a new vision of the natural world facilitated by the technology of the lens. Grew was applying, for the first time, serious magnification through the microscope to the inner structures of plants in order to make systematic observations, which allowed him to draw new conclusions about the composition of organic bodies. The world he discovered by using this technology had never been seen before; it required a novel vocabulary to describe and understand, as components and processes that were previously unseen revealed themselves through optical enhancement. Grew's experience as a physician led him to rhetorically and methodologically draw parallels between plant and animal bodies in his studies of flora. He explored the similarities in these two kingdoms between branching internal structures, the pathways of vessels, processes of reproduction and the movement of fluids, through a deliberate and careful comparative method that is apparent both in his writing and in the accompanying illustrations. This paper will discuss the discursive and visual comparative strategies employed by Grew in his effort to describe and represent his observations of plant life, especially addressing the role of the anatomical discipline in crafting a new understanding of a previously inaccessible dimension of plant life.

4 - **Christoph Sander** (Max Planck Institute for Art History Rome, Italy)
Visible Magnetism. Diagrams and Experiments in Early Modern Natural Philosophy

Human beings neither can see nor feel magnetism and there were no optical instruments to make magnetic force visible in pre-modern times. What already ancient scholars were able to feel, however, was how a piece of iron in their hand is drawn towards a magnet, and medieval scholars were able to see how a compass needle aligns itself in north-south direction. In other words, the effects of magnetism became manifest to sense experience through experiments or the use of instruments like a compass. Departing from a similar reasoning, pre-modern philosophers considered magnetism often as an 'occult' force: assuming an occult insensible cause for the yet sensible and manifest effects of magnetism. Around 1500 scholars began to cope with magnetism's seemingly occult nature not only by investigating it experimentally but also by trying to give a visual account of magnetic force. They thus tried to give a visual understanding of what was intrinsically insensible, namely occult. Most important in this regard were the concepts of magnetic polarity and the diffusion of magnetic force in a 'sphere of activity', resembling modern magnetic field lines. By transforming experimental findings into geometrical modes of diagrammatic visualization, this early-modern research on magnetism not only paved the way to our modern understanding of this phenomenon but also contributed to the value of diagrams within physics and natural philosophy. This paper will both present the major steps in this development and reflect on the contributions of 'magnetism research' within the visual culture of early-modern sciences.

Room 4: **S63 Diplomacy and Images in Science - 2. Visualizing Environmental Crisis**

Sponsored by IUHPST/DHST Historical Commission on Science, Technology and Diplomacy

Conveners: **Simone Turchetti** (University of Manchester, UK), **Matthew Adamson** (McDaniel College, Hungary)

Chair: **Giulia Rispoli** (Max Planck Institute for the History of Science, Berlin, Germany)

1 **- Doubravka Olšáková** (Academy of Sciences of the Czech Republic, Czech Republic)
Think Globally, Act Locally: How Brontosaurus, a Prehistoric Animal, Became a Symbol of limits to Growth and Mass Environmental Movement in Communist Czechoslovakia

Brontosaurus became a prominent and unmistakable visual symbol of a mass ecological movement in Communist Czechoslovakia. The movement as such was emerged outside the official mass movements agreed by the Communist establishment and reflected a growing interest in environmental issues. This widespread interest was stimulated by the participation of Czech and Slovak researchers in large international research programmes. The results of their research became generally known and attracted the attention of Czech and Slovak societies. In the paper, I focus on two aspects of the Brontosaurus movement. First of all, I investigate its historical background, which shows that the idea was based on the dissemination of the Limits to Growths report. Limits to Growth report was well known in Czechoslovakia and in the 1970s, several members of the Club of Rome were allowed to present lectures in Czechoslovakia which were open to a wider audience. Even the official Communist Party daily, the Rudé Právo, informed about the content of the lectures, albeit with 'appropriate' comments whose aim was to convince the general public about the decline of the West and contrast it with the right approach to environment adopted in the East. The second aspect I deal with is related to the visual history of science in 'Communist' societies: the simple logo of Brontosaurus represented a radical departure from the contemporary local presentation of the role of science in society (as will be shown using comics in youth magazines), but differs from contemporary logos of environmental movements in the West. Although the Brontosaurus movement logo is an example of 'local' activities, it is also the result of science diplomacy which brought to Czechoslovakia representatives of the Club of Rome at a time of increased Soviet pressure to 'normalise' the situation in Czechoslovakia after 1968 occupation of the country.

2 - **Agustí Nieto-Galan** (Autonomous University of Barcelona, Spain)
"The bicycles of Stockholm": Environmental diplomacy, scientific expertise and dissent at the 1972 UN Conference

From June 5 to 16, 1972, Stockholm became the world capital for the environment. 113 states (with the absence of Eastern bloc countries and the Soviet Union, as an inevitable result of Cold War tensions) adopted the principle of "Only One Earth", to highlight the planetary importance of pollution, and approved an action plan with specific recommendations and a solemn declaration of principles. Maurice Strong (1929-2015), a fossil-fuel magnate, who is seen second from left in the front row leading a group of delegates through the streets of Stockholm, was the general secretary of the conference. After Stockholm, Strong became the first director of the United Nations Environment Programme (UNEP). Nevertheless, what was really achieved in Stockholm was a matter of huge controversy. Beyond Strong's optimistic official rhetoric, the city of Stockholm became a battleground for the hegemony of opposed environmental values and policies. Outside the official premises of the conference, which hosted state delegates and formal discussions, activist groups organized alternative conferences, exhibitions, happenings and demonstrations, which strongly criticized the omission of hot global political issues such

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as hunger, poverty and war, and the divide between environment and politics. Also, on the sidelines of official addresses and radical opposition, major names such as environmentalist Barry Commoner (1917-2012), economist Barbara Ward (1914-1981), and science writer René Dubois (1901- 1982), also made their voices heard among the numerous commentators. This paper, therefore, discusses some preliminary results of the way in which that troubled, controversial atmosphere in Stockholm shaped the conference, considered as one of the earliest attempts to sketch the main features of environmental diplomacy in the 1970s.

3 - **Régis Briday** (LISA, France) & **Sebastian Grevsmühl** (EHESS Paris, France)
Ignoring what cannot be ignored: visual diplomacy and the ozone hole

The Montreal Protocol (1987) is often heralded as the first and most successful global environmental treaty. One key element, pertaining directly to visual diplomacy, remains however a conundrum. According to chief United States negotiator to the Montreal Protocol Richard Benedick, the negotiators of the Montreal Protocol chose to deliberately ignore the ozone hole findings precisely because there was no scientific theory at hand explaining its exact mechanisms. Yet how does one ignore the elephant in the room? Our paper will discuss the still and moving images of the scientific ozone hole findings that were widely circulated in the public sphere and readily available to anyone. In particular, we will show how close visual analysis can help determine the role images played in the shaping of political responses to a looming global environmental threat and if the claim of deliberate ignorance of scientific findings for diplomatic reasons is plausible.

4 - **Matthew Adamson** (McDaniel College, Hungary)
Picturing atomic development: the IAEA bulletin and global nuclear technical assistance

In January 1961, the Bulletin of the International Atomic Energy Agency (IAEA) included not only articles on the Vinca dosimetry experiments, nuclear power prospects in Finland, and nuclear safeguards, but something new, a so-called “Picture Story” consisting of cartoon-like images illustrating the basic function and uses of radioisotope tracers, especially in biology and agriculture. This unusual item suggested the direction the IAEA Bulletin would take in the presentation of the Agency’s activities. From newsletter-like items accompanied by the sorts of images one would find in newspapers, the Bulletin increasingly displayed images with a pedagogical and persuasive purpose, most especially in reports on atomic technical assistance. This paper examines the first years of the IAEA’s Bulletin to better understand how the Agency cultivated a global clientele for its brand of nuclear technical assistance. From the first IAEA preliminary assistance missions, this cultivation was a crucial goal (Mateos & SuárezDíaz, forthcoming). The IAEA had mobile means of exhibiting its capabilities (Rentetzi, forthcoming), but, in effect, its most mobile exhibit of all was its quarterly bulletin, circulated around the globe. Despite these assets, however, the IAEA faced a dilemma. UN agencies were already deeply engaged in the work of development, a characteristic international activity of the Cold War era (Frey, Kunkel & Unger, 2014). How could the IAEA draw attention to its own cohort of circulating experts (Mehos & Moon, 2011) and persuade not only countries with advanced nuclear infrastructures but also those without that the Agency’s technoscientific capacity and culture could serve their needs? This study finds that, over time, in concert with the Agency’s increasingly well-articulated description of its technical assistance work, the IAEA bulletin featured articles—and pictures—intended to further the IAEA’s image as an effective development agency, even while the aid and associated scientific networks failed to meet the lofty ambitions of the IAEA’s statutes.

Room 5: **T20 - Nuclear Energy and Particles Physics**

Chair: **Fabio Bevilacqua** (University of Pavia, Italy)

1 - **Eleonora Loiodice** (University of Bari, Italy)

The importance of prevention: MIT scientists' idea of "life belts" around the cities in 1950

The situation in the USA, in the 1950s, was not so easy and the feeling of always being in danger was constant, because of the "containment policy", contrasts, tensions, the promulgation of the Marshall Plan and the birth of NATO. American people lived with the fear of an imminent outbreak of an atomic war. That's why Norbert Wiener, Karl Deutsh and Giorgio de Santillana wrote a project to prepare American cities in the event of an atomic war. The project, published in the magazine «Life» (18 December 1950), was titled How U.S. cities can prepare for atomic war - M.I.T. professors suggest a bold plan to prevent panic and limit distruction. In that project the professors outlined their idea of "life belts" around the main cities. The idea was to create circular highways about ten miles from the city centre, with roads leading into the city like spokes on a wheel. The three men designated the perimeter of the life belts as evacuation points for city dwellers, also designing essential facilities and places. The paper aims to analyse the project, contextualizing it in the visions of the three professors of MIT attentive to the role of the scientist in political and social life.

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2 - **Polina Petrukhina** (Lomonosov Moscow State University, Russia)

High-energy physics laboratory case study: the changing role of material culture

High-energy physics (HEP) is based on enormously large setups: accelerators and particle detectors. Despite their size these devices because of their materiality could be considered as the most local and definite actors compared to the whole widespread scientific network of the collective experimenter. Their role could be described by combination of two concepts: trading zones [Galison] and processes of interest translations [Latour]. Being localizations of heterogeneous practices material objects are engaged in connecting distinct parts of the collective experimenter: the cognitive core and periphery actors through translations of their epistemic and non-epistemic interests. Such functioning of instrumental settings in HEP networks will be demonstrated with a historical case and one of the present day. I will highlight that the gas jet target – the basic equipment for the experimental chain in the USSR-USA collaboration at NAL in 1972-1980 [Pronskikh] – exhibits a hybrid nature. As an instrument of physical research it enabled determining the proton radius and examining its diffraction. Moreover, it also was an actor engaged in political interactions as a mediator in changing science policy and strengthening USSoviet relations. The historical study will be complemented by an empirical examination of interactions in a contemporary HEP laboratory (JINR, Dubna) mediated by material detector elements where both divergencies (differences in language, meanings, national working styles) and convergences or at least their necessity (joint practices in the collider implementation and collaboration reorganization) come into play. Predicated on the case studies I will shed light on diachronic changes in the role of material culture.

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3 - **Daniela Monaldi** (York University, Canada)

The Statistical Style of Reasoning and the Invention of BoseEinstein Statistics

This paper is a preliminary exploration of the connections between the statistical style of reasoning and the research practices of statistical mechanics in the early period of the long quantum revolution. This period saw a radical transformation of physicists' practices, from sensorial approaches based on direct measurements and mechanical models toward instrumentbased laboratory practices and mathematics-bound theoretical practices. This transformation is exemplified by the evolution of the statistical style of reasoning. Before 1925, the instantiations of the statistical style in physics went through two phases. The first phase consisted of the formulation of the Maxwell-Boltzmann statistics on the basis of the population-gas analogy, rooted in the visualizable mechanical model of the ideal gas. The second phase was characterized by the generalization of the Maxwell-Boltzmann statistics through analogies between ideal gas molecules and other microphysical entities, analogies that shaped and were shaped by the rise of microphysics and quantum theory. Einstein's invention of the Bose-Einstein statistics started a third phase and created the conditions of possibility for the development of quantum field theories. However, it also represented a leap away from sense-based mechanical modelling, and was therefore perceived as a loss of Anschaulichkeit and, in Erwin Schrödinger's words, a "sacrificium intellectus".

4 - **Hein Brookhuis** (KU Leuven, Belgium)

Making MYRRHA: a techno-political history at SCK CEN 19952020

With definitive approval from the Belgian government in 2018, the Belgian Nuclear Research Center (SCK CEN) is currently starting the construction of a GEN-IV nuclear research reactor named MYRRHA. Presented as a multi-purpose reactor it aims to reduce (toxic) nuclear waste and also produce medical radio-isotopes. As a research infrastructure that has been in the making since 1995, MYRRHA offers a unique opportunity to analyze recent developments in (New) Big Science. Recent scholarship has identified an increasing focus on economic and societal returns in legitimization of Big Science from 1980 to 2020. As a national research center, SCK CEN embodies many characteristics of these developments. In the early 1990's, SCK CEN claimed to have undergone a significant transformation that would reshape its relation to the state, society, and the industrial market. As the initial plans for MYRRHA were conceived shortly after this transformation, this paper will analyze how a proposed large-scale research infrastructure dealt with these dynamics, and how it both answered to new demands, and as well shaped new expectations. In this paper, I propose to locate the history of MYRRHA as a techno-political enterprise within the growing historiographical literature on 'New Big Science', which addresses the ongoing transformation of Big Science research facilities and their position in current science policy. By analyzing the expectations and organization of MYRRHA in this framework, this paper aims to enhance our view on the legitimization and coordination of Big Science in the recent history of science policy.

5 - **Rocco Gaudenzi** (Max Planck Institute for the History of Science Berlin, Germany)

Analogies as visual tools in nuclear and particle physics

As the grammarian Pierre Fontanier suggested long ago, one of the primary functions of analogies and metaphors is "to present an idea under the sign of another, more striking or better known". And while the definition certainly applies to the process of explanation of abstract scientific concepts—it concerns science in its rhetorical mood, as it were—it does in fact also capture a fundamental aspect of the very production of those concepts when the domain of investigation is far-removed from daily reality, or lies orders of magnitude below the human scale. In this talk, I will detail how nuclear and particle physicists respectively came to grips with the "unimaginable" properties of nuclear matter and elementary

particles by presenting them under the sign of already known systems in the physics of fluids and solid matter.

Room 6: **T16 - Environmental studies**

Chair: **Andrea Candela** (University of Insubria, Italy)

1 - **Fiona Amery** (University of Cambridge, UK)

Colour Perception and Audibility: Sensing the Aurora Borealis During the Second International Polar Year, 1932-1933

During the Second International Polar Year of 1932-1933, two sensory registers of the aurora borealis became significant for the detailed scientific investigation of the phenomenon: colour perception and audibility. Within the visual domain of elusive, fleeting atmospheric phenomena, the aurora presented unique challenges to such scientists as Balfour Currie of Canada and Carl Størmer of Norway. Photography was the primary method of recording the northern lights but could not capture its brilliant hues. Eye-witness log records therefore almost always accompanied photographic plates of the aurora. Yet, even though polar scientists trained their eyes to look for patterns in the light displays and gauge their colours, the problem of calibration between different stations remained an issue. Spectroscopic analysis and photographic filters were thus sometimes used to substantiate the data gained from long nights watching the aurora from mountaintops and meteorological huts. The concern as to whether the aurora produced objective sound was another common point of scientific inquiry during the period. Speaking to concerns over the reliability of indigenous testimony and the illusive nature of the aurora, it's apparent 'swishing' sounds were a contentious issue. I will explore the practicalities of how these problems of observation were approached and mitigated by the scientists at Fort Rae, Canada, Tromsø, Norway and the Shetland islands. In doing so, I endeavour to reveal the material cultures underpinning their investigations and the ways in which they used corporeal registers as epistemological tools to shape international knowledge of the aurora borealis during the 1930s.

2 **- Andrey Vinogradov** (Rachel Carson Center for Environment and Society, Germany)

Fish vs. Oil: struggle with pollution of Caspian and Volga waterways (1870-1931)

At the beginning of the 1870s, an "oil boom" in Baku province significantly increased the rate of oil extraction in the Russian Empire. Most of it was transported by waterways – the Caspian Sea and the Volga river – in wooden barges, which caused a large percentage of leaks. Due to the oil pollution, the number of fish in the river rapidly decreased, and the inhabitants of the Volga cities suffered from the lack of clean water. The enhancement of the oil extraction was inextricably intertwined with the development of water transportation infrastructure and opened up new opportunities in foreign policy and industrial growth for the Russian Empire. In contrast to that, the limitation of the oil transportation could slow down the pace of economic development, but would undoubtedly correspond to the interests of all residents of the Volga region and especially of the fishing industry, in which a significant number of citizens were employed. Trying to comply with the idea of the common good, the state has sought to base its anti-pollution policies on "science-based principles", which has increased the importance of the expert community in litigations. Leading Russian ichthyologists, zoologists and hygienists were actively involved in the conflict: on the basis of special research and experiments, they declared opposite opinions about the causes and nature of pollution, toxicity of oil and its influence on the river fauna, actively defending their positions in popular periodicals. The broad public discussion affected scientific circles, officials, industrialists and citizens, greatly contributed to the formation of

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conservation science in Russia and significantly influenced the development of Russian environmental legislation.

3 **- Stathis Arapostathis** (National and Kapodistrian University of Athens, Greece)
Expertising Greece: Science Advice, Pollution and State formation, 1980-2020

The paper is study that focuses on the co-production of public policies, scientific expertise and the management of pollution and toxicities in Greece the last forty years. It studies four decades of environmental advice and techno-scientific expertise in cases of air pollution and toxic hazards. Four case studies will be the focus to unravel the role of experts in the management of environmental risks: a. the case of Chernobyl (1986) in a peripheral European country like Greece, b. the air-pollution of urban centers like Athens (1980s) and Volos (2000s), c. the "Red-Minoan" (2018), the dust storm that impacted severely the southern part of Greece and particularly the island of Crete. The cases have been selected as key critical episodes, of national and regional interest, in the formation of governance of risks through expert advice. The paper argues that the materiality of scientific advice was important in configuring regimes of trustworthy expertise, in participating in the environmental politics and in defining the public policies. Regimes of trustworthy expertise forged together with the material and literary technologies of epistemic communities of the period. Measurements, observations, modelling and scientific predictions as well as public statements and framing of the contamination of air, soil, water participated in the environmental politics over pollution in urban and non-urban areas. Scientific experts (physicists, atmospheric physicists, meteorologists, environmental engineers) aimed in acquiring important role in defining the governance of environmental and public health risks. Through their engagement in shaping civic epistemology and regulatory science they contributed in the formation of the state. The paper is based on primary sources that involve scientific and engineering archives, the technical and scientific press and the popular press. It is based also on some key interviews with key scientists in each case.

4 - **Gemma Cirac-Claveras** (University Pompeu Fabra, Spain)
Re-imagining the space age. Aircraft, fieldwork and satellites

In 1981, scientific administrators of the French space agency announced that it would sponsor a vastly expanded global environmental research program based on the use of satellite remote-sensing data –a development that resonated with major space agencies, such as NASA, which since the end of the Moon race began turning itself into an environmental agency. This paper explores how this ambitious French satellite environmental research program was framed. It looks at the experts involved in satellite work since the mid-1960s, their practices, skills, values, motivations, and social relations. They were basically astronomers inheritors of the sounding-rocketry program; geologists, hydrologists and agronomists converted from aerial photography; physicists experts in radiation budget and spectral analysis that had so far remained at the margins of the core of the institutional space effort; and computer scientists. They belonged to organizations, diverse in geographical distribution, interest and size, and often in concurrence. They had been working in parallel since the 1960s and only came into closer dialogue in the 1970s, when a remote-sensing program for surveying natural resources was being germinated under the auspices of the space agency. Their experiences and expectations, technical skills, and social dynamics gradually transformed the original program toward a particular form of environmental satellite remote-sensing in France. What had started as a technology for surveying natural resources became the germs of a global satellite environmental research program. These experts were not only shaping what was satellite remote-sensing for, but also how was to be used, and by whom. 2 This paper pertains to the broader question of how technologies acquire new meanings. It also makes a plea for further examination of contexts not considered central by mainstream historiography, but whose consideration may illuminate new aspects of the history of science, particularly of the history of satellite technology and the Earth sciences.

5 - **Sofia Varino** (Potsdam University, Germany)

An Unnatural History of Gaia Theory According to James Lovelock & Lynn Margulis

In this paper, I examine how British chemist James Lovelock (b. 1919) and American biologist Lynn Margulis (1938-2011) developed Gaia theory for scientific and general audiences from the 1970s onwards. I begin by examining the reception history of Gaia theory in scientific publications since the 1970s and its later circulation across popular science and mainstream media outlets, as Lovelock and Margulis continued to expand their systematic approach to planetary ecology, supported by Margulis's theory of endosymbiosis. Focusing on the visual and sensory strategies employed by the two scientists, I argue throughout that Gaia theory has historically emphasized how living matter behaves in animate, vital, autopoietic ways. I draw on Bruno Latour's actornetwork theory to analyze how the hypothesis has developed over time, enacting models of planetary symbiosis mingling machinic and organic materialities, and how these have in turn informed visual models of the Anthropocene. In addition, I deploy the vital materialisms of Jane Bennett to critically engage with Gaia theory's narratives of a lively planet, highlighting how genealogies of physiological, biochemical, computational, and neurological knowledge have shaped Gaia theory's central model of the Earth as a responsive, sentient entity, with cognitive and sensory faculties of agency and selfregulation. Contrasting notions of Gaia and of the Anthropocene, I consider how we can harness the multiple genealogies of Gaia theory's visuality and materiality towards a speculative history of planet Earth's non/post/ahuman future.

Room 7: **S42 - Views from the periphery: visual, material, and sensory cultures of science in early modern Scotland**

Conveners: **Lewis Ashman** (University of Edinburgh, UK), **René Winkler** (University of Edinburgh, UK)

In a geographical sense Scotland lay at the periphery of early modern Europe, and its intellectual life has often been viewed in similar terms – particularly with regard to science. Scotland's four early modern universities rarely, if ever, feature in general accounts of the Scientific Revolution, and there has been some disagreement among scholars as to whether science should be seen as forming any part of the Scottish Enlightenment. Yet there is evidence that significant intellectual connections existed between Scotland and continental Europe, in addition to those with its southern neighbour, England, with which it entered into regal and parliamentary unions in 1603 and 1707 respectively. In light of these connections, it may be asked to what extent scientific cultures in Scotland differed from those elsewhere, and how developments in Europe did not just influence science in Scotland but were shaped and contributed to by Scottish thinkers and practitioners of science. It may also be asked to what extent Scotland's geographical position determined its role in the intellectual life of early modern Europe, and whether its status as a periphery helps us to understand science in early modern Scotland. This symposium will therefore consider the validity and usefulness of the view that Scotland was peripheral to developments in science under way in the rest of Europe and Britain. Papers will consider various themes from across the early modern period that raise important questions about the visual, material, and sensory cultures of science while bringing a critical focus to the historiography of early modern Scottish science. This symposium will aim to explore the connections, parallels, and divergences between the theories and practices of science in Scotland and the rest of Europe and Britain, drawing attention to intellectual life at Europe's geographical margins.

Chair: **Monica Azzolini** (University of Bologna, Italy)

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1 - **Lewis Ashman** (University of Edinburgh, UK)

A sign of the times: Newton's calculus and the limits of geometry in eighteenth century Scotland

The eighteenth century has been characterised as a period of decline for British mathematics, and this decline is often viewed through the prism of calculus. Failure to keep up with innovations made in continental Europe has been attributed to an overzealous attachment to the work of Isaac Newton, and consequently to the privileging of geometrical demonstration over the algebraic form of analytical calculus. In Scotland, this apparent preference for geometry over algebra has been described as 'mathematical Hellenism' and contrasted with the embrace of 'continental analysis' in the nineteenth century. Although Newton had cautioned against the use of algebraic symbols and promoted the geometrical methods of the Ancients in his later writings, Scottish mathematicians did not simply reject analytical calculus as a result. Rather, the epistemological distinction between lines and symbols was a subject of debate in eighteenth century Scotland, with considerable practical implications for mathematics. This debate was especially relevant for calculus, the definition and application of which was itself a matter of some controversy throughout the century. While earlier works by John Craige and George Cheyne made limited use of geometrical methods, Colin Maclaurin's 1742 A treatise of fluxions sought both to provide calculus with rigorous geometrical foundations and justify the efficiency and validity of algebraic methods. Maclaurin's arguments anticipate those of John Playfair in the 1790s, who saw geometry as an unrivalled method of proof and essential for education, but lamented the decline of mathematics in Britain and advocated for the adoption of continental analysis. This paper will explore the use of geometrical demonstration in Scottish publications on calculus, revealing the limits of geometry's usefulness in the eyes of Maclaurin and Playfair in particular. It will aim to show how algebraic symbols were seen as innovations of profound practical and conceptual power in eighteenth century Scotland.

2 - **David McOmish** (University of Edinburgh, UK)

Edinburgh’s Supernova: examining the universe anew after the collapse of Aristotelian Cosmology at the University of Edinburgh, 1612-1640

The supernova of 1572 and the comet of 1577 had a profound effect upon attitudes towards Aristotelian cosmology and its attendant metaphysical assumptions. Across Europe, individuals explored and developed many new ideas to fill the void left by this paradigmatic collapse. According to the overwhelming consensus of 20th and 21st century historiography, the impact of the new ideas and approaches to cosmology found across Europe’s traditional intellectual hubs was minimal to non-existent in Scotland. Evidence from published student disputations and manuscript copies of student notebooks has been used to argue that virtually no one in Scotland engaged with the new cosmologies and that Scottish universities remained doggedly conservative and almost completely Aristotelian. New evidence from a long-ignored early modern manuscript from Edinburgh has revealed that Edinburgh University’s student disputations from across the 17th century are redacted passages taken from a cosmological commentary written by a Parisian professor of mathematics. The commentary reveals that Edinburgh students were in reality exposed to a myriad of new philosophical, mathematical, and scientific responses aimed at explaining a postAristotelian universe. This paper will examine how the works of writers such as Bernardino Telesio, Valentinus Naboth, Francesco Patrizi, Giambattista Benedetti, William Gilbert, Johannes Kepler, and Galileo were presented in the manuscript, the student notebooks (and thus lectures), and the redacted printed Theses. It will present the strong case for the emergence of a community of scholars in Edinburgh whose intellectual culture began to cohere around a sceptical, observational, mathematical approach in the wake of the collapse of the Aristotelian paradigm.

3 **- René Winkler** (University of Edinburgh, UK)

Robert Sibbald's Auctarium Musæi Balfouriani and the role of museums and collecting in the making of natural scientific knowledge during the early Scottish Enlightenment

Museums, whether private studios, princely gallerias or collections attached to institutions, played an important role in the making and shaping of early modern knowledge about nature. Paula Findlen's ground-breaking examination of the Italian collections at Bologna, Rome and elsewhere, has stimulated a lively scholarly debate on the social, intellectual, commercial and aesthetic values manifested by the natural history cabinets of early modern Europe. However, in discussions concerning the material Republic of Letters and Specimens, Scotland often appears absent, or at best relegated to the role of a peripheral adjunct of England. In 1697, Sir Robert Sibbald (1641- 1722) – Geographer Royal for Scotland and Edinburgh's first professor of medicine – donated a substantial part of his own collection of natural history specimens to the city's university. This supplemented the collection of Sibbald's well-travelled virtuoso friend, Andrew Balfour. Sibbald catalogued his collection in the Auctarium Musæi Balfouriani, the only printed catalogue of an early modern Scottish museum. This paper will argue that catalogue and museum represented no Wunderkammer of the strange and the bizarre, but had a clear didactic purpose as a guide to natural history, instigated by Sibbald's Baconian ideas. In a country suffering from religious and political upheaval, the Auctarium is also evidence of an active scholarly community before the Treaty of Union in 1707. Examining Sibbald's collection in detail allows us to see how this community of virtuosi collected and exchanged natural history knowledge and specimens and connected Scotland to the rest of Europe intellectually and materially.

4 - **Martha McGill** (University of Warwick, UK)

Science and the supernatural: bodies, minds and invading spirits in early modern Scotland

While early modern Scottish scientific culture is sometimes characterised as peripheral, the country looms larger in studies of the supernatural. The Scottish witch trials were relatively severe, with Scotland executing perhaps ten times as many accused witches per head of the population as England. Scotland was also associated with magical belief more generally, becoming what Michael Hunter terms an 'occult laboratory' for figures such as Robert Boyle. This paper will challenge notions of Scottish backwardness by exploring how science and supernatural beliefs were interwoven. The paper will focus in particular on how understandings of body and mind were underpinned by beliefs about the supernatural world. The importance of the soul within early modern medical and natural philosophical theory is commonly recognised. Less well known is the significance of ideas about angelic and demonic invasion. The early modern body was understood to be porous, with the humours in a constant process of interchange with the wider environment. There have been detailed surveys of how natural (especially climatic) forces were thought to influence the human disposition. But according to early modern belief systems, the natural world was imbued with supernatural powers. Just as the body was open to currents of air, it was open to angels and devils. Supernatural spirits could work on human beings on a near-continual basis, inspiring particular emotions, thoughts or resolutions. The paper will demonstrate how the idea of spirits working on humans was grounded in medical and natural philosophical theory, and will show how the scientific and religious culture of late-seventeenth-century Scotland encouraged the development of an empirically demonstrable supernaturalism.

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Room 8: S72 - How can the description of visual and material practices contribute to a better understanding of scientific cultures? - 1. Mathematical cultures

Sponsored by DHST-DLMPST scientific section IASCUD (International Association for Science and Cultural Diversity)

Convener: **Karine Chemla** (CNRS / University of Paris, France)

The symposium aims at understanding how historians and philosophers might draw on visual and material resources used in given contexts, and on the ways actors used them (that is, the practices that go with them), to better grasp scientific cultures. Part 1 focuses on mathematical cultures. To address the issue at stake, we concentrate on diagrammatic resources and their uses in drafts (Haffner) and in published papers (Steensen, Secco). Haffner relies on engagements with diagrammatic resources, within a mathematical culture, to distinguish between different times of mathematical activity (research practices and writing practices). Secco examines the shaping of a new culture of proof, in relation to how actors shape a new articulation between diagrams and computing devices. Steensen analyzes how the introduction of new diagrammatic practices might characterize the mathematical work carried out in the context of an emerging culture, and might as well constitute one of the outcomes that other mathematical cultures adopt and recycle. By contrast, Wagner analyzes the impact of culture-specific diagrammatic practices on the shaping of concepts and rules in this context.

Chair: **Karine Chemla** (CNRS / University of Paris, France)

1 - **Anna Kiel Steensen** (ETH Zurich, Switzerland)

The mathematical use of graphic position in C. F. Hindenburg's combinatorial school

How can we use mathematical texts to describe practices that use diagrams and diagrammatic features of written language? What is the relation between how a reader interprets the diagram and how actors consider the mathematical status and function of the diagram? In this talk, I will address these questions in the case of German mathematician C. F. Hindenburg (1741 – 1808). Specifically, I focus on how Hindenburg (e.g. [1795]) makes mathematically significant the relative positions of individual letters, numbers and line segments (not geometric position, but graphic position as a spatial feature of letters etc.). Following Knuth, who wrote that Hindenburg gave "combinatorial significance to the digits of numbers written in decimal notation" [2006: 69], I am interested in a specific semiotic process: how interpretations of diagrams arise from the interplay between text and diagrams, and how the interpretations relate to Hindenburg's mathematical use of position. To describe this process, I apply a structural-analytical approach, which does not presuppose that the interpretation of the diagram is given or universal, but constructs it in the analysis. The heritage of Hindenburg's combinatorial school is generally regarded as limited when it comes to defining new mathematical concepts and proving theorems. The present project opens the question of the school's influence: its semiotic work may have contributed to opening up a new domain for mathematical consideration. The project thus indicates how a local visual-textual practice can influence wider mathematical practice.

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2 - **Emmylou Haffner** (University of Paris Saclay, France)

Writing practices in mathematical drafts: what can the materiality of writing before publication tell us about mathematics?

The varieties and singularities of ways of writing in mathematics are well known by historians of mathematics, and are identified as rooted in certain scientific cultures. Many characterizations of mathematical writing focus on published papers alone, putting aside an important part of the mathematical work: the researches done before writing down a text for publication. Mathematical drafts provide us with material traces of the research process(es) and of the writing practices of the mathematician at work, and allow us to see that such writing practices can sometimes differ significantly from the ones witnessed in publications. Using examples from the archives of 19th century German mathematicians Richard Dedekind (1831-1916) [1] and Bernhard Riemann (1826-1866) [2], who shared a common mathematical culture and important methodological tenets, I will study some aspects of these writing practices such as drawings, tables, and spatial arrangements of the writings. I will pay particular attention to the extent to which these writing practices are specific to research writing, in contrast to writing practices observable in these two mathematicians published works, and whether they are shared by the two authors.

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3 - **Gisele Dalva Secco** (Federal University of Santa Maria, Brasil)

Computer-assisted proofs as a new form of mathematical culture? The case of the Four-Color Theorem

The Four-Color Theorem (4CT, delivered in [1] and [2]) is the first case of an original mathematical result obtained through the use of computing devices. The philosophical citizenship of this result was due to an argument presented in [3], in which the uses of computational machinery is intended as a clear-cut case for the introduction of experimentation in mathematical practices. Building on the methodological guidelines suggested in [4] I offer in my talk a description of [1] and [2], focusing on how computing devices interact with other important resources of the proof: diagrams. With this description, my aim is to propose the 4CT proof as the turning point in the relations between mathematics and computer science – the advent of new forms of cultures of proving [5] whose understanding is one of the tasks philosophers and scientists must urgently share and act upon [6, p.3].

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4 - **Roy Wagner** (ETH Zurich, Switzerland)

Diagrammatic cognition and distinct mathematical cultures

The cognitive and philosophical discussion on the use of diagrams in mathematics often focuses on the norms that would render diagram-based inferences correct in some universal sense. Mathematical use of diagrams, however, is not in fact committed to such norms. Diagrams may be used to organize information, simplify explanations and suggest new arguments and conjectures without committing to rigor (to the extent that the relevant mathematical culture is rigorous, rigor may rely on complementary forms of reasoning). In order to understand how a "risky" diagram may be used to reason mathematically, we need a cognitive theory of mathematical (specifically, diagrammatic) reason that is not focused on rigorous mathematical inference. The work described in [1] and [2] provides a neuro-cognitive infrastructure for such a theory, while [3] provides a philosophical counterpart. After briefly presenting this theoretical infrastructure, I'll analyze some historical and modern examples for non-rigorous or "risky" diagrammatic reasoning. This kind of reasoning follows diagrammatic elements that might diverge from the represented mathematical situation into forming new objects or inferences. In turn, these objects and inferences may shape new mathematical concepts and rules that may be have a culture-specific effect arising from the culture-specific diagrammatic representation.

Room 9: S82 Envisioning Mathematics - 1. Conjectural Imagery

Conveners: **Tatiana Levina** (National Research University Higher School of Economics, Russia), **Anya Yermakova** (Harvard University, USA)

What do we imagine, thinking of the foundations of mathematics? How can we envision conjectural reasoning, in diagrams, sketches of proofs, and other varieties of mathematical thought experiments? Is comprehensibility of visual traces of mathematical thought encased in the chosen symbology? For Georg Cantor, for example, an absolutely infinite sequence of numbers was the "appropriate symbol of the absolute". The scholar Anne Newstead delves into Cantor's imagination in her article "Cantor on Infinity in Nature, Number, and the Divine Mind," where she shows number classes forming the symbol of a ladder (Newstead, 2009). The most abstract science, mathematics, is not always related to imagination as much as to the ability to build hypotheses. The art of mathematical conjecture could be grasped by the list of 23 mathematical problems, set out by Hilbert. Barry Mazur (Mazur, 1997) wrote that the art of conjecturing has achieved a formidable, and quite formal, prominence in the mathematical landscape, insisting that it is of greater interest to the philosopher of mathematics than the art of proof. Gödel's incompleteness theorem — often seen as the greatest logical achievement since Aristotle — did not herald the end of mathematical logic. Instead it induced a blossoming of conjectural thinking that even led to the development of modern computers. Returning to the mathematical imagination, let us remember the drawings and diagrams of erudites from different disciplines studying the theoretical and applied extensions of mathematics. One paper in this symposium will explore archival 'scratchwork' from logicians and polymaths who were investigating the foundations of mathematics at the turn of the 20th century, such as Nikolai Bugaev (1837-1903) and Ivan Lapshin (1870-1952). A careful review of drawings and diagrammatic reasoning in such scratchwork elucidates various background assumptions and background intentions, which are noticeable in printed literature left by these scholars but rarely explicated with clarity.

Chair: **Tatiana Levina** (National Research University Higher School of Economics, Russia)

1 - **Daria Drozdova** (National Research University Higher School of Economics, Russia)
Geometry and Visualisation of Temporal Dimension of Motion in 17th-18th Century Mathematics and Mechanics

The textbook narrative of the Scientific Revolution of the 17th century contends that the early modern transformation of physics and mechanics was grounded in mathematization, that is, the application of mathematical principles and procedures to physical entities and events (Floris Cohen 1994; Roux 2010). In this context geometrical forms or numerical proportions are usually understood as an instrument for expressing physical laws and regularities. However, more recently scholars argue that in fact 17th century thinkers took mathematical objects themselves to be generated in mechanical processes, as when, for example, geometrical lines were understood to be the product – and not a mere representation – of motion (Guicciardini 2009, Gal & Chen-Morris 2011). If mathematization is more than the mere application of prior and independent mathematical knowledge to the description and representation of non-mathematical objects, this seems to signal a shift towards constructivist foundations of mathematics (Guicciardini 2003). However, such a transformation faces a major obstacle: compared to geometry, mechanics includes an additional dimension, namely time (Koyré 1966). The representation of the movement of a physical body as a geometrical line abstracts away the fact that the trajectory of the body is a manifold of timesequenced positions: the line represents these positions concurrently. In my paper, I will present various approaches to the problem how to visualize the temporal dimension of motion geometrically. I start with the famous example of medieval graphical representation of uniformly increasing velocity which was used by Galileo in his deduction of the law of free fall (Galileo 1638, Damerow et al. 2004). Then I analyze a long living tradition of representing motion by trajectory with separate indication of moving body position at certain moments of time. I conclude my review with an analysis of modern graphical visualization of motion (distance, velocity, acceleration) as a function of time and will argue for the conclusion that the inclusion of time was solved only in a surprisingly late stage of the development of mathematical physics.

2 - **Jens Lemanski** (Fern University in Hagen, Germany)
Visual Turns and Crises of Intuition in 18thcentury Philosophy of Mathematics

Whether the fundamentals of mathematics need to be presented purely rationally or visually is a question that has been controversially discussed for many centuries. Until the late 19th century, this controversy was particularly fought over Euclidean geometry and Archimedean physics. Especially in relation to the 19th century, historians of science speak of “visual turns”, which are then replaced after a certain period by “crises of intuition” (“Krisen der Anschauung”). Both visual turns and crises of intuition are often supported and motivated by philosophical arguments. In my lecture, I will concentrate on the sequence of visual turns and crises of intuition in the 18th century, which depend especially on the interpretation of Euclid and Archimedes. I will examine two debates that are separated by a mid-18th century crisis of intuition: (1) The debate between Daniel Friedrich Hoheisel, Andreas Rüdiger and Christian Albrecht Körber on whether geometric movements can be proven solo oculorum usu. (2) The debate between Immanuel Kant and Abraham Gotthelf Kästner on the role of geometric figures and logical axioms in geometry. I will argue that both debates are marked by the same rationalist or empirical assumptions, but that the second debate has certain new argumentative weightings.

3 - **Irina Starikova** (National Research University Moscow, Russia)
Diagrams in mathematical thought experiments

In empirical science, the value of thought experiments (TEs) has been widely acknowledged.[1] However, in an abstract domain like pure mathematics, thought experiments (MTEs) can also be valuable.[2] A more careful look at mathematical practice suggests that MTEs may go beyond the limits of rule-governed uses of diagrams and in certain cases can be more effective. Through analyzing examples, I will show some advantages MTEs may have over standard diagram uses, with the aim of

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contributing to understanding how mathematical practices develop, in particular, how they can be experimental and how their empirical factors can be valuable. This knowledge can also contribute to our understanding of the foundations on mathematics. In particular, this knowledge can help knowing more of how sensory experience contribute to shaping evident mathematical beliefs.

4 - **Andrei A. Paramonov** (Institute of Philosophy, Russian Academy of Sciences, Russia)
Drafting as elemental force: Topological images in the works of Merab Mamardashvili

This paper investigates the problem on the status spatial images and drawings may have in a philosophical texts. What makes us to put down our writing or interrupt our conversation and go to the visual image of something, i.e. start drawing? However this kind of question can be raised not only in relation to drawings in philosophical texts. For example, what does a geometer do when making a draft or drawing a straight line? It would be too much simplification, according to the Russian and Georgian philosopher Merab Mamardashvili (1930-1990) to believe that draft in geometric problems serve only as a visual illustration to a formal proof. In geometric draft, he believes, the possibilities of building a kind of "organizing fabric" are played out, where the space of “clearly located understanding” is unfolded on special finite objects. The draft in this case turns out not to be a visual model of the ideal geometric bodies, with respect to which the proof is conducted, but is a model of our understanding of these ideal bodies and their properties. In this paper, the question of the status of the drawing is addressed to the heritage of Mamardashvili himself, the subject of the study is his work on "natural-historical epistemology", his works on Descartes, Kant, and Proust, in which he often refers to graphic schemes-drawings, spatial and topological images. An attempt is made to build a general topological structure of these images. The problem of event topology is considered through the prism of the correlation of verbal and graphic. The topic of the event topology is traced, in particular, on the published Mamardashvili's lectures on Marcel Proust. A visual model of the so-called topos of understanding as a structural principle of Mamardashvili's intellectual manner is proposed.

Room 10: S17 - Acting with Images and Objects: The Political Epistemology of Mobile Atomic Exhibitions - 1

Convener: **Maria Rentetzi** (Technical University Berlin, Germany)

Our starting point is the assumption that scientific knowledge produced especially after the second half of the 20th century has been situated in a strongly political context. Politics and diplomacy have been historically linked not only to new geopolitical orders but also to the emergence of new structures of knowledge, concepts, scientific practices and actors. These phenomena are prime candidates for epistemological investigation. This panel brings front and center a version of political epistemology that explores scientific images and objects as political instruments, which in turn affect, as such, scientific practice. The focus is on atomic exhibitions and on their mobility as an epistemic-cum-political virtue. Historians of science have recently recognized the power of exhibitions to engage the public in the production of knowledge (i.e. Kohlstedt 2010; Rader and Cain, 2014). Exhibitions, however, have the potential to do much more. They make political statements; they become sites for the visualization of different social futures (Molella and Knowles, 2019); they represent fertile spaces for diplomatic negotiations (Rentetzi, forthcoming). Despite the vital role of exhibitions in the production of knowledge and the formation of political worldviews, there is hardly any work on the historical role of atomic mobile exhibitions in shaping nuclear science and politics. 2 “Acting with images and objects” is an attempt to highlight the decisive role of mobility in the postwar period, especially for the international organizations that were keen to spread images of a common atomic future worldwide and in so doing to shape local scientific cultures. Our proposed papers combine an interest in global and transnational histories of

atomic exhibitions with their epistemic and political cultures. As we acknowledge the epistemic value of images and objects, we discuss how mobile atomic exhibitions such as those designed by the UN and its related organizations or any national attempts to exhibit the atom, defined nuclear futures.

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Chair: **Maria Rentetzi** (Technical University Berlin, Germany)

1 - **Maria Rentetzi** (Technical University Berlin, Germany)

Mobility Matters: How to Form a Transnational System of Nuclear Power

This paper addresses the role of the US material culture and knowledge on atomic exhibitions in shaping the materialities of the UN-related International Atomic Energy Agency. The argument is that mobility mattered the most in IAEA's political planning. From mobile laboratories to exhibitions, instruments, and experts mobility became the agency's main concern in its attempt to establish a standardized shared nuclear culture and form a transnational system of power relations. Eventually, it was the US' material experience that was carried over to the IAEA, which through its technical assistance programs shaped local cultures around the world. Indeed, right after the Second World War mobile exhibitions of the peaceful uses of atomic energy organized by the US Atomic Energy Commission proved to be an exceptionally successful tool in promoting political messages and legitimizing atomic energy on a national level. A mobile atomic exhibition entitled "Man and the Atom" toured the country attracting 4 more than one million people only in New York City in 1948. After the US President Dwight Eisenhower delivered his speech to the UN General Assembly on December 1953 introducing the Atoms for Peace initiative, the AEC initiated a new program of travelling exhibitions, this time more ambitious than ever, known as the "Atoms for Peace" mobile campaign. Based on the US experience, the IAEA developed an elaborate system of public information and mobile atomic exhibitions to promote the peaceful uses of atomic energy, often working together with the World Health Organization and UNESCO. Despite the importance of "exhibiting the atom" to both the formation and dissemination of United Nations specialized Agency's ideals about postwar development on a global level, there is hardly any work on the mobile atomic exhibitions. Addressing this knowledge gap, this paper analyzes the historical role of exhibitions in the production of nuclear knowledge.

2 - **Loukas Freris** (Technical University Berlin, Germany)

The Image Technical Assistance: The of IAEA's Mobile Radioisotope Laboratory travels to Greece

'The mobile radioactivity measurement laboratory demonstration took place yesterday.' This is how the Greek newspaper Eleftheria, in April 24, 1959, informed its readership of IAEA's Mobile Radioisotope Laboratory visit in Athens. This paper focuses on one of the major TA programs authorized by Greece and unravels the complex negotiations between the Greek Atomic Energy Commission and the IAEA. It follows the first Mobile Radioisotope Laboratory, one of the two laboratories that the US government donated to the IAEA for the technical training of new physicists on the use of radioisotopes in medicine, agriculture and industry, on its maiden trip from Austria to Greece and highlighting the ways through which the IAEA sought to familiarize humanity with atomic energy. From 1959 to 1965, the two units visited sixteen countries in Europe, Asia, Africa and South America and approximately 1500 technicians

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and students attended to the so-called training courses. However, these laboratories, were used not only for training purposes but also for demonstration purposes to diffuse information regarding new radioisotope techniques to scientists and the general public. I argue that the function of the Mobile Lab as an mobile atomic exhibition is just as important as its function as a scientific and technical education place. Through a 'playful' and somewhat 'magical' look, the mobile lab was intended -on the one hand- to erase the memories that linked the 'atom' to notions of destruction and death and on the other hand to identify and equalize atomic energy with progress. Without doubt the Mobile Radioisotope Laboratory was of symbolic importance for the future of the world of knowledge with regard to the structure of matter and peaceful forms of atomic energy use.

3 - **Tatiana Kasperski** (Pompeu Fabra University, Spain)

From Nuclear Carnival to "Geek" Picnics: Engaging the Public in Nuclear Science and Technology in post-Soviet Russia

After the Chernobyl disaster and the breakup of the Soviet Union in 1991, the Russian nuclear enterprise – with 33 operating reactors -- declined significantly. The industry began to recover in the late 1990s, and especially in the 2000s under President Vladimir Putin with several wildly ambitious programs for the development of the nuclear sector. These projects were accompanied by major efforts of the industry and the state to develop new instruments and forms for engaging the citizens in favor of the atom. The well-funded projects included the creation of nuclear information centers with special exhibitions, glossy publications and films, and museums both in the cities hosting nuclear power plants (NPPs) and in regional capitals. The industry started to organize visits to the NPPs, carnivals, beauty pageants and plays, festivals, educational projects, and artistic and scientific competitions. The info centers annually attract tens of thousands of school children, young workers of the industry and teachers to such programs as "geek" picnics, family "laboratories," and thematic school weeks, as the industry claims "to popularize knowledge and profession of the atomic branch." Focusing on such cases as the bi-annual "carnival" organized by the Beloiarsk Nuclear Power Plant and the activities of these regional multi-media nuclear information centers, this paper will analyze how the contemporary promotion of the atom aimed at changing dominant post-Chernobyl public imaginary about (Soviet) nuclear energy associated with secrecy and nuclear disasters in two major ways. On the one hand, the nuclear industry is portrayed as open, friendly, "fun," a place to be for young, smart, ambitious and "cool." On the other, the atom is touted as a source of national pride and military and scientific might in Putinist Russia. It will also suggest how these visions resemble or differ from public manifestations and practices of nuclear knowledge in the Soviet period.

4 - **Donatella Germanese** (Max Planck Institute for the History of Science Berlin, Germany)

The Italian Atomic Exhibition on Wheels, on the Screen, and on Paper

Five trucks caravanned through Italy for months in 1954 and 1955, transporting equipment and objects of the Mostra Atomica and serving as showrooms at the same time. The atom trucks were not without precedent in Europe – note for instance the Atom Train in UK. As highlighted by the Corriere della Sera, a leading Italian newspaper, the Mostra Atomica was organized by the United States Information Service (USIS) in cooperation with US, British, French, and Italian organizations, all devoted to the promotion of nuclear energy. In the years before, Italian people had become used to American sound trucks travelling to towns and villages and projecting documentary films in support of the Marshall Plan. While the propaganda efforts of the years 1948-1952 were not really successful, and the Italian Communist Party was still strong, the campaign for the "peaceful" utilization of nuclear energy and radiation seemed to reach its goal: the organizers reported more than three million visitors. It was particularly emphasized that the one millionth visitor was a child – a circumstance tuned to the policy of addressing children in the modernization efforts of the country. Based on photographs, newsreel, reports in the daily press as

well as in industrial and trade union magazines, my paper will trace back how the atomic mobile exhibition was marketed by the USIS and popularized by Italian media.

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Room 11: S53 - Gardens-Laboratories in Early Modern Botany, Chemistry, and Physiology

Convener: **Fabrizio Baldassarri** (University of Bucharest, Romania)

In the early modern time, gardens developed as a new, denser zone for investigating nature and its variety: botanical gardens were built as spaces to collect, accommodate, cultivate, and perform observations on specimens. Yet, gardens became hallmarks where theories and hypothesis were purportedly tested by experiment, and scientific arenas were hands-on experience united with higher learning, ultimately helping shape the scientific revolution. Gardens-laboratories indeed surfaced as relevant places for testing knowledge, such as chemical, mechanical, and physiological doctrines, and in which male and female scholars equally contributed to knowledge production, a story that has been lately suffered from marginalization. The aim of this symposium is to move from the epistemic state of gardens in the late sixteenth century to the gardens-laboratories of the late seventeenth century. While a lot of attention has been already devoted to the foundation of sixteenth century botanical gardens (see esp. Egmond), our investigation will start from the sixteenth-century experimentation with plants through herbaria and dried gardens, a substantial foundation of botanical knowledge, as Carrion will focus on in her presentation. Fornasier will then explore the case of the Parisian Jardin des plantes, founded by the physician and paracelsian enthusiast Guy de La Brosse, where scholars combined alchemy with the study of plants, somehow anticipating the study of the Royal Society, while proposing an alternative philosophy of nature. Baldassarri will next move the focus to the second half of the seventeenth century, and will discuss the ascent of water in Marcello Malpighi's investigation of plants, in Nehemiah Grew's botany, and in John Ray's physiology of plants. Finally, Davies will deal with a few women who, while collecting local and exotic plants, crucially contributed to the work of identifying and documenting the nature of several species, ultimately showing that gardens were important laboratories of knowledge.

Chair: **Iolanda Ventura** (University of Bologna, Italy)

1 - **María M. Carrión** (Emory University, USA)

Nature Gazing in the European 16th-Century Dried Gardens

The European collections of dried plants from the 16th-century known as herbaria or dried gardens (orti sicci) have been considered a significant early botanical source; their specimens, nomenclature, organization, and collections have been interpreted as a substantial foundation for modern scientific knowledge (Gerard Thjisse, Tinde Van Andel, Brian Ogilvie, Alette Fleischer, Florike Egmond, Laura Findlen). A few scholars have compared the contribution of these books in contrast with the ancient

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tradition of illustrating collections of plants as pharmacopeias, which in the Renaissance continued in the translation of founding texts such as De materia medica to the European vernacular languages, as well as an expansive bridge with drawing, painting, and cultivation of natural aesthetics (Egmond, José Pardo-Tomás). However, the matter of how these collections of books contribute visual epistemologies that fuse aesthetic and scientific gazing has not been teased out. This paper examines how the 16th-century European dried gardens establish a platform of gardens-as-laboratories that connect, with their gaze, painting and drawing traditions with that of the emerging botanical gardens. The analysis will focus on how these collections constitute aesthetic and scientific experiments with live plants turned necrotic by virtue of preservation treatments and time. A reading of a small, representative sample of these plants and a few passages from the narratives of the naturalists who composed these books, "Nature" will highlight the experimental method that led to the textual and visual aesthetic and scientific narratives of these plant collections. In doing that, this paper considers their importance for natural history and philosophy, for aesthetics and ethics, for botany and art, seeking to acknowledge their contribution to early modern history. With that new understanding of the past, the questions about nature and humanity posed in these books at the beginning of the era of the Anthropocene, may find some new answers.

2 - **Matteo Fornasier (**Ca' Foscari University of Venice, Italy)

The Botanical Philosophy behind the Jardin des Plantes

For more than two centuries, namely the sixteenth and seventeenth centuries, the city of Paris was the scene of a no-holds-barred fight between the Sorbonne's Faculty of Medicine and all other physicians who did not adapt to the teachings of the Faculty. No one was allowed to practice medicine without the authorisation of Sorbonne's doctors, strong supporters of Galenic medicine and a Scholastic and Aristotelian way of thinking universe. Those "irregular" physicians, paracelsians mostly, found a powerful ally: the king himself. They gathered around the court and, protected by the authority of the crown, they demonstrated the efficacy of their new medical practices. The so called Maison médicale du Roy increased in power and became a true Sorbonne's competitor in control of medical practice in Paris. One of the most important achievement of the king's doctors was the Jardin du Roy (later Jardin des Plantes). It was conceived by one of the king's physicians, Guy de La Brosse, who was also a botanist and a paracelsian iatrochemistry enthusiast. De La Brosse laid the theoretical foundations of his project with a book about the importance of plants in medicine, titled De la nature, vertu, et utilité des plantes. This is a botany book, all focused on plants' nature, anatomy, use of them in medicine and preparation of remedies but also explicitly imbued with renaissance philosophy. The third and central part of the book presents Paracelsus and his iatrochemistry as an important innovation in medicine. Paracelsian chemistry and its principles are explained in detail, highlighting it as the base of a better medical practice. De La Brosse's natural philosophy is the mainstay of this botanical garden in the heart of early modern France, supported by the king himself, site of iatrochemical laboratories and free courses open to everyone.

3 **- Fabrizio Baldassarri** (University of Bucharest, Romania)

The Ascent of Water in Malpighi's, Grew's and Ray's Physiology of Plants-Laboratories

In 1672, Nehemiah Grew (1614-1712) and Marcello Malpighi (1628-1694) were commissioned by the Royal Society to document botanical observations through the microscope as a way to detail about vegetal life. In the same year, Both have indeed presented their work on the anatomy of plants to the Royal Society, which were later published as Malpighi's Anatome plantarum (published in 1675) and Grew's Anatomy of Plants (published in 1682). These two works reveal an innovative, anatomical approach to vegetal nature, which is a sort of anticipation to comparative anatomy, and a crucial testimony to the early modern experimentation with plants. They performed observations in garden-laboratory in which green nature was anatomised and carefully inspected. Moreover, for Malpighi, the

study of plants was a means to open new ways of investigation in living bodies, while for Grew was a way to test the mechanical and chemical principles to expound life. In this paper, I will discuss in particular the explanation of the ascent of water in Grew, Malpighi and John Ray (1627-1705). This is a meaningful object of investigation in European physiology of the time. Grounded on Bacon's botanical observation, on Descartes' mechanization of vegetation, and on van Helmont's experimentation with plants, scholars explored the causes and mechanics of the movement of liquids (i.e., sap) within plants as an attempt to explain organic life in these bodies, but also to use these investigation to detail about the animal functioning. Grew, Malpighi and Ray proposed either a complete mechanical or half-mechanical half-chemical description of the ascent of water, while Locke, Leibniz and Newton too proposed a different interpretation of the phenomenon. In the end, investigating the movement of sap within plants make them true laboratories to explain living functions, ultimately resulting in a significant section of the anatomy, physiology, and philosophy of nature.

4 - **Julie Davies** (University of Muenster, Germany)

Early Modern Women and Their Garden Laboratories

Building collections of local and exotic plants from around the world was an increasingly popular hobby for European women (and men) of means in during the seventeenth and eighteenth centuries. However, as in many areas of scientific history, the stories of women's contributions to knowledge production through these activities is still being recovered and retold. This is particularly true for women from the seventeenth and early eighteenth century working with plants as their preLinnaean status has marginalized their stories further. However, the activities of these women contributed to the work of collecting, identifying, classifying and documenting the nature of and growing conditions for many species in several direct and indirect ways. This paper will examine the botanical practices and interests of several early modern women, including Mary Somerset, first Duchess of Beaufort (d. 1715), Agnes Block (d. 1704) and Maria Sibylla Merian (d. 1717, though usually more well-known for her contributions to entomology). It will explore which elements of their work with plants can be viewed as knowledge producing activities based in their home garden laboratories. In comparing the activities of these, and other women, in England, Holland and Germany, the paper will also consider the activities in the context of the women's broader, intellectual network and to what extent their location influenced the nature of their activities. In particular, it will consider their connections to both formal scientific societies, such as the Royal Society of London and the Lepoldina, as well as less formal networks social, religious and commercial in nature.

Pause from 13.15 to 13.50

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Wednesday 2 September, 13.50 - 15.10

Room 1: S49 - Visual, Material and Sensory Cultures of Science as a crossroad between histories of displays and displays of histories - 1. Exhibitions and Teaching

Conveners: **Eugenio Bertozzi** (University of Bologna, Italy), **Sébastien Soubiran** (University of Strasbourg, France)

Material culture of science and the importance ascribed to the associated objects brought scientific museums and collections to be a major focus of interest for historical studies on science and technology. Recent approaches include the reconstruction of the study of historical laboratories and cabinets (Blondel, 1994; Sibum,1995, 2016; ; Boudia 2008), the exploration of the "object trajectories" and "biographies" (Daston, 2000; Bennet, 2005). On the other hand, museum studies investigated the relationship between the construction of museums and the establishment of scientific disciplines (Lourenco, 2018) or challenged the supposed neutrality and impartiality of museum exhibitions (Macdonald, 1998; Lynch & Alberti, 2010). The Symposium aims at widening this panorama by exploring how scientific museums and collections embed the visual, material and sensory cultures of Science. In particular, three main aspects will be investigated: 1/ How the different cultures of Science contribute to renew the way museums display scientific knowledge to the public and to what extent museums can express the different cultures developed within the history of science field?; 2/ How the history of the way scientific knowledge was displayed in museums and collections affected visual, material and Sensory cultures of Science. What kind of new historical researches can be fostered by looking at the museum as an "historical object in itself", with a multilayered, stratified and inner evolution? 3/ How did museums mobilized visual, material and sensory cultures of science as to deal with social and political issues. How global histories of progress, race, political and religious beliefs have entered and shaped museum exhibitions? The three research questions will be explored in relation to historical exhibitions, future exhibitions and to the partership between exhibitions and teaching. Each session foresees the participation of historians of science and museum professionals and is balanced between theoretical contributions and specific case studies.

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Chair: **Sofia Talas** (University of Padua, Italy)

1 - **Laila Zwisler** (Technical University of Denmark, Denmark)
The museum comes to class

Bruno Latour, Steve Woolgar and John Baird amongst others have shown, that the use of things and representations play a central and complex part in processes of science. The things and representations are often made by actors coming together through to form a multidisciplinary collaboration. Very little of what goes on is that straight forward. But how do we express all this complexity using our university collections? The historians at the Technical University of Denmark have made the museum come to class and in this paper I, will discuss some of our approaches to university students and high school students. The university students meet the artefacts and archivals from the university collection in history and science theory teaching. The historical material is embedded in the theme of different classes. One example is a class about our world being measured and recorded. Here, we use the story of developing measuring methods. This show, that instruments more than carriers of unchangeable knowledge. Instead we see the life and roles of instruments in the creation, change and circulation of knowledge. We experience the fight of many actors, who fought with materials and tinkered with bits and pieces to end up in a place, where actors felt, that they had something, which they could see on graphs and prints. In other classes students meet drawings and the bodily process connected with the drawing process and an extensive collection of materials. High school students meet the collection in teaching material for high school. In one of these the students use the instruments in a virtual lab to get the feel for the tactile and bodily processes in the lab. The lab is connected to a number of stories of science, industry, technology, medicine and ethics.

2 - **Carmen López San Segundo & Francisco Javier Frutos-Esteban** (University of Salamanca, Spain), ***Linternauta: A Web Application for the Interpretation of Magic Lantern Slides as Sources of Scientific Culture***

The public or private sessions of magic lantern slides that combined the projection of images, the recitation of texts and the interpretation of musical melodies reached an important sociocultural relevance at international level in different contexts related to science, education and popular culture between the 19th and 20th centuries. Although the magic lantern sessions developed a thriving equipment industry and satisfied a varied demand for consumer practicesits study as an object of a scientific nature unfortunately has been outside of academic research until the late twentieth century. The magic lantern sessions had as their central element the projection slides that habitually they were made of transparent glass illustrated since fables and tales as well as allegories, comedies, dissemination subjects or current events. Many institutions and private collectors hold magic lantern slides but cannot address the essential task of cataloguing them in order to disseminate their enormous heritage value. There are large numbers of magic lantern slides which are properly preserved, but often lack an optimal organization to establish their meaning and cultural significance. The dispersion of collections of magic lantern slides has been one of the main obstacles to producing a systematic study. The magic lantern slides are distributed among four major types of heritage institutions: private collections, archives, libraries and museums, each of which understands their value differently. As part of the 'Dynamics of Educational and Scientific Renovation in Secondary Schools Classrooms (1900-1936): An Iberian Perspective' and 'A Million Pictures: Magic Lantern Slide Heritage as Artefacts in the Common European History of Learning' research projects, the University of Salamanca investigators carried out an exploratory study of 198 Spanish magic lantern slide sets.This was a content analysis with the objective of classifying the slides according to discursive genre, intended to open up the neglected and extensive visual heritage of the magic lantern and to provide guidelines for making magic lantern slides available as historical sources for research into scientific culture. This exploratory study brought to develop a controlled vocabulary that facilitates the classification of magic lantern and a web application – Linternauta that helps with the interpretation of Spanish magic lantern slide collections.

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3 - **Caterina Morelli** (University of Bologna, Italy)

Botany between past and present

The Brendel models were sought-after in the 19th and early 20th century as aids for teaching botany all over the world (Fiorini, 2008; Mayoni, 2016) – the Botanical Garden and Herbarium of the University of Bologna owns a collection of 95 Brendel botanical models – introducing a new paradigm of learning through experience for the study of botany. These models are polymateric and can be disassembled according to variable criteria. Therefore, the Brendels bear witness to a multi-sensory and interactive approach to the scientific study of plants. The aim of my research is the development of a methodological approach able to convey to the public the dynamic dimension of these scientific objects, designing an exhibition that merge the traditional display with technology and nature. The digital paradigm and, more particularly, 3D printing is used to design interactive and multimedia installations in order to reintroduce the physicality of objects and the use of senses, especially tactility, within the designed path. The enhancement of Brendel models' inherent characteristics, through a cross-disciplinary approach that belongs to Digital Humanities studies, meets the needs of the public that "today expect learning that stands up as an experience (Macdonald, 2007), and expect a physical experience enlisting all the senses (Hooper- Greenhill, 2006)." (Kenderdine,2016).

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Room 2: **T13 - Medicine and Technology**

Chair: **Paolo Savoia** (University of Bologna, Italy)

1 - **Hanna Vikström** (Umeå University,Sweden)

Who decides what should be in a decayed tooth? Dental filling materials, science and debates, 1860-1880

In the 19th century, dental health deteriorated rapidly. Excruciating toothache made those who could afford it to turn to dentists, in hopes of saving teeth. Dentists struggled to find suitable materials that were malleable, long lasting, had a pleasant color, did not react with the acids in the mouth and adhered to the tooth. There is a common notion that dentists historically, first used gold and then dental amalgam from the late 19th century. But that narrative is simplified and flawed as dentists at the time experimented, and often failed, trying to find the ultimate material. To establish dentistry as a profession, dentists simply had to fill decayed teeth successfully, and they tried their best to understand how to do it. This article explores the importance of material culture, through dental fillings materials, and the role of science, technology, knowledge and senses in the establishment of dentistry as a profession. Through an analysis of one of the most prominent professional dental journal at the time, the American-based Dental Cosmos, this paper examines which type of knowledge was crucial for dentists in succeeding to fill teeth, which materials they used, and how the knowledge was circulated. Most dentists at the time were unaware of the science behind successes and failures, and they sought additional knowledge on the matter to succeed, and opposed each other. The dental practitioners were dependent on different types of knowledge including scientific, tacit and practical knowledge. That was

not all but they were dependent on instruments, technology, returning patients as well as their senses, specifically their touch as their skillful hand hands, was often referred to as key to a successful filling.

2 - **Srijita C. Pal** (University of Southern California, USA)

Visualizing Medical Transport: The Myth and Reality of First World War Ambulance Journeys

The First World War innovated new ways of wounding and repairing the human body. Crucial to the initial recovery process was getting soldiers from a place of conflict to a place of medical care, a journey that began with stretcher bearers at the front and ended with stationary hospitals many miles away. Allied medical manuals published during and after the First World War often used diagrams to represent the process of transporting a wounded soldier to medical care. While these diagrams painted an orderly and systematic procedure, the reality of medical transport in the war was much more complicated. The conditions in which patients arrived at places of medical care were often the result of delays in transporting wounded soldiers and the official manuals, although aware of the situation, did not accurately portray conditions as effectively as the first-hand accounts of ambulanciers and medical professionals could. By analyzing this contrast between these diagrams and reality, this paper argues that the transport of the wounded was a critical failure in the otherwise miraculous narrative of military medicine on the Western Front. By contrasting the clean and delineated formalized routes of medical help to the experiences of patients, ambulance drivers, doctors, and nurses that actually functioned in these routes, it becomes clear that the existing narrative of First World War military medicine as a success was a necessary myth during the war, but in retrospect, is largely inaccurate.

3 - **John Nott & Anna Harris** (Maastricht University, Netherlands)

Knowing the normal, learning disease: technology, sensoriality and the student body

In health, as in disease, the body is not easily standardised. That pathology and normality exist on a complex spectrum of bodily manifestation is an enduring question at the heart of the philosophy of medicine (Canguillem, 1943, trans. 1991). Insights from STS and medical anthropology have suggested that this may be because the body—in both health and disease—does not exist as a single entity but is enacted in many ways, and in many spaces and times, through practices which make both health and disease visible, audible, tangible and knowable (Mol, 2002). As the primary locus for the reproduction of medical practice and epistemology, medical schools are important sites for the cultivation and disciplining of sensory attention in medicine. Often, students are taught to know the sight, sound, smell and feel of “the normal” before learning to sense deviations from it. However access to the requisite range of bodies is not so easily obtained; nor is it readily reproduced in simulations, photographs and films, which tend towards assuredness and fixity in their representations. Drawing on ethnographic and historical fieldwork in medical faculties at Maastricht University (the Netherlands), Semmelweis University (Hungary) and the University for Development Studies (Ghana), we explore how knowledge of the normal and pathological draws from sensory interactions with the material surroundings and educative technologies which makeup and inhabit these three sites. In doing so, we expand on the collaborative and historical-ethnographic comparisons which contribute to the overarching ‘Making Clinical Sense’ project from which this research derives.

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Room 3: S14 Teaching science with light projection: regimes of vision in the classroom, 1880-1940 - 2

Conveners: **Nelleke Teughels** (KU Leuven, Belgium), Wouter Egelmeers (KU Leuven, Belgium)

In the early 19th century, the ideas of reform pedagogues such as Johann Heinrich Pestalozzi (1746-1827) gave rise to a didactic turn towards the visual that criticized an exclusive textual mediation of knowledge through books and lectures (Depaepe 1999). The pedagogues and policymakers who strove for a more child-centred approach to teaching were soon joined by media producers and marketers in their aim to transform the classroom into a multimodal space for learning. From the turn of the 20th century onwards, teachers were increasingly pressured to incorporate high-profile media technologies such as stereoscopes, lantern and film projectors into their lessons (Cuban 1986). The accuracy of photographic images and the flawless projections enabled by these new technologies inaugurated new regimes of vision and sensoriality that equated light with truth and vision with knowledge (Eisenhauer 2006). At the same time, projection-aided lessons provided powerful commentaries on what was shown, conditioning pupils' practices of looking and giving rise to particular ways they were supposed to understand the world (Good 2019). We propose a two-part symposium engaging with educational uses of light projection from diverse perspectives. The papers explore this topic in relation to the material and practical aspects of visual teaching and the various regimes of vision that are engendered by the use of visual media technologies.

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Chair: **Wouter Egelmeers** (KU Leuven, Belgium)

1 - **Nelleke Teughels** (KU Leuven, Belgium)

Scientific vision and the material culture of the classroom: discursive shifts and classroom transformations in Belgian schools, c. 1900-1940

By the end of the nineteenth century, the child-centred approaches to teaching put forward by enlightenment pedagogues such as Johann Heinrich Pestalozzi (1746-1827) had led to a didactic turn towards the visual: policymakers and teachers joined pedagogues on their quest to transform the classroom from a language-oriented to an image-oriented space for learning (Depaepe 2000). This also entailed an attempt to 'domesticate' the image and educationalise it by bringing it into the classroom and incorporating it into a discourse of scientific vision (Ibid.). The optical lantern was put forward by pedagogues and policymakers as an instrument that could be regarded as an objective visual extension, similar to the esteemed microscope (Eisenhauer 2006). This status of the lantern as an instrument of scientific vision was largely due to the introduction of photographic lantern slides. The accuracy of photographic images created flawless enlarged images, technological 'reproductions of reality'. Policymakers were eager to introduce this technology - and the ideas and metaphors it represented - in Belgian schools, with the aim of modernizing and optimizing teaching, and science education in particular. However, this also demanded a physical transformation of the classroom. This paper investigates the practical implementation of a new, scientific regime of vision in Antwerp municipal schools by comparing the Antwerp city council's and school directors' discourse on the introduction of the optical lantern and investigating building applications and school renovation plans for the period 1900-1940.

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2 - **Margo Buelens-Terryn** (University of Antwerp, Belgium)

Science at the service of politics. The interplay between scientific lantern lectures in educational institutions and the pillarization in Antwerp and Brussels (c.1860-1920)

At the turn of the nineteenth century Belgian society was increasingly shaped by pillarization, i.e. he separation of a society into groups by religion and associated political beliefs, as a result of the School War (1878-1884) and political democratization. In this context, the magic lantern became the visual mass medium par excellence for scientific, didactic and propagandistic purposes (Kessler and Lenk 2019). By using different (sensory) methods, 'feelings of belonging' could be created (Eifler 2019). These illustrated lectures were part of the leisure activities that were provided by the various pillars. From newspaper announcements and reviews of these lantern lectures it becomes clear that science was a very popular theme. This fit into the framework of 'pedagogical missions' and the moral and intellectual development of these potential voters (Onghena, 2013). Several schools and other educational institutions opened their classrooms for this type of lecture (after class hours). This paper examines how the various pillars used scientific lectures in their 'struggle for the voter', by analysing advertisements and reviews in newspapers from different ideologies, almanacs, census data and other related documents from Belgian institutions and societies. By using Geographic Information Systems (GIS), it becomes clear how urban spaces were appropriated for this purpose and to what extent classrooms, schools and educational institutions played a role in this.

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3 - **Audrey Hostettler** (University of Lausanne, Switzerland)

Managing interest, fostering activity: progressive education and film screenings in Swiss schools during the interwar period

At the turn of the 20th century, Switzerland was at the core of important debates on a pedagogical reform movement, that of the so-called "progressive education". Pedagogical methods encouraging a modernization of the school institution, and a focus on the children's interests and activity, were debated on a national and international scale, most notably through the Institut J.-J. Rousseau, an educational science institute based in Geneva and inspired by pedagogues like John Dewey or Georg Kerchensteiner. When the Swiss schools grew interested in the cinema as a potential educational tool around the First World War, in a context where people from all backgrounds expressed their views on the new medium, teachers quickly tried to conceptualize a use of the film that would be strictly specific to their own needs. This implied an effort to seek – and promote – a compatibility of the film with the most innovative pedagogical ideas of the time, namely those of progressive education. This compatibility was nevertheless far from evident. Despite the film's indubitable modernity and its ability to bring "life" into the classroom, its use was challenged by the physical activity and participation of the pupils that progressive education promoted. My presentation aims to show how the first conceptualizations of classroom films in Switzerland, basing on the concepts of "interest" and "activity", were shaped after progressive education principles, and to confront these discourses and two distinct "dispositifs" of actual film practices, in Geneva and in Zurich, around 1920 and 1930.

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Room 4: **S64 - Diplomacy and Images in Science - 3. The symbolic power of scientific images in international spaces**

Sponsored by IUHPST/DHST Historical Commission on Science, Technology and Diplomacy

Conveners: **Simone Turchetti** (University of Manchester, UK), **Matthew Adamson** (McDaniel College, Hungary)

Chair: **Roberto Lalli** (Max Planck Institute for the History of Science, Berlin, Germany)

1 - **Simone Turchetti** (University of Manchester, UK)
Unknown Pleasures in Music, Science, and Diplomacy

The sleeve of Joy Division's Unknown Pleasures marked the post-punk era. Sketched in 1979 by graphic designer Peter Saville, it would since feature in alternative music magazines, t-shirts, tattoos and much more. The iconic album cover widely popularized one of the most recent astronomical object under study, the pulsars, visually representing their radio signals as a white "stacked plot" on black background. The graph had first appeared – in inverted colours- in the 1970 PhD dissertation of US astronomer Harold (Hal) Craft and previously featured in other astronomical works too. The history of how post-punk (unintentionally) celebrated and popularized the newly discovered astronomical objects has been widely researched. What is less known, however, is how related radio-astronomical work featured in international discussions on the transmission and reception of radio-signals from outer space. The diplomatic issue involved international scientific organizations (the International Astronomical Union in particular), prominent radio astronomers, national security organizations, and country representatives of various nations who considered and abandoned plans for a new international regulatory framework. Unknown Pleasures sleeve was thus not only to become one of the most iconic images blending music and science, but also what brought closure to a controversial case in international relations.

2 - **Grigoris Panoutsopoulos** (University of Athens, Greece)
Investigating the Materiality of CERN's Science Diplomacy

From its inception, CERN made its diplomatic ramifications clear, being one of the most characteristic examples of science diplomacy. Its diplomatic role can be seen in both its organizational structure as well as in the public discourse of its representatives. However, despite the fact that a lot has been written regarding its diplomatic aspects, little attention has been paid to the material culture of CERN's science diplomacy. A facet of pivotal importance, since the worldwide networks that the organization builds have an inextricable and exceptionally important material part. Besides, the circulation of technological innovations and scientific instruments carries by itself a significant social, political, diplomatic, geopolitical and even financial dynamic, so much so that it decisively affects how the entirety of science diplomacy develops. One of the most characteristic examples of these material science diplomacy networks concerns how the colliders and the detectors, which are the vital instruments of the laboratory, were built piece by piece with components made by a multitude of research institutes and industries, all of them spread geographically, operating in many cases as diplomatic assets in political negotiations. As we attempt to highlight the material dimension of CERN's science diplomacy in this presentation, we will focus on two groups of photographs. Both cases concern pivotal moments in CERN's diplomatic evolution. The first one revolves around the Cold War period and the establishment, for the first time, of a relationship between CERN and the USSR in 1967, showing the colossal operation that was set in motion in order to transport the gigantic Mirabelle bubble chamber from the laboratory of Saclay in France to the Soviet Serpukhov Laboratory. The second group of photos represents the

transformation of CERN from a European to a global laboratory. More specifically, these photos depict how the fabled Large Hadron Collider, was constructed piecemeal in various places across the world, from the US to Pakistan, between 2000-2008. The transportation of these pieces and their assembly at CERN symbolized the unity of all the material networks of the organization, justifying the "worldwide machine" label that was given to this particular collider.

3 - **Beatriz Medori** (University of Lisbon, Portugal)
Radioactivity on tour: the picture of Eve Curie at the Portuguese Oncology Institute

On January 9, 1940, Eve Curie was pictured at the Portuguese Oncology Institute (IPO) with its director, Francisco Gentil, chief radiologist, Bénard Guedes, and the director of French Institute in Portugal, Raymond Warnier. The picture was then reproduced in IPO's Bulletin, a monthly journal of anti-cancer propaganda directed to the public at large. Addressing Eve's photograph as 'picture', for its epistemic nature, I seek to understand why it came to be taken at IPO, but also why it became such an important tool for Portuguese anti-cancer propaganda. Eve briefly stopped in Lisbon on her way to lecture throughout the USA, in what wouldn't be her first journey across the Atlantic. In 1921, Marie Curie visited the country with her daughters for the first time. Merging these two journeys, I aim to understand how both Curies, as public pictures of radioactivity, were pictured into the fight against cancer. For that I recur to two other chief portraits: that of Marie Curie receiving her 'gram' from President Harding at the White House (1921), and that of Jules Henry receiving a special bound edition of Eve's Madame Curie from the American Society for the Control of Cancer (ASCC) (1938). Given that IPO was translating ASCC's campaigns to Portuguese and created a Bulletin "shaped by that same society", I aim to show how Eve's picture at IPO was diplomatically used to represent a war against cancer that needed to be fought 'globally', through the circulation of practices and publications, but not only. Mother and daughter constructed a picture of radioactivity that took many forms in a public sphere also exposed to the perils of radiation. Thus, Portuguese anti-cancer campaigns demanded public diplomacy. Finally, Eve's picture at IPO's Bulletin also framed the expectations of those apparently invisible on the photograph: the public of anti-cancer propaganda.

Room 5: **T2 - Galileian Studies**

Chair: **Helge Kragh** (University of Copenhagen, Denmark)

1 - **Filip A. A. Buyse** (Domus Comeliana, Italy)
Galileo and the Transformation of Sensory Qualities: from Intrinsic Properties to Extrinsic Qualities

Galileo was the first to introduce, after antiquity, the primary/secondary distinction into natural philosophy. Subsequently, bodies-in-themselves did not have any sensory qualities anymore. We just experience them to be like that. In the first section, this paper argues that Galileo's doctrine of qualities - which he explained in his Il Saggiatore (1623) - is not just an update of an atomistic view. In addition, this paper contests the view that Galileo's concept of the body was just a mere mathematical abstraction or idealization and defend the idea that it was rooted in the corporeal world. Secondly, it shows that Galileo applied already his doctrine of qualities in his earlier works, not only in his argumentation but also in the illustrations of his telescopic observations that he added to his texts. According to his first biographer, A. Baillet, Descartes was in Italy when Il Saggiatore (1623) - which was directly immensely popular - appeared. Consequently, the French philosopher was influenced by Galileo's views which he transmitted via his influential works to other natural philosophers. Obviously, Spinoza (1632-1677) was one of them. In the third section, this paper analyzes how Spinoza applied the Galilean distinction in his

philosophy and correspondence with special attention for the example of the sun. In addition, it will be shown how Spinoza's views were linked to his activities as a lens-grinder and microscopist, and how his views are in resonance with the trompe l'oeil art of the Dutch Republic. Finally, this paper demonstrates how Johannes Müller (1801-1858), developed, influenced by Spinoza's ideas, his doctrine of specific energies; and how "the father of contemporary physiology" transmitted his views via his well-known students into contemporary physiology. This explains that, in today's neuroscience, sensible qualities of bodies (e.g. colors) are still regarded as extrinsic qualities which are generated in the body of the observer.

2 - **Hannah Tomczyk** (University of Cambridge, UK)

Making the mathematization of velocity useful

I trace the development of the concept "velocity" in big steps from the middle ages, where it is first subjected to mathematical treatment (Maier 1952), to the mid-18th century, where it becomes useful for ballistics (Steele 1994). In this development, (non-uniform) velocity becomes more and more meaningful in concrete environments. In the early 17th century, Galileo Galilei uses the term in experimental environments (Damerov et al. 2004, Van Dyck 2005), with the goal of learning about the mathematical nature of motion. The concrete goal of making velocity useful in ballistics on the battlefield is achieved much later, in the mid 18th century, thanks to the works of Benjamin Robins and Leonhard Euler. Some of the conceptual changes that take place in the meantime are the following: the notion of velocity as an intensive magnitude, which enabled the mathematical treatment of velocity in the middle ages, is replaced by the notion of instantaneous velocity. The use of ratios to express laws of nature is replaced by the use of equations, which enables new ways of dealing mathematically with those laws. And on the material level, the introduction of experimental methods, velocity measurement devices, and an increasing control over relevant material components is needed to make the mathematical treatment of velocity meaningful for concrete contexts.

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3 - **Cesare Pastorino** (Technical University Berlin, Germany)

Collecting Material Evidence from Mathematical Instruments: The Case of Johannes Kepler's use of Galileo Galilei's Compasso Geometrico e Militare as a Source of Experimental Data

Can scientific objects be used as a way to publicize scientific results in non-textual form? In this paper, I will address this issue considering the case of Galileo Galilei's experiments on the specific weight of substances, and Johannes Kepler's use of data that Galileo embodied in his famous mathematical instrument, the Compasso Geometrico e Militare. Galileo's experiments on the specific weight of substances have overall received little attention. A group of his manuscripts included measurements of the weight of precious metals and stones. However, these private notes remained unpublished until the beginning of the twentieth century and did not circulate at Galileo's time or after. Domenico Bertoloni Meli has recently suggested that Galileo used a different way to make his experimental data public. His famous instrument, the Compasso, embodied a scale whose values ultimately derived from experimentation on the specific weight of several materials (Bertoloni Meli 2004). However, did anyone ever actually regard and use the Compasso as a material source of experimental data in the way suggested by Bertoloni Meli? In this talk, I will show that Johannes Kepler did. In a little-studied treatise of practical mathematics, the MesseKunst Archimedis (1616), among other sources, Kepler published data on the weights of substances derived and reconstructed from two mathematical instruments, the

sector of the Flemish mathematician Michiel Coignet, and what he called a "Paduanisch Instrument." In this talk, I will demonstrate that the latter instrument was, in fact, Galileo's Compasso. I will then reconstruct Kepler's concrete use of the Compasso as a source of material evidence and compare Kepler's estimates of the data in the Compasso with my own. This assessment is the first evaluation ever of this remarkable set of data, after Kepler's analysis.

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Room 6: S11 Calculating Tool, Diagram and Algorithm in the Ancient Eastern and Western Mathematics - 1

Conveners: **Kostas Nikolantonakis** (University of Western Macedonia, Greece), **Zhigang Ji** (Shanghai Jiao Tong University, China)

Calculating tools and diagrams originated almost simultaneously with mathematics. Actually we know that two styles in Greek mathematics can be distinguished: a demonstrative (e.g. Euclid, Apollonius, Archimedes) and an algorithmic one (e.g. in Heron, Theon and Diophantus). While the first style has been classically given higher status than the second one by historians, the algorithmic tradition and the mathematical practitioners' tradition should also be regarded as a constituent part of Greek mathematics. Pebble arithmetic was used in order to perform calculations of all kinds. 'Pebbles' (psēphoi) that symbolized different numbers through different forms and sizes were moved and arranged on a marked surface – Salamis table - avax. Some pebble arithmetic probably shows up in later Greek 'Neo-Pythagorean' arithmetic, most notably in Nicomachus of Gerasa (probably second century AD) and, slightly later, in Iamblichus of Chalcis. The second subgroup of mathematical practitioners was concerned with measuring and calculating areas and volumes. Unlike the pebble arithmeticians, they had textual traditions and their texts show a combination of algorithmic and demonstrative aspects. In the ancient oriental civilizations, the ancient Chinese ancestors employed for calculation counting rods (suan chou 算筹), which later developed into the abacus (zhu suan 珠算) as an excellent calculating tool in the ancient mathematics. In Japan, three types of computational methods, such as counting rods, Chinese abacus and Napier bones were used in pre-modern Japanese mathematics. Diagrams played an important role in ancient Chinese mathematical works. Many illustrations are found in the mathematical works of the Song and Yuan Dynasties, which represented profound meanings such as calculating, reasoning on theorems, executing algorithms and even proving. When western algebra was introduced into China in the Qing Dynasty, the Chinese mathematicians did not merely accept western knowledge, but they also transformed it with their own traditional methods. In the 15th century, in his book Summa the Italian mathematician Pacioli quoted a lot from Euclid's Elements, while displaying new approaches to practical algorithms with many graphs of a new type. In Japan, the worship of Sangaku (算額, Mathematical tablets) were a popular type of worshiping in the Edo Period (1603-1867) and the Meiji Period (1868-1912). As a special type of carrier for mathematical communication, it is a unique cultural phenomenon in the history of world mathematical culture. The Jinkōki by Yoshida Mitsuyoshi, a scholar in the Edo Period, is an epoch-making and innovative work for the traditional Japanese mathematics. Algorithms and diagrams show that its content also tells of the traditional Chinese mathematics. Calculating rods and abacus tell the materiality of calculating tools. Diagrams are visual carriers of mathematical ideas. Algorithms corresponding to calculating tools and diagrams present a rational combination of mathematical Sensory Cultures. Thus, they constitute the theme of our Symposium in the ancient eastern and western mathematics.

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1 - **Kostas Nikolantonakis** (University of Western Macedonia, Greece)

The algorithmic aspect in the frame of Ancient Greek Mathematics: the cases of Heron of Alexandria and of Theon of Alexandria

Ancient Greek mathematical tradition is very well known for its demonstrative style. This is exemplified by the works of eminent mathematicians such as Euclid, Apollonius, Archimedes etc. The algorithmic style is less known but it co-existed and developed in parallel with the demonstrative one. Some of its aspects might have existed even before the demonstrative one, even though there does not exist so many documents. In our presentation we will examine two protagonists of the Greek algorithmic mathematical tradition: Heron of Alexandria and Theon of Alexandria. In our analyses we will examine the structure of Heron's and Theon's texts (enunciation, demonstration, calculation algorithm) and stress the need of a validation for algorithms to which they attest. For this we will focus on texts from Heron of Alexandria's Metrica and Theon of Alexandria's Commentary on the Almagest.

2 - **Zhigang Ji** (Shanghai Jiao Tong University, China)

Seeing is believing: a cases study on the role of diagrams in ancient Chinese mathematical texts

It is well known that the distinctive feature of Liu Hui's third-century annotations of the Nine Chapters of the Arts of Mathematics is "analyzing principles with words and dissecting solid with diagrams"（析理以辭，解體用圖）. In his annotations, he refers to "checking the diagram" (謹按圖驗)，"drawing a figure"(又按為圖) , and "the crucial point of the diagram" (其圖大體). This shows that "diagrams" played an important role in Liu Hui's annotations. However, all the diagrams in Liu Hui's annotations of the Nine Chapters have been lost. Some illustrations drawn by the third century commentator Zhao Shuang remain in the Zhou bi Suanjing. The diagram of the Sun's height and the hypotenuse diagram reveal Zhao Shuang's attempts to prove the formula determining the Sun's height and the Pythagorean theorem by means of graphs. Illustrations were widely used in the mathematical works all through the Song and Yuan Dynasties. As Yang Hui points out in his preface of A Detailed Explanation of the Nine Chapters Algorithms (1261), "If the problems and methods do not make sense, I will interpret them with charts." (凡題法解白不明者，別圖而驗之。) In the mathematical works from the Song and Yuan Dynasties, the diagrams are endowed with various functions. This paper will elaborate on the following aspects: Diagram for calculating：diagrams of this kind include Nine-nine table, the gelosia method of multiplication and the tabulation of the binomial coefficients. Diagram for problem-explaining: these are simple mathematical figures, such as squares, triangles and circles. These diagrams also describe the life scenarios involved in problems. Diagram for theorem-reasoning: the Sun's height diagram shows that the calculation formula is reasonable. Diagram for algorithm-proving: for example, the diagram for extracting square roots illustrates the square-root process, which resembles a "visual algorithm". Illustrations in the ancient mathematical works are not only presenting a "visual transformation", but also providing readers with a "sensory integration". This may verify the practicability of a famous saying "seeing is believing" for the ancient Chinese mathematical works.

3 **- Hongyan Jia** (Shanghai Jiao Tong University, China)

The Understanding of Western Algebra Knowledge by Qing Dynasty Mathematicians - An analysis of the geometric diagrams in Jiegenfang bili

The Jiegenfang suanfa (1709) was the first mathematical book that introduced Western algebra into China. It clearly presented basic knowledge and algorithms corresponding to elementary algebra. The Jiegenfang bili (1723) was compiled based on the Jiegenfang suanfa. However, the latter was not a faithful copy of the former. It was a new adaptation and employed a lot of geometric diagrams that were not used in the former. Based on a study of the contents of the Jiegenfang suanfa and a comparison between this book and the Jiegenfang bili, this paper will put forward the following theses. First, the compilers of the Jiegenfang bili deleted and adapted much of the information found in the Jiegenfang suanfa. Second, the method of geometric diagrams is closely related to ancient Chinese algorithms. We

will suggest that mathematicians' understanding and absorption of the introduced algebra knowledge was influenced by their own knowledge background. Therefore, this paper will examine how mathematicians of the Qing dynasty understood and digested the knowledge of western algebra at the time. We will also discuss why mathematicians published such adaptation works. Meanwhile, this paper will also show the influence of the ancient Chinese mathematical knowledge system that the Qing dynasty mathematicians possessed on the dissemination of Western algebraic knowledge.

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Room 7: **S33 - Hybrid ontologies: the circulation of visual cultures, gender, and expert communities - 2**

Convener: **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)

Chair: **Mauro Capocci** (University of Pisa, Italy)

1 - **Pnina Geraldine Abir-Am** (Brandeis University, USA)
The International Mobility of Adenovirus and the Discovery of RNA splicing: The Perspective of Women and Junior Scientists

The discovery of RNA splicing in 1977, is widely seen as a major landmark in molecular biology. By revealing that eukaryotic messenger-RNAs are not co-linear with DNA but rather are the products of multiple splicings of non-contiguous segments of a primary transcript of the genome, the discovery led to a new paradigm of genetic regulation. In addition to clarifying how alternative splicing explains genetic diversity, the discovery of RNA splicing led to the understanding of how the splicing mechanism is performed by the spliceosome, the largest standalone biological assembly. The discovery also has therapeutic ramifications for diseases resulting from splicing errors. (M. Fry, "The Surprising Discovery of Split Genes or RNA Splicing," Landmark Experiments in Molecular Biology, Elsevier; (2016) 481-521; P.G. Abir-Am, "RNA Splicing at 40: Reflections on Scientific Progress, Policy, and Social Justice". (https://hssonline.org/wpcontent/uploads/2014/07/Apr-2017-newsletter.pdf) The discovery of RNA splicing was made by teams which used the adenovirus genome and mRNA as a model system. This human virus (which causes the common cold) arrived at the Cold Spring Harbor Laboratory in Long Island, NY, (hereafter CSHL) in 1971 with a post-doc from the University of Uppsala, who studied the virus for his Ph.D. First, this talk explores how the mobility of adenovirus from Uppsala to Cold Spring Harbor, led to several collaborations which included the would-be Nobel Laureates for this discovery. Second, the talk explores how an attempt to sequence the junction of the hybrid Ad2-SV40 virus, (SV40, a monkey virus, was the prevalent model prior to adenovirus' arrival) pointed several labs at Cold Spring Harbor Laboratory in the direction of the discovery. Third, the talk highlights the key role of women and junior scientists, in this reorientation. Last, the talk discusses why the public memory of the discovery does not include these women and junior scientists.

2 - **Daniela Sclavo** (University of Cambridge, UK)
From Local Cuisines to Seed Banks and Laboratories: Chiles (Peppers) as Scientific Objects

Chile (Capsicum, pepper) has been harvested in Mexico for about six thousand years, which has led to a significant diversification of the species (Friese et al. 2011, p. xxii; Bellon et al. 2009; Casas & Lira 2016).

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Even when it is the most important condiment in the world (Nabhan 2018), chile has been greatly overlooked in the history of agriculture and technology. More specifically, it has not been analysed as a scientific object that is part of a circulating network of knowledge. From the 1970s and 1980s until today, chile varieties have been a subject of study for geneticists, ethnobiologists and conservation scientists from national and international institutions ((Pickersgill 1971; Eshbaugh 1975; Laborde & Pozo 1984). This has resulted in the circulation of chile and its seeds from the field in local communities to the laboratory and to international seed banks. In this work, I aim to explore how chile and its seeds have travelled in different professional and cultural environments; from the women "cocineras" in local communities in Mexico that maintain its diversity with their culinary traditions and knowledge, to the community banks that encompass the work of the Food and Agriculture Organization (FAO), scientists and local people (Aragón-Cuevas 2011, 2013), to the work of geneticists and ethnobiologists, and to the big international seed banks that hold the most extensive chile collections, such as the United States Department of Agriculture (USDA). By doing so, I expect to reveal how crops can be part of the history of the circulation of scientific objects by focusing on these as the same materials that travel and allow knowledge exchange, adoption, or integration in different transnational expert communities.

3- **Ana Barahona** (National Autonomous University of Mexico, Mexico)
Collaborative networks and hybrid objects: women geneticists in Mexico, 1960s-1970s

This paper will address the trajectories of two leading figures in cytogenetics in Mexico, Argentine-born physician Susana Kofman who studied with human geneticists Jérôme Lejeune and Jean de Grouchy in France, and Mexican physician Leonor Buentello who specialized in virus genetics with virologist Richard von Hass in Germany. Although they had different academic backgrounds and careers, they shared a similar research and medical agenda that coincided in time and place: working together at the first Unit on Human Genetics of the Mexican Institute for Social Security, both participated in the early diagnosis of genetic diseases and revealed the correlation between clinical observations and karyotyping. By focusing on the one hand, in chromosomes as hybrid scientific objects that circulated between the clinic and the laboratory, between the bed and the bench, and on the other, in the workplace (the Unit) conceived as both a literal and figurative space in which women and men engaged in the creation, dissemination, appropriation, and consumption of scientific knowledge, this paper will address the local contexts, material cultures, and specific practices that allowed these women Mexican cytogeneticists to be part of the production and transmission of knowledge in the 1960s and 1970s, thanks to their belonging to national and international collaborative scientific networks. Within the constantly changing nature of human genetics after WWII, various opportunities were presented that allowed Kofman and Buentello to negotiate their way into more central roles: technical developments from leucocyte culture and karyotyping of patients at the hospital with genetic diseases or conditions, and a rudimentary kind of genetic counselling. These opportunities to link the clinic with the laboratory enabled them to become key actors in the development of human genetics in Mexico. This case also reveals how important the circulation of knowledge was in the formation of Mexican scientific elites, as well as demonstrating the national and transnational concerns that shaped local practices.

Room 8: **S59 - Scientific landscape: the global and the local**

Convener: **Elena Sinelnikova** (Russian Academy of Sciences, Russia)

This symposium analyses the phenomenon of the scientific landscape as a complex system of research institutes (institutes, universities, scientific societies, museums and laboratories, etc.), which is influenced by various actors (government, scientists and scientists, private initiative, a network of cooperation, scientific financing, and others). There are various paths of formation and change of global and local scientific landscapes in different historical periods. This is illustrated by the fact, for example,

that the new Russian scientific landscape was formed because of the Bolsheviks' measures in the public and scientific fields in the first decade after the October revolution. This is likewise illustrated by how the global scientific landscape changed during the World War I as German science was eliminated from it. Addressing to such a complex phenomenon as the scientific landscape raises many important questions. What factors influence on the formation and change of the global scientific landscape? How does the world and scientific landscape of individual countries relate? What determines the formation of the scientific landscape in different countries? What are the main indicators of its changes? What is more important for changes in the scientific landscape? A power initiative or an initiative of the scientific community? What is the significance of education for the scientific landscape? What is the relationship between the scientific landscape and science products by an institution, country, laboratory, research team? What is the influence of the internal logic of the development of science on the formation and change of the global and the local scientific landscape? What elements make the formation of a scientific landscape possible? In this session we start exploring some of these questions, and we hope to improve our understanding of the global and the local scientific landscape in different historical periods.

Chair: **Nadia Asheulova** (Russian Academy of Sciences, Russia)

1 **- Maryam Gasan Seyidbeyli** (Azerbaijan National Academy of Sciences, Azerbaijan)
"Risala At-Tibb" (A Treatise On The Medicine) Of Nasir Ad-Din At-Tusi

Nasir ad-Din at-Tusi, an outstanding scholar and organizer of science in Azerbaijan, made a significant contribution to the development of all the well-known branches of sciences as mathematics, ethics, cosmology, mineralogy, trigonometry, geography, history, law, medicine, morality, logic, theology, poetics, calligraphy. The great historical merit of Nasir ad-Din at-Tusi is the establishment of an astronomical observatory in the city of Maragha (1259) in South Azerbaijan. He is the author of about 160 scientific works. He has also worked on medicine as "Kavonin at-Tib" ("Laws of Medicine"), "Havoshi Bar", "Kuliyeti Konun -i Bu Ali" (Comments on "Canon" Bu Ali"), "Khally Muskuloti" "Konun" –i Bu Ali" ("Resolution of the difficulties of the "Canon" Bu Ali "). However, these works of the thinker have not yet been studied either in Azerbaijan or abroad. In particular, he wrote comments on the work of Ibn Sina "The Canon of Medicine". The article studies the unknown work of Nasir ad-Din at-Tusi "Risala at-tibb" (Treatise on the Medicine). In this work, N. Tusi addresses human hygiene and its relationship with medical issues, mainly in the field of the psyche. He subdivides human health into four groups, clearly defining the limits of each group. "Health is like moving in a straight line," the scientist writes, "and the disease is a deviation from this line". Tusi gives very interesting tips in the field of hygiene and medicine. He notes how much excess in food and in sleep has a harmful effect on the body. The philosopher directly connected the physical and spiritual health of a person with the category of happiness as the most important component of human life and society. In his opinion, an important condition in acquiring happiness is a healthy body, knowledge and enlightenment.

2 **- Elena Sinelnikova** (Russian Academy of Sciences, Russia)
Scientific Societies In Russian Province After The October Revolution

The transfer of faculty and scientific staff from the center to the periphery occurred as a result of the socio-political and economic crisis that erupted in Russia after the October Revolution. This process began from the end of 1917, but acquired a particularly massive character in 1918- 1919. The internal migration of scientists has led to the formation of a qualitatively new scientific and educational landscape in the country. In large provincial cities, new educational institutions, scientific societies, museums and libraries were created, uniting the scientists of the center and representatives of the local scientific intelligentsia. The teaching staff of already existing universities has also significantly replenished with scientists from the center; for the first time, significant territories of the country underwent systematic comprehensive study. The complex process of interaction between professional

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scientists who came from the center (Petrograd and Moscow) and representatives of the local scientific intelligentsia often took place within the framework of scientific societies created at universities. As a rule, all scientific disciplines whose representatives were part of the organization appeared in their names. The number of scientists of one specialty, even taking into account the specialists who came from the center, remained insufficient to create separate special scientific societies. The creation of scientific societies of an interdisciplinary nature was the solution to this problem. Scientists who came from the center brought to the provincial cities the culture of the scientific community of the capitals, in which active participation in public scientific life was an integral part of scientists' life. The aim of the paper is analysis of the activities of provincial scientific societies created as a result of internal migration of scientists in the provincial cities of Russia in the first years after the October revolution. The reported study was funded by RFBR, project number 20-011-00240.

3 - **Nadia Asheulova** (Russian Academy of Sciences, Russia)
Presenting The New Comparative Project Of Academies Of Sciences In China and Russia, and The Max Planck Society Post Ww II

In 2019 three well-known academic organizations in history of science and technology in Germany, China and Russia signed the agreement on the research collaboration. The Agreement among CAS Institute for the History of Natural Sciences, Max Planck Institute for the History of Science and St. Petersburg Branch of the Institute for the History of Science and Technology of the Russian Academy of Sciences focuses on comparative study of Academies of Sciences in China and Russia, and the Max Planck Society post WW II. This study advances our understanding of the current challenges of national science systems and comparative perspectives on the three institutions. Specific questions to be pursued in this study are: Which national science systems and institutions served as a model in other countries? What has in fact been taken over or adapted in the respective cases and in which cases did the appeal to foreign models primarily serve a discursive and legitimatory function? To which extent have internationalization and globalization processes eroded national traditions and structures, overriding local practices and concerns? A study is a powerful tool for obtaining information on the transition and reform processes of the science system in the three countries. Participants of the project will present the first results and future research plans.

Room 9: S78 Internationalism, Nationalism and Localism. Images and Places of Mathematics in Europe from Napoleon to the Wars of the Twentieth Century - 4

Sponsored by *SISM - Società Italiana di Storia delle Matematiche* (Italian Society for the History of Mathematics)

Conveners: **Maria Teresa Borgato** (University of Ferrara, Italy), **Erika Luciano** (University of Turin, Italy)

Chair: **Maria Teresa Borgato** (University of Ferrara, Italy)

1 - **Claudio Fontanari** (University of Trento, Italy)
Francesco Severi's personal library

Francesco Severi (1879-1961) is one of the greatest Italian mathematicians, being together with Guido Castelnuovo and Federigo Enriques the recognized leader of the legendary Italian school of algebraic geometry. In his obituary (Roth, pp. 282-283), Leonard Roth praises "the uniformly high level of his considerable scientific production: as a rule Severi attacks only important questions of general character

and usually of great difficulty". As Roth points out in 1963 (but today the same remark could be stated verbatim), Severi's papers "remain part of the living body of geometrical discipline. Aside from their theoretical importance, they follow the best of all recipies for scientific longevity: embedded in many of them is a most interesting problem which still defies all attempts at solution." In this paper we present a first overview of the catalogue of Severi's personal library, which was donated to the "Istituto Nazionale di Alta Matematica" in Rome in 1959, a couple of years before Severi's death. It is known that his former student Beniamino Segre was appointed as the supervisor of the work of arrangement of the "Biblioteca Severi" (Roghi, pp. 63-64). We are going to read the catalogue of his personal library as a physical map of the intellectual universe of Severi. Indeed, as claimed by Laura Di Nicola referring to Italo Calvino's own books, "Il segreto dei libri è proprio nello spazio fisico e insieme concettuale, in quella scacchiera materiale che si fa proiezione di un'immagine interiore di biblioteca." (Di Nicola, p. 275).

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2 **- Massimo Galuzzi** (University of Milan, Italy)

Ludovico Geymonat. Philosophy, political commitment and mathematics

In mathematics, rigorous science "par excellence", there is, nevertheless, a dialectic between pure logic and reference to visual objects. It is impossible to imagine Euclid's Elements, or even Hilbert's Grundlagen, without figures. This is also true for Mathematical Analysis, where complex numbers lose their imaginary, impossible, status only when they were thought of as the points of a plane. I will consider some of the historical and philosophical work of Ludovico Geymonat trying to identify in them the description of this dialectic and the epistemological questions that are connected to it. Ludovico Geymonat, one of the most significant Italian intellectuals of the twentieth century, is considered, above all, for his philosophical contributions, but also for its clear and precise political militancy. However, Geymonat has always considered his mathematical training as an integral part of his thought. He obtained the degree in mathematics in 1932 (under the supervision of Guido Fubini), after having obtained the degree in philosophy in 1930 (under the supervision of Annibale Pastore), and for a few years he was Fubini's assistant of Algebraic Analysis at the Department of Mathematics of Torino, until the moment he refused to join the Partito Fascista and was forced to leave the university. He did not return to university teaching until many years later in 1949, after his engagement in the Guerra di Liberazione Italiana. His Storia e filosofia dell'analisi infinitesimale and some other his essays will be examined according to the point of view set out above.

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3 **- Maria Giulia Lugaresi** (University of Ferrara, Italy)

The Fabio Conforto Fund in the IAC, INDAM and University of Rome Archives

Fabio Conforto (1909-1954) is one of the most relevant figures of the Italian mathematical landscape in the difficult historical period that goes from the thirties to the beginning of the fifties of the Twentieth Century. The establishment of the IAC (Istituto per le Applicazioni del Calcolo) in 1932, realised by Mauro Picone, and the birth of the INDAM (Istituto Nazionale di Alta Matematica) in 1939, due to Francesco Severi, well exemplify the prominent role of Italian mathematics in the European context. Besides the educational activity inside the University of Rome, Conforto carried out a significant research activity in the field of algebraic geometry, but also of the study of applied mathematics. He was in fact one of the

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collaborators of Picone at the IAC and one of the professors of the INDAM, managed by Severi. The versatile personality of Fabio Conforto clearly emerges from the relationship he established with outstanding Italian and foreign researchers, like Alessandro Faedo, Enrico Bompiani, Wilhelm Blaschke and Wolfgang Gröbner in the period 1938-1951. The Fabio Conforto Fund in the IAC, INDAM and University of Rome Archives, together with Conforto's correspondence, now preserved in Florence, are well representative of mathematical research of that period.

Room 10: S18 - Acting with Images and Objects: The Political Epistemology of Mobile Atomic Exhibitions - 2

Convener: **Maria Rentetzi** (Technical University Berlin, Germany)

Chair: **Maria Rentetz**i (Technical University Berlin, Germany)

1 - **Maria Elena Aramendia-Muneta** (Public University of Navarra, Spain)
Scientific Communication or Propaganda? The Atoms for Peace rally in Spain (1954-1964)

The expectations created by President Eisenhower "Atoms for Peace" speech in 1953, opened up a new world of possibilities for nuclear energy. Underdeveloped countries, such as Spain, saw in nuclear energy an opportunity to fast-track to modernization. The announcement by the US of the 'Atoms for Peace' initiative placed Spain in a privileged position to access US nuclear technology. This was, however, just another step along the path of US aggrandisement; US's ultimate goal was to win influence in Europe in opposition to the USSR. Atoms for Peace exhibitions took place throughout Spain, subsidised by the US and characterised by the promotion of nuclear energy, through US inspired media, such as movies, imagery, and publications. We distinguished two main periods: a) From the end of 1955 until the end of 1960, the US Embassy in Madrid under Eisenhower' term of office and with Mr. Lodge as US Ambassador. b) The year 1964 under Johnson' term of office. During the first period the 10 exhibit "Atoms for Peace" was really presented in each corner of Spain. In fact, there were two formulas of exhibit: Atoms for Peace per se or included as a part of the American Cultural Week with a total of 53 exhibits. Then, a rise until 1964, Atoms in Action, which was the reformulated previous Atoms for Peace with only one exhibit in Madrid. This led in 1962 to a proposal to construct a nuclear power facility 70 km east of Madrid, which was accepted in 1963. The Jose Cabrera, or Zorita, facility opened in 1968. It seems that nuclear energy had a deep impact on Spanish society through the influence of the US Atoms for Peace policy, with Franco's regime acting as a channel to introduce the iconic atomic world to the Spanish.

2 **- Gisela Mateos & Edna Suárez-Díaz** (National Autonomous University of Mexico, Mexico)
***'Improvisation is the rule and flexibility and absolute necessity': Mobile Atoms in Latina America* 3**

A series of photographs of Unit 2 of the Mobile Radioisotope Exhibition (MRE) on the roads of Guanajuato, in Central Mexico, show the literal disruption that occurred with the arrival of atomic technologies to rural life in the early 1960's. The transnational mobilization of science and technology embodied in the MRE can be seen as a collective endeavor to move a set of standardized instruments and materials through the eventful roads of Latin American countries (Mateos and Suarez-Diaz, 2015, 2019). A variety of actors -drivers, local and transnational bureaucrats, diplomats, and experts- exercised improvisation and flexibility as essential hinges to ground politics with technology and science. The truck carried a small chemistry laboratory and a radiation counting room, with basic instrumentation such as Geiger-Müller counters, centrifuges, and glassware. Radiation counting, dilution, and biological and

medical tracing were taught to be used in industrial, agricultural, and health applications among others. In this paper we will focus on these objects and the images produced around them, as a myriad of students in Mexico, Uruguay, Argentina, Brazil, and Bolivia were trained on basic radioisotope techniques. Through the concrete actions and the highly contextualized re-significations of modernity that took place at every stop during the MRE itinerary, politics was finely weaved with technoscientific practices. The exhibition carried not only bits of nuclear sciences and technologies, but also the political symbolism of the "friendly atom" as a token of modernization.

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3 - Joshua McMullan (University of Leicester, UK), commentator

Room 11: **T6 - Zoology and Entomology**

Chair: **Mitchell Ash** (University of Vienna, Austria)

1 - **Cecilia Veracini** (University of Lisbon, Portugal)
Portuguese trade of non-human animals in the Age of Discovery (15 th-16th C.)

In the last decades the history of the interface between human and non-human animals in the early Modern period have had a greater academic attention as demonstrated by the increasing number of studies about animals' perception and role, collections and Renaissance menageries, among others. In the 15th and 16th centuries with European expansion we also assist to a massive displacement of animals to Europe and also from and to other continents. In fact, in addition to trading in animal parts such as horns, elephant teeth, skins, birds feathers, civet musk and so on, many live animals were shipped for different uses. Nevertheless the numbers of this trade and the species involved remain less studied. In this process Portugal, as "Atlantic platform", had a fundamental role. Since 1400 this country has been one of the main participants in the importation and trade of exotic animals coming worldwide, but also participated in their trade in other places entering in the local commercial routes (e.g. Asia). Live animals were bought and sold but they were also an important source of fresh food during long journeys. Through these practices many of these animals were introduced out of their natural habitat, becoming in some cases invasive species (e.g. civet cats, some species of monkeys and birds). Animals were a constant and in many cases mandatory presence in all the phases of European expansion, as demonstrated by literary and iconographic sources. This paper will review the role of Portuguese in trade, importation and use of both exotic and domestic non-human animals in the early Modern period. It will be a review of the most traded taxa, their quantities, and the most used commercial routes.

2 - **Nadezhda Slepkova** (Zoological institute RAS, Russia)
Zoology in the space of Eurasia: how the Zoological museum in St. Petersburg became a largest center for taxonomic research in Russian Empire

The modern Zoological Institute and its Museum in St. Petersburg is a visible image of the efforts made by individuals, the scientific community and the state to accumulate animal collections for studying of their diversity, properties and value for people. The Institute has one of the four largest zoological collections in the world. The collection, created over three centuries, consists of 60 million storage units

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today. In this report we are going to tell how the Zoological museum in St. Petersburg has occupied one of the world's leading places in taxonomic research. A number of factors contributed to this. If in the 18th century the zoological collection of the Kunstkammer of the St. Petersburg Academy of Sciences was the most significant in the country, by the beginning of the 19th century with the advent of Russian universities it ceased to be the only one, and at some time ceased to be the largest. However, the rapid development of zoology in the 19th century led to the formation of other areas of research besides systematics. There were morphology, embryology, and experimental disciplines. The tasks of teaching of the new ideas in biology related to the testing of Darwin's views, the development of new directions have made systematics not fashionable among university professors. By the end of the 19th century, the Zoological museum remained the only institution whose main purpose continued to be the study of biodiversity. This direction was defended in sharp discussions between morphologists and taxonomists, who represented the classical German party in the Academy of Sciences. It was here that all the materials on biodiversity from the vast territory of the Empire and the surrounding states began to flock in huge numbers. This was facilitated by both the purely scientific status of the Museum and by its metropolitan position.

3 - **Tom Quick (University of Manchester, UK**)

Purifying the Therapeutic Maggot in Interwar America: Efficiency, Purity, and the Genealogy of Antibiotics

Throughout history, in many cultures and places, medical practitioners have identified fly larvae with the healing of wounds. Most recently, surgeons have turned to placing larvae in wounds as one potential means of avoiding over-reliance on antibiotics. In recounting a key episode in this integration of larvae into scientific surgical practice, this paper addresses the relevance of so-called 'maggot therapy' to the history of modern biomedical science. It's contention is that inter-war maggot therapeutics constituted a critical condition of possibility for the development of antibiotic agents during the 1940s. From the end of First World War, surgeons became ever more interested in the healing of wounds. Alongside such pioneering techniques as the Carrol-Dakin method of asepsis and the plaster-cast centred 'Orr method', maggot therapy emerged as one of the brightest new hopes of the era. This paper will show how maggot therapy constituted an alternative vision of medical practice to the 'laboratory medicine' that was believed to be in the ascendant - one in which life itself would be refashioned to serve human medical ends. In the hands of military surgeon and maggot therapy pioneer William S. Baer, fly eggs were purified using disinfectants, and reared in pathogen-free cages. As the treatment gained in popularity maggots were subject to ever more intense purification, to the extent that US Department of Agriculture scientists developed chemical 'extracts' of the substances they secreted, excluding the animals from the treatment entirely. As the 1930's progressed, maggot physiologies were thus exploited in the hunt for ever more effective antibacterial agents. Their conversion into 'living disinfectants', this paper will show, anticipated the similar conversion of soil and mould microbes into 'antibiotics' around 1940.

<u>Pause</u> from 15.10 to 15.25

Wednesday 2 September, 15.25 - 16.45

Room 1: **S50 - Visual, Material and Sensory Cultures of Science as a crossroad between histories of displays and displays of histories - 2. Future Exhibitions**

Conveners: **Eugenio Bertozzi** (University of Bologna, Italy), **Sébastien Soubiran** (University of Strasbourg, France)

Chair: **Caterina Morelli** (University of Bologna, Italy)

1 - **Sofia Talas** (University of Padua, Italy)
Renovating a university physics museum: challenges and perspectives

In the 1990s, a Museum of the History of Physics was founded at the Department of Physics of the University of Padua. The instruments were very simply displayed according to the area of physics they were related to, from mechanics to optics, from acoustics to electricity. We are now developing a project to renovate the Museum, with the aim of using scientific instruments as primary sources of information, to shed light not only on the research and teaching that have been carried out in Padua throughout the centuries, but also on the way local scientists and mechanics worked, in relation with the political, social and economic context they lived in, both at local and international level. The paper will discuss some of the main peculiarities of the project. We will outline how the new display should express various aspects of the recent approaches in the history of science, hoping that the project itself may contribute to stimulate reflection and new discussions on these topics.

2 - **Timo Mappes** (German Optical Museum Jena, Germany)
Transforming static displays of optical instruments to holistic interactive presentations

The ongoing transformation of a classical static display exhibition to a holistic interactive experience is discussed within this contribution at the example of Deutsches Optisches Museum (D.O.M.) in Jena, Germany. The displays of the exhibition at the former Optisches Museum Jena had been statically and unchanged since the 1990s. We scanned the entire galleries of the museum with a 3D camera. The result of this scan is freely accessible as documentation of the museum's history online. To enable the intuitive journey through the former exhibition, we created a virtual dollhouse hosted at the website of D.O.M. [[1] https://www.deutsches-optisches-museum.de/sammlung.html]. The new exhibition will be opened in 2023. Then three elements will shape each exhibition area as didactic building blocks: a) interactive experience stations as experiments explaining basic principles of optics, e.g. refraction, reflection, immersion, resolution, light-guiding; b) historic artefacts that make use of the principle learned in the first building-block. These historical objects are shown including their individual application and thus the impact of their use is illustrated in a storytelling. E.g. a microscope used by Robert Koch, a telescope used by Napoleon Bonaparte, a spectroscope used to find the Lamb-shift, the setup to take the first movie to see cell-division with phase-contrast; c) showcase for latest research results in optics & photonics. Here, updated every annual quarter, the latest published research results shall be communicated by junior scientists to the general public. While the display cases of the former exhibition were packed with instruments, the new exhibition puts the focus on highlights. Thus, far less objects will be on display within the permanent exhibition. However, they will be embedded in stories to fascinate the visitors. And, this permanent exhibition described here is completed by a show-depot on a dedicated floor, illustrating the impressive evolution of optical instrumentation.

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3 - **Eugenio Bertozzi** (University of Bologna, Italy), **Sébastien Soubiran** (University of Strasbourg, France), ***Private jewels or public showcases for the Academia? the Museum of the Third Millennium***

The presentation will reflect on the role that scientific museums played in the history of European Universities from the 18th century up to now and will question whether this role might change in the next future regarding the changing environment European universities are confronted to. Started as places where scientific disciplines have established their own academic identity (19th Century,1st generation), toward the end of the 20th Century university museums concurred to promote historical researches on the sciences, as discussed in the Symposium (2nd generation). As such, they often became the places where the "jewels" of the university heritage are kept and exhibited. A third generation of museum appears to open up under different auspices: the "museums of the third millennium" seems to be more and more functional to an alliance between University and the hosting Cities: besides the cases already mentioned in the Symposium, two further cases taken from Bologna and Strasbourg will be discussed.

Room 2: S21 - Visualizing and Modelling Sensory Actions (VMSA) for Inquiring Science & Technology into History - 2

Convener: **Raffaele Pisano** (Lille University, France)

Chair: **Raffaele Pisano** (Lille University, France)

1 - **Antonella Foligno** (University of Urbino, Italy)
Model-Building Practice as a Cognitive Enterprise

Since representation is an ubiquitous term, my presentation aims at giving an account on the relation between scientific representation and cognitive science. The scientific community use the term 'model' to make reference to structures of different nature: physical objects, fictional objects, descriptions or equations; which are consequently useful tools for scientific reasoning. The aim is to show that models are surrogate structures of the surrounding physical reality. Scientists usually connect the data of physical reality with the abstract features of models by means of a process that requires at least two steps: i) interpretation, namely elements of an abstract model are provided with general physical interpretations; and ii) identification or denotation, elements of a representational model are identified with elements of the real system (Contessa, 2007). Within this perspective the role fulfilled by the user becomes of central importance; a model is a mind-dependent object, which exists only in the mind of the scientific community, defined as a social construction and developed within a certain cultural context (Giere, 1988). A scientific model is an epistemic representation insofar as it gives a representation of any particular set of physical phenomena under observation, even though the knowledge drawn about it does not correspond to what we directly observe in nature. There is, in fact, an epistemic gap between the conclusions that we infer from models and what we directly observe in nature, and it could be the case that these kind of scientific reasoning and the inferences drawn from them do not yield conclusions with certainty. The conclusions inferred need to be translated by following a set of arbitrarily established rules. On the one hand, the model is easier to study than the target-system, and on the other hand representation stands for something like a licence to draw inferences.

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2 - **Vincenzo Cioci** (Lille University, France)

Exploring Sensory Galileo's Tools for Modelling Motion into History of Physics & Nature of Science

Pendulum, water clock, inclined plane, launching ramp are some of the sensory tools used by Galileo to extend his senses in order to describe his new forthcoming new science of motion. My inquiring describes these new historical insights within Nature of Science Physics—and— Mathematics details along with Galilean scientific wording. This work also dealts with a) projecting educational paths for high school and universities based on the analysis of Galilean measurements notes, history, drafts—and—texts to be included in curricula, b) Nature of Science such as sensory performing tools to explore fundamental kinematics experiments made by Galileo in context, c) visualizing and modelling results in the historical sources/context. In my talk, I will discuss case studies from sensory actions as exposed by Galileo (Opere Nazionali and its English translations).

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3 - **Daniel Jon Mitchell** (Science History Institute, USA)

"A Much More Purely Experimental and Descriptive Science:" Tyndall, Guthrie, and the Disciplinary Reformation of Late-Victorian Physics

Historians usually treat the community of British physicists during the late 1860s through the 1870s as one corporate bloc, united behind a commitment to energy as a unifying theoretical concept, and precision measurement as the principal mode of advancing the field (e.g. Gooday 1990). This view has marginalized an established tradition of qualitative experimental physics during a period that witnessed a dramatic expansion in science teaching. Focusing on John Tyndall and Frederick Guthrie, I characterize this tradition in terms of (a) an intrinsic interest in the sensory presentation of everyday objects and phenomena (b) the instrumental production of stable visualizations of novel phenomena, and (c) a dual social-pedagogical insistence upon "self-gotten" observational and experimental knowledge through craft-based practices of instrument construction (Brock, 1998). I then describe the institutional growth of the qualitative tradition through Tyndall and Guthrie's involvement in the government-sponsored Department of Science and Arts (DSA) scheme of scientific education for the 'industrial' classes, and Guthrie's subsequent founding of the Physical Society of London. These findings lead me to conceive of the ultimate triumph of the quantitative program of energy physics (Smith, 1998) during the 1880s as a disciplinary 'reformation.' This perspective promises to integrate a wide range of actors, audiences, practices, institutions, and contextual factors into the making of the physics discipline in Britain (cf. Simon, 2016).

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Room 3: **S24 - Universities and Their Cities. Visual Traces of Universities and Scholars in University Cities across Eras - 2**

Conveners: Milada Sekyrková (Charles University Prague, Czech Republic), Marek Ďurčanský (Charles University Prague, Czech Republic)

Chair: Milada Sekyrková Charles University Prague, Czech Republic)

1 - **Juliane Mikoletzky** (Technical University Vienna, Austria)
The Fascination of the „Campus"Idea. 200 Years of Location Development of the Vienna University of Technology (TU Wien)

The building of Vienna Polytechnic Institute, at its foundation in 1815, was located outside the city walls in the suburb of the „Wieden"; architecturally, it was meant as a counterpart oft he dominant baroque St. Charles Church. But after the incoporation of the Wieden and neighbouring suburbs into the City of Vienna, it soon developed into a „City University". But since the late 19th Century, space began to run short, and the university began to occupy a number of additional sites, mostly in walking distance from the old main building. Until the end oft he 20th century, a number of new buildings were put up, some oft hem with the character of urban landmarks. But each time when the University was offered a fresh start on a completely new campus outside the city, these offers were declined – the last one in the 2010s. People wanted to stay in the city and profit from the central facilities. Nevertheless, since the last decade, the TU Wien and its facility management started to label the various locations as „Campuses", thus referring to a completely different concept of University building. The paper will examine the history oft he site development oft he TU Wien, ist impact on city structures and visual expressions and the changing ideas of a „university" behind them.

~~2 - **Jan Kotůlek** (Technical University of Ostrava, Czech Republic)~~
~~***Century of Příbram as an University City 1849-1945***~~ **[CANCELLED]**

Up to 1849, when the Mining Academy was established in Příbram, the city was known merely for its ore mines. At the first sight, there was visible impact of the Academy on the buildings in the city: adaptation and renovation of Ernestinum castle and convictus. Professors and students gradually built new elites of the industrial city consisting mainly of industrial workers. They supported culture of coffee houses and cultivated the culture life in general. In the evenings and weekends, smell of coffee and cigars supplemented the smell of the silver mines. Students brought another subculture previously missing in the city, namely culture of student clubs and feasts, e. g. Bergparaden or assemblies (Skok přes kůži). The established tradition has endured until the present time. In Příbram, German professors and students were in minority. However, they still possessed significant political and economic power. National controversies in the Academy reverberated in the city public, e.g., as the German professors wanted to move the Academy from Příbram to a German region. After 1918, German professors gradually moved to Prague. Now, the Czech professors wanted to move to Prague as well. We show how the university visualised itself within the city and within the mass media, trying to either move to Prague

or force the ministry to invest massively into the buildings. The main events were awarding of the honorary doctorate to the president Masaryk in 1924 and celebration of 10th anniversary of Czechoslovak Republic in 1928. In 1945 the communist minister of education Zdeněk Nejedlý decided to move the Mining University to Ostrava, "the steel heart of the Republic", contrary to wishes of both Příbram city council and professorial board. Nevertheless, Mining University is still visible in Příbram after 75 years.

3 - **Ab Flipse** (Vrije University Amsterdam, Netherlands)
The Vrije Universiteit Amsterdam as a Campus University: 'Cité Universitaire' between Dream and Reality

In the 1950s, the Vrije Universiteit (VU) Amsterdam, which was founded in 1880 and had its main buildings in the city center, decided to move all its faculty buildings, laboratories and new Hospital to the boarder of the city, to become a campus university. It will be demonstrated how this idea sprung forth from the then Calvinist identity of the university, and its emphasis on a close academic community and connection between the different disciplines (sciences, humanities). However, it was not until the 1990s that all research and teaching was concentrated on this location. In the meantime, the planned coherence of the collection of buildings – in the sixties presented as a 'cité universitaire' – was not realized and the campus ideal disappeared, as did the religious identity of the university. However, in the 1990s, the ideal of a campus university was rediscovered, which led to several improvements on campus and architecture, and the idea of a campus university then contributed to the formulation of a new identity of this university. However, when, from the turn of the century onwards, right next to the campus, a new business district arose, the university again had to adjust its campus plans

Room 4: S65 - Diplomacy and Images in Science - 4. The symbolic power of scientific images in international spaces

Sponsored by IUHPST/DHST Historical Commission on Science, Technology and Diplomacy

Conveners: Simone Turchetti (University of Manchester, UK), Matthew Adamson (McDaniel College, Hungary)

Chair: Matthew Adamson (McDaniel College, Hungary)

1 - **Carlos Godinho** (University of Lisbon, Portugal)
Nationalizing Scientific Diplomacy: the Celestial Sphere in the 1500s and 1900s Portuguese Politics and Diplomacy

The celestial sphere, a cosmological model originally from ancient Greece, had a key role as a symbol for Portuguese politics and diplomacy in two different periods, 400 years apart. First, it was appropriated by king Manuel I, as his heraldic badge in 1495. Secondly, it was reused by the Republicans in the new national flag of 1911, after the overthrown of the Monarchy. The 1900s use of the celestial sphere was intended to symbolize the 1500s "golden age" of national history when the colonial empire was being established. This nationalization of the scientific symbol was also in line with the progressive ideology of the Republican regime which, for example, was translated into the secularization of the state. By means of propaganda, the sphere became a political statement aimed to generate national consensus and to claim internationally the Portuguese historical right over its colonies, which were sought after by other European nations.

2 - **Ronald E. Doel** (Florida State University, USA)

Alternative Narratives: Learning from Examining Historical Photographs of the Empire of American Science

Photographs of scientists, and scientific activity, are rarely utilized by historians of science to interpret the past. When they are, they often serve as potted plants, illustrating arguments derived from traditional written sources—even though photographs sometimes challenge such historical narratives. Historians of photography have similarly overlooked photographs depicting scientific work: for instance, no major works addressing Roy Stryker's famous FSA/OWI images call attention to photographs of scientists in their files, including Arthur Rothstein's "Chemistry Student" and Jack Delano's "A Class in Chemistry: In the Lecture Room of the Chemistry Building." During the Cold War, various United States governmental entities, particularly the U.S. Information Agency, sought to use photographs of scientific research to promote a vision of American vitality and democratic values. USIA photographers and editors, working throughout the United States and throughout the world, created elaborate photo-stories for newspapers and wide-circulation magazines such as Life and Look; other staff members then carefully monitored international reactions to these illustrated stories, devised new campaigns, and shared results with analysts at the Central Intelligence Agency and with White House officials. These efforts were not exclusively state-directed: photographers for the Washington, D.C.-based Science Service also created image-driven stories of scientists and scientific work for a wide range of North American publications, as did the Rockefeller Foundation and large corporations such as General Electric. Drawing on largely unexplored historical photograph collections, national archival collections, and individual holdings for Cold War era photographers, this paper explores what images were created of American science in the 1950s through 1970s, and how political and cultural gatekeepers—including editors, publishers, and government officials—sought to refine the messages they provided for global audiences as tools of Cold War diplomacy.

3 - **Maria Paula Diogo, Ana Simões & Paula Urze** (Nova University of Lisbon, Portugal)

Techno-diplomacy in the age of New Imperialism. The Pink Map episode in images

By the end of the 19th century and early 20th century infrastructural technologies were at the core of imperialism both as tools to achieve strategic ends and as actors which enacted different European colonial strategies. More often than not, episodes framed in the media or in political fora as military or diplomatic events had a hidden history in which technology played a critical role. The Pink Map episode is a fine example of how European powers clashed when struggling to impose incompatible technological projects to rule the African territory. After the principle of effective occupation of colonial territories was imposed by the Berlin Conference, Portugal claimed sovereignty over a stretch of land connecting Angola's west coast to Mozambique's east coast (Pink Map). At the heart of the Pink Map was the building of a trans-African railway, which jeopardized the British ambition of hegemony over Africa and particularly Cecil Rhodes' Cairo to Cape Town railroad line. A diplomatic clash ensued: the British demanded the withdrawal of the Portuguese troops by sending an Ultimatum (1890) to the Portuguese king, who accepted it, causing violent anti-British sentiments in Portugal and various riots. This hot political topic of heavy technological underpinnings incited passionate arguments and sarcastic cartoons. In this paper we present and discuss these cartoons, particularly those authored by Rafael Bordalo Pinheiro, a well-known artist for his illustration, caricatures, sculpture, and ceramics designs. Bordalo Pinheiro was the creator of a popular cartoon character known as Zé Povinho who portrays the Portuguese people. Zé Povinho who is portrayed as a common and simple man, often deceived by politicians, but still sharp in his criticism against injustice and tyranny, is one of the main protagonists of Bordalo Pinheiro's cartoons voicing the Portuguese national feeling of humiliation during the Anglo-Portuguese crisis following the Pink Map.

Room 5: **T21 - Scientific Instruments**

Chair: **Lucio Fregonese** (University of Pavia, Italy)

1 - **Henk Kubbinga** (University of Groningen, Netherlands)

Nicolaus Mulerius and his Academy-Portrait: Copernicanism in the Netherlands anno 1618

Nicolaus Mulerius was the first Professor of Medicine and Mathematics at the newly founded University of Groningen (1614). His preference concerned Mathematics which, to him, reduced to Astronomy. Already before his nomination he had published tracts related to Astronomy: in 1595, a manual for the use of the 'astrolabium' (in Dutch) and, in 1611, a book of tables entitled Tabulae Frisicae lunae-solares [..]. After his nomination, he produced a textbook Institutionem astronomicarum [..] (1616), while working already on a new—this time annotated—edition of Copernicus' masterpiece De revolutionibus [..](1617). Until recently, that chronologically third edition of De revolutionibus [..] was considered at most an anomaly: a Groningen professor was, almost by definition, an Aristotelian, in the sense that he had solemnly promised to stick to the letter of the 'corpus aristotelicum'. Hence the oddity of seeing such a presumed geocentrist publish a massive plea for heliocentrism. However, helped by the newly discovered auction sale catalog of Mulerius' private library (Bibliotheca Angelica, Rome; 1988), the riddle could be solved (2014). In my paper I would like to focus on Mulerius' formal, so-called Academy-Portrait, made, by a thusfar unidentified artist, in 1618. On it, Mulerius features with two astronomical models, one of which finally revealed his thoroughly Copernican mindset. Copernicanism in a QRC-mirror.

2 - **Yoshimi Takuwa** (Tokyo Institute of Technology, Japan)

Francesco Algarotti's 'Newtonian prisms' and their experimental accuracy

Although Italy was the pioneering country in the field of both optical theory and instruments by the middle of the seventeenth century, once Isaac Newton's "New Theory about Light and Colors" appeared in 1672, Italian scholars did not engage in controversy on the examination of new theory. Previous studies, such as those of Paolo Casini, indicate that it was in 1709 that several copies of Optice (latin translation of Newton's Opticks) were imported into Italy, and it was in the late 1720s that Italian academic circles accepted the new theory; a symbolic event holding replications of Newton's optical experiments was done by Francesco Algarotti in 1728 at the Academy of Sciences of the Institute of Bologna. In the Civic Museums of Treviso, there are three triangular prisms associated with Algarotti. Since they were preserved by Algarotti's family before being donated to the museum and the prisms' frames were wax-branded with 'I. N', they seem to have been used by Algarotti in order to repeat Newton's experiments. What is more, it may be possible that Catherine Bartron Conduitt, Newton's niece, gave these prisms to Algarotti who traveled to England in 1736. Algarotti's three prisms were examined by Vasco Ronchi in 1957. He could measure the optical characteristics for one prism but not for the other two prisms. Last year, I had a chance to see these three prisms and compare them with four other so-called 'Newton's prisms' in England. I conducted my own simple examination that allowed me to measure the rough refraction indexes of the prisms. The data may give us a hint to explain why Algarotti wrote that he failed to repeat Newton's experiments with the 'Italian prisms' and then succeeded with the 'prisms from England' in his Il newtonianismo per le dame (1737).

3 - **Manuel Xavier** (University of Lisbon, Portugal)

Instrumental Failure or Surveyor Incompetence? Gago Coutinho's Salmoiraghi theodolites

This paper is about a clash for authority between user and maker over a set of custom-made scientific instruments. In 1908, Portuguese surveyor Carlos Viegas Gago Coutinho (1869–1959), working in Mozambique, commissioned four adapted theodolites for high-precision geodetic surveying. The Italian shop 'La Filotecnica', owned by engineer Angelo Salmoiraghi (1848–1939) — a well-established maker and provider of hardware to the Rome Observatory —, was selected to provide them. But the

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instruments were problematic, triggering a clash for authority over their meaning. From the user's perspective, the instruments were poorly manufactured; from the maker's perspective, the user's incompetence was to blame. Central to this clash was the fact that user and maker were estranged and far apart. The Mozambican wilderness was also a remote and fragile space of practice, weakening Coutinho's claims for authority. Seeking to place the knowledge he produced under a metropolitan scientific institution in Europe equivalent to the Rome Observatory, he sided with the Lisbon Astronomical Observatory. But Salmoiraghi was not persuaded. Judgments about material culture and embodied practices were passed and could become surprisingly polarized. Some of these features have been analysed in other cases (Fleetwood 2018; Schaffer 2012). By focusing on this welldocumented set of instruments (MUHNAC collections, Lisbon), and stressing the importance of space of labour, human, and instrument, I will analyse this crisis between user and maker, concerning material design, instrumental error, and professional authority.

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Room 6: S12 - Calculating Tool, Diagram and Algorithm in the Ancient Eastern and Western Mathematics - 2

Conveners: **Kostas Nikolantonakis** (University of Western Macedonia, Greece) **Zhigang Ji** (Shanghai Jiao Tong University, China)

Chair: **Zhigang J**i (Shanghai Jiao Tong University, China)

1 - **Chunzhi Tian** (Shanghai Jiao Tong University, China)

Pacioli's Study of Euclid's Elements - An analysis of the geometric diagrams in Summa

A famous mathematician and "The Father of Accounting and Book keeping" in Europe, Luca Pacioli published his first influential mathematical compendium in 1494 in Venice. The book called "Summa de Arithmetica, Geometria, Proportioni et Proportionalita" (hereafter referred to as Summa) covered essentially all of the Renaissance mathematics. Summa includes practical arithmetic, algebra, commercial mathematics (business and trade) and elementary geometry. Pacioli said that the geometric part was the second main part in Summa. In this part, he quoted abundantly from Euclid's Elements. In the Elements, there were no practical calculations. However, Pacioli made some changes and adaptations, and in particular he added methods to calculate the areas of triangles, squares, circle and all kinds of solids and he drew many diagrams to illustrate different problems. Besides, Pacioli paid much attention to practical calculation. For example, in the last chapter of the geometric part, he included many different kinds of diagrams, such as barrel, ricks, boxes, ladders, scales and so on. On the one hand, he followed the logic of the deductive system; on the other hand, he made some improvements and adaptations according to the social context and practical need. In this paper, I will discuss the concrete diagrams that Pacioli drew and how he used different algorithms to solve different problems. Moreover, I will analyze the possible reasons why he made these changes.

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2 - **Ri-na Sa** (Shanghai Jiao Tong University, China)

The Study of the Spread of Chinese Traditional Mathematics in Japan- According to the algorithms and diagrams on the Jinkōki

The Japanese traditional culture was deeply influenced by Chinese culture, and this holds true also for the traditional mathematics from China, which spread to Japan and had a great impact. The work Jinkōki by Yoshida Mitsuyoshi, a scholar in the Edo Period, is a piece of epoch-making and innovative work for the traditional Japanese mathematics. According to the algorithms and diagrams that Jinkōki contains, one can find out its content also attests to influence by traditional Chinese mathematics. Jinkōki involves a lot of traditional measurements and commercial calculations. Many mathematical questions derive from Chinese mathematical works from different historical times. This paper also discusses the profound influence of traditional Chinese mathematics on Japanese commercial economy in the field of abacus. It provides a new assessment of the importance of traditional Chinese mathematics and present clear clues showing how Japan developed its own traditional mathematics on the basis of Chinese mathematics.

3 - **Tsukane Ogawa** (Yokkaichi University, Japan)

Elimination theories in China and Japan

A decisive step in the development of traditional mathematics was the evolution of elimination theories for simultaneous equations of higher degrees. The elimination theory in the Jade Mirror of the Four Unknowns (Siyuan yujian) published by Zhu Shijie in 1303 is the most highly developed classical stage in China. In Japan, Seki Takakazu developed several theories involving resultants to eliminate unknowns. Comparing these theoretical achievements is difficult because the former dates to the 13th and the latter to the 17th century. But this presentation presents my attempt to do so from the point of view of the expressions of the equations.

In the Jade Mirror of the Four Unknowns, in order to eliminate the unknown y from the simultaneous equations

$a2y\,2 + a1y + a0 = 0$, (1)

$b2y\,2 + b1y + b0 = 0$, (2)

where $ai = ai(x,z)$, $bi = bi(x,z)$, Zhu recalculated the problem as

$(1)\times b0 - (2)\times a0 : (a2b0 - a0b2)\,y + (a1b0 - a0b1) = 0$,

$(1)\times b2 - (2)\times a2 : (a1b2 - a2b1)\,y + (a0b2 - a2b0) = 0$.

Then he eliminated y *1).

On the other hand, in the Method of solving concealed problems (Kaifukudai no hou) Seki Takakazu calculated as follows:

$(2)\times a2 - (1)\times b2 : (a2b1 - a1b2)\,y + (a2b0 - a0b2) = 0$, (3)

$(2)\times a1 - (1)\times b1 + (3)\times y : (a2b0 - a1b2)\,y + (a1b0 - a0b1) = 0$. (4)

And then he eliminated y. Note that the result exactly matches Sylvester's resultant.

The two methods are much the same as summarized above, but they work out very differently in practice. In the Jade Mirror of the Four Unknowns, a single term of at most four unknowns is assigned to a lattice point on the two dimensional plane and only the coefficients are put there. It cannot therefore be expanded to more than five unknowns. In the Method of solving concealed problems, a polynomial is expressed as a vector consisting of coefficients. The elimination method is cumbersome in the former but in the latter has a flexible generality. But by following and amplifying the Chinese method "Tianyuan shu" to express polynomials, Japanese mathematics never specified unknowns. This limitation may have come from the importance placed on the tradition of Chinese mathematics, or from the practice of performing algebra with instruments, or from the ideological influence of Neo-Confucianism.

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Room 7: **S34 - Hybrid ontologies: the circulation of visual cultures, gender, and expert communities - 3**

Convener: **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)

Chair: **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)

1 - **Marta Velasco Martín** (University of Castilla-La Mancha, Spain)
Yeasted bananas in glass bottles and gendered practices in the Drosophila population Genetics

"When we were little kids, we took excursions on Sundays and many times we hunt flies. I still have a gauze net. They [María Monclús and Antonio Prevosti] both used it. They had several techniques they were improving over time [...]. Well, before leaving home, my mother crushed bananas and put some yeast usually used to make bread, that is, we used to come to buy it here, right here, at this store. She let it ferment overnight and the next day she put it in [glass] jars, jars so wide-mouthed like this [that of a cup of coffee] and smelled like demons". This collective memory belongs to María Monclús's daughter and son. They shared it in an interview about her mother which occurred in the bakery where they used to buy yeast, nowadays, also a coffee shop. The practices they narrated had been described and drawn by María Monclús herself in a paper on the ecology and taxonomy of Spanish Drosophila's species published in 1964. Bananas and glass jars are components of a material culture of the Drosophila genetics as did the draws in which they were represented, the pictures in which they appeared and the memories to which they belong. These hybrid objects, material and emotional, circulated between the field and the laboratory but also between the classroom, research stations and kitchens of geneticists' households such as María Monclús. Using images of glass bottles containing yeasted banana and flies from scientific papers, pictures, notes and scholar books, this paper will show these visual epistemologies as tools which allow emotional memories to came up and, thus, practices of the Drosophila population genetics, marked by gender, to be conjured.

2 - **María Jesús Santesmases** (Spanish National Research Council - CSIC, Spain)
Imaging the human fetus: chromosomes, ultrasound scanning and photographs in the 1960s

In May 1966, a Spanish weekly published in its front page the photograph of a thumbsoaking unborn covered by a membrane. The images of human fetuses circulated among public audiences joining in the biomedical shapes of fetal chromosomes and the live images provided by ultrasound scanning. Those three arenas for a public epistemology of the child-to-be-born combined, that is, the circulation of the three of them created new cultures of embryos, pregnancy, and biomedicine more generally. The particularities in Spain, imposed by Franco dictatorship that lasted until he died in 1975, would be analyzed as the environment in which this new biomedical culture of fetus emerged. A set composed of devices and meanings were incorporated by biomedicine. I will reconstruct the intertwined history of this set in a history of the human fetus as a biomedical hybrid ontology, its national particularities and its international circulation.

3 - **Mauro Capocci** (University of Pisa, Italy) commentator

Room 8: **S27 - Layers of history: From the coast to the mantle in Mediterranean science**

Convener: **Beatriz Martínez-Rius** (Sorbonne University, France)

Experiencing the sea is not a straightforward task. Since marine environments are unreachable for human direct experience, perceiving them requires the mediation of technologies, instruments, and artifacts that provide us filtered data. Visual representations result from those filtering technologies, ranging from maps and charts, to figures and schemas. These representations have offered ways to experience the sea in its three dimensions for pursuing activities of all sorts: From trade and military surveillance, to securing coastal settlements. However, the sea can't be represented as a whole: Selecting which layers, and through which practices, it ought to be studied bears epistemological consequences, since it will define how the marine environment will be perceived. This panel aims to shed some light on how the selection of visual practices, historically situated in political, social and economic contexts, has shaped different ways of experiencing and representing the seas. The Mediterranean Sea, a pivotal and contested area for humans during centuries, offers a unique case where those practices overlapped, originating an array of approaches to experience the same geographical area. The papers presented, ranging from the study of the atmosphere-hydrosphere interphase to the ocean crust, focus on the efforts pursued by different communities of experts in transforming different layers of the Mediterranean Sea in spaces perceptible to human senses. Our papers drive attention to how visual representations sought to depict particular features of the sea, whereas other traits needed to be invisibilized depending on which perception must be developed. By combining these papers, we aim to assemble an image of the Mediterranean that depicts the complexity of a space that has long been considered as a mere vastness of water.

Chair: **Beatriz Martínez-Rius** (Sorbonne University, France)

1 - **Lino Camprubí** (University of Sevilla, Spain)
3D Visions of the Mediterranean

This paper offers a history of the Mediterranean Sea through the multiple and heterogeneous efforts to visualize its basin as a 3D volume. Starting with early maps of reefs and other shallow accidents, I will interrogate how visualizations of the ocean's bathymetry and column of water acquired depth from the 19th century onwards, including very recent images coming from the environmental sciences, human geography and even history. This visual tour will enquire about the place of images in scientific and cultural constructions of this Sea. It will also seek to identify what sorts of visualizations are missing, that is, what can historians of science and technology hope to add to the existing visual record of the Mediterranean as a volumetric space.

2 - **Davide Orsini** (Mississippi State University, USA)
A Sea of risks: environmental monitoring and representations of radiological risks in the Mediterranean during the Cold War

This paper illustrates how during the Cold War a group of radioecologists from the Italian National Committee for Nuclear Energy (CNEN) represented radiological risks at sea connected to atmospheric tests, the operation of civilian power plants, and of nuclear vessels in the Mediterranean area. Experts conducted environmental monitoring campaigns around nuclear sites adopting specific sampling techniques, research strategies, and mapping to measure and represent radioactive emissions of nuclear reactors. Italian experts included data on reactors designs, types of emissions, and patterns of dispersion resulting from geomorphological, atmospheric, and demographic conditions of the site into their routine monitoring practices and in the redaction of emergency plans. My argument is that Italian

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radioecologists adopted an envirotechnical approach when monitoring environmental radioactivity because they had to take into account both the technical characteristics of reactors and the particular ecological conditions in which they operated. I also show how lack of data, malfunctions of monitoring devices, or unpredictable environmental phenomena created knowledge gaps which required the elaboration of creative sampling strategies. All these operations are not visible in final reports, where representations of risk appear as fait accompli. In the paper I want to make the labor of representing risk visible and therefore I want to argue that every representation should be understood as an artifact in itself.

3 - **Beatriz Martínez-Rius** (Sorbonne University, France)
Secrecy, oil and geology in representing the deep Mediterranean

Although currently considered poor in hydrocarbons, the oil potential of the western Mediterranean was still to be proved during the cold war. Driven by promises of wealth, states and oil companies embarked on the exploration of a still unknown space: The Mediterranean seafloor. In this paper, I analyze how the oil industry influenced the production of the Mediterranean's geological knowledge. I will do so by analyzing the transference of representations produced by the industry, such as seismic profiles, stratigraphic columns, and isopach maps (which depict sediment's thickness), to the scientific community. Indeed, the oil industry controlled most of the data obtained because oil companies monopolized the offshore exploration technologies. Since the seafloor could only be seen through representations depicting particular features of that space, the images produced by oil companies reflected the relevant features for industrial exploitation. During industrial surveys, for instance, drilling operations tended to destroy the upper layers of sediments to reach those of industrial interest. From the samples taken, only selected analysis related with the oil-generating potential were conducted, thus defining the representations generated. Although confidential policies at oil companies prevented the diffusion of their data to the scientific community, some representations deemed to be of lower industrial-value were allowed to be disclosed, becoming key to enhancing marine geological research in the academia. By analyzing what was transferred, as well as what remained confidential, this paper aims to discuss the role that industrial confidentiality can play in orientating the production of scientific knowledge not always in a detrimental sense, but also by contributing to it in a beneficial way.

Room 9: S86 - Visual and Material Cultures in the Mathematics of the Ancient World - 3

Conveners: **Karine Chemla** (CNRS / University of Paris, France), **Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)

Chair: **Adeline Reynaud** (French National Centre for Scientific Research - CNRS, France)

1 - **Mathieu Ossendrijver** (Free University Berlin, Netherlands)
Diagrams and figures in Late Babylonian mathematical practices

This paper presents results of an ongoing study of diagrams and geometric reasoning in Late Babylonian mathematical sources (ca. 600-50 BCE). While the Old Babylonian mathematical corpus (ca. 2000-1800 BCE) is relatively well studied, the Late Babylonian mathematical corpus is relatively small and about half of the known tablets remain unpublished. In both periods, diagrams and geometric figures feature prominently in the mathematical sources. This paper addresses some notable differences in the representation of the diagrams and in the formulation of mathematical procedures involving geometric figures.

2 - **Karine Chemla** (CNRS / University of Paris, France)

From material objects to diagrams. Counting rods in China between the first and the thirteenth centuries CE

As far as we can tell from the available Chinese mathematical sources, until the 10th century, counting rods were merely material objects, and we can restore features of practices with them on the basis of the clues found in mathematical documents. From the 10th century on, however, some mathematical writings begin representing counting rods and configurations of numbers made with counting rods. My talk will focus on two key facets of these representations. First, I want to discuss the spaces in the pages where these representations were placed. I argue that these spaces allow us to distinguish between different mathematical cultures and also that they shed light on the nature of what was written using counting rods. Second, I intend to focus on how, in different contexts in which counting rods were represented on the pages of writings, Chinese characters were used in these representations. This second angle likewise supports the idea that these representations attest to different mathematical cultures. Interestingly, in some cases, the way in which inscriptions were added to representations with counting rods seems to indicate that these inscriptions played a part in arguing for the correctness of the related procedure. This will thus lead me to discuss the relationship between proof and computation from another angle.

3 - Alexei Volkov & Viktor Freiman (University of Moncton, Canada)

Calculation of the area of a circle in East and West: Infinitesimal procedures and their visualisations

A large number of geometry textbooks published in Europe and North America in the 19th and 20th century featured several approaches to teaching the formula of the area of a circle of which the most frequently used was as follows: the circle was subdivided into a number of sectors, and its area was approximated with the sums of the areas of the triangles inscribed in these sectors. A similar approach, applied with certain variations, can be found in works of medieval European authors (e.g., Leonardo da Vinci, 1452 – 1519) while for the first time the idea of subdivision of the circle into sectors leading to the desired result appeared in the work of Archimedes (c. 287 – c. 212 BC) Measurement of a Circle. In our paper we will compare the methods of the ancient and medieval Western mathematicians, in particular, Archimedes, with that of the Chinese mathematician Liu Hui 劉徽(fl. AD 263), who designed an infinitesimal procedure to calculate the area of a circle in his commentary on the ancient mathematical treatise Jiu zhang suan shu 九章算術. We will also discuss later interpretations and adaptations of the methods based on the division of the circle into growing number of sectors and especially focus on the related visual representations that can be found in a large number of the European and North-American school textbooks of the 19th and 20th centuries.

Room 10: **S4 Learning by Doing and Doing to Learn: Skills, Texts and the Materiality of Surgical Knowledge in Early Modern Europe - 2**

Conveners: **Elaine Leong** (University College London, UK), **Maria Pia Donato** (CNRS - Institut d'Histoire Moderne et Contemporaine, Paris, France

Chair: **Paolo Savoia** (University of Bologna, Italy)

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1 - **Peter Murray Jones** (King's College, Cambridge UK)
Show and Tell: A Medieval Operation for Early Modern Surgeons

John Arderne's Practica for fistula in ano (1376) enjoyed a wide circulation in England. He wrote in Latin, but four different Middle English translations of his works were also made. Deviating from the organising conventions of scholastic surgeries, Arderne visualised and described his surgical operation in temporal sequence as if he was providing a how-to descriptive manual for an apprentice surgeon. He included many statements about his own experience in performing operations, and other witness statements of efficacy. Manuscripts of Arderne's writings were heavily illustrated within or alongside the text-block, reinforcing the textual bias towards visualisation and personal witness. After 1500 Arderne's Practica retained its popularity both in Latin and English. This happened despite his 'barbarous' Latin style, and the evolution of the English language. Manuscripts of Arderne copied in the sixteenth century were commissioned or owned by practising surgeons and medics, rather than by university teachers or scholars. This paper will investigate surviving English manuscripts of John Arderne's Practica made in the sixteenth and seventeenth centuries. It will also consider the single printing (1588) of Arderne's Practica, edited by the barber surgeon John Read. Particular attention will be devoted to one manuscript owned c.1645-8 by the ship's surgeon Walter Hamond, held now in the library of the Royal College of Surgeons in Ireland. This is a fifteenth century Latin copy, but it was interleaved by Walter Hamond with his own observations written in English. Hamond reflected on the continued usefulness of Arderne's surgical techniques and recipes, suggested some improvements, and also commented on the financial charges Arderne made for his services and their contemporary equivalents.

2 - **Annemarie Kinzelbach** (German Museum for the History of Medicine, Ingolstadt, Germany)
Transforming Skills: Two Early Modern Manuscripts and Surgery of Hernia in Early Modern Imperial cities

In my paper I am analysing two connected yet diverse illustrated manuscript sources focusing hernia surgery. The earlier source documented the technics for colleagues, whereas the latter shows performed practice for a still to be determined public. In 1559 in Lindau the surgeon Caspar Stromayr sent a copiously illustrated manuscript to his colleague in Zurich. Stromayr explained the various forms of hernia and described in detail (word and pictures) the specific surgical procedures applied. Before and after his lifetime generations of this family practiced such specific 'art' of surgery in public offices in several imperial cities (Lindau, Überlingen, Nördlingen, Augsburg), the most successful in Augsburg, where they also were employed by the counts Fugger. I suggest that Stromayr's materialised exploration of skills is complementary to the left side of another richly illustrated manuscript in the German Museum for the History of Medicine. For this our DFG-project detected close links to the "Schneidhaus" (cutting house) of the Fugger in Augsburg, an early modern hospital specialised in surgery of hernia and bladderstones. Primarily, the texts on the left sides in this manuscript generate questions. Each one of nineteen pages documents between 28 and 20 performed cures. The texts seem to provide some form of case-history for hernia-surgery. However, what, exactly, was here made material evidence, and for whom? What were these about 460 cases supposed to represent? Why does this record state the names of individual patients, their age, their origin, but never gives dates? Why needed registration of performed surgical practice to be adorned by vignettes? Assisted by account-books documenting several thousand such surgical cures, this paper is supposed to answer these questions. Moreover, the complementary manuscripts as materialised evidence of specialised surgery will help to understand in which way a transfer of manual practices into picture and text on paper contributed to the field of surgical knowledge and representation.

3 - **Silvia De Renzi** (Open University, UK)

Teaching surgery in seventeenth-century Rome: Books, bodies and Guglielmo Riva's printed pictures

Early modern surgeons developed a visual repertoire that, mixing the ordinary and the extraordinary, reflected the complex status of surgery itself. Seventeenth-century printed collections of surgical observations, such as by the German Hildanus and the Dutchman Blasius, include depictions of tumours, growths and rarer phenomena that disfigured bodies but galvanized professional pride. Alongside these were illustrations of the ordinary tools and techniques that since the early sixteenth century had instructed readers of surgical textbooks. This visual tradition is central to the recent reassessment of the place of surgery in early modern medicine, but how images were deployed in the diverse settings of surgical education remains an open question. This paper examines the nexus between the visual language and the uses of an almost textless set of printed pictures associated with Guglielmo Riva, a surgeon with a medical degree and strong anatomical interests who taught surgery in a major hospital of Rome. This striking and today virtually unknown collection exists in at least four copies in European libraries, confirming wide-spread interest in Riva and that this work circulated as a whole. The 37 plates vary by layout, conventions and topics; I focus on the largest group which represent common surgical conditions arranged in grids. While some panels share familiar iconographies, others do not. I analyze their visual strategies to claim that they were didactic props. Their precise function however is puzzling, and I suggest that they supplemented textbooks and the experience of real bodies in hospital pedagogy.

Room 11: **S70 - Material Transformations: Chemical Knowledge and the Production of European Porcelain, c. 1708-1820**

Conveners: **Gabriella Szalay** (Harvard Art Museums, USA), **Suzanne Marchand** (Louisiana State University, USA)

Although Europeans had been aware of porcelain since the fourteenth century, it would take nearly four more centuries before they would arrive at the correct formula for making this special kind of ceramic body, whose pristine white color and thermal-resistant properties had made it a 2 more highly prized commodity than gold. In this panel, we will highlight the pivotal role of chemical knowledge in both the foundation and operation of European porcelain manufactories, beginning in the eighteenth and extending through to the nineteenth centuries. Here the term chemical knowledge is understood to describe a variety of actions and capabilities, including but not limited to the ability to determine the properties and suitability of local clays for making porcelain and familiarity with metal ores that when mixed with the proper agents could be used to color high-firing materials. As each of the author included in this panel argue, chemical knowledge much like porcelain itself was in a state of flux during the period under investigation. At the advent of European porcelain production, it rested in the hands of artisans, who operated on a largely trial-and-error basis and freely borrowed from other material traditions. By the early decades of the nineteenth century, it had been codified and placed under the watchful eye of university-trained chemists moonlighting as state administrators. How this shift affected the visual, material and sensory culture of European porcelain is a question that will be addressed with reference to color recipes used at the famed Meissen manufactory, stylistic and technical intersections between the textile and porcelain industries, and the division of labor among the actors that were responsible for making porcelain, both literally and figuratively.

Chair: **Suzanne Marchand** (Louisiana State University, USA)

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1 - **Nicholas Zumbulyadis** (Independent Scholar, USA)

The Role of Archival Recipes in Interpreting the Chemistry of Early Meissen Enamels

In this presentation, I will examine the thesis that studies in the history of chemistry can contribute to a deeper understanding of issues in cultural heritage science and art history (and vice versa). The point will be exemplified by a discussion of my recent work involving the transcription of complete chapters from Johann Gregorius Höroldt's handwritten book of recipes for various enamel colours in use at the Meissen Porcelain Manufactory, a document composed in 1731. Already transcribed are the texts for the Böttger lustre (1) as well as three recipes for iron red, for the purification of cobalt blue and for the preparation of the so-called "good Black." Parsing out the transcribed recipes can be used to interpret the composition of the various enamel colours on Meissen porcelain from 1720-1740 obtained from XRF data (2). Besides aiding the interpretation of spectroscopic data, this work also points at Höroldt's deep intuitive grasp of chemistry. As I will show, the documents by Höroldt, and also David Köhler before him (ca. 1720) anticipated aspects of cobalt chemistry that were not treated in the open scientific literature of the time until 50-80 years later, such as Abich's preparation of pure cobalt carbonate (Koboldkalk, see Crell's Chemische Annalen 1784) and Thénard's preparation of cobalt aluminium spinel (Journal des Mines 1802). It is thus seen that observations from art history and archaeometry can in turn feedback into the history of chemistry

References:
1. N. Zumbulyadis, *„…und thuet einen Graußamen Knal": Ein Beitrag zur Technikgeschichte des Böttgerlüsters*, Keramos, 222, 3-16 (2013). 2. N. Zumbulyadis and V. Van Thienen, *Changes in the Body, Glaze and Enamel Compositions of early Meissen Porcelain, 1723-c.1740,* Archaeometry 62, 22–41 (2020).

2 - **Gabriella Szalay** (Harvard Art Museums, USA)

Patterns and Dyes: Textiles and European Porcelain Production in the Long Eighteenth-Century

It is well known that the artisans who worked in Europe's earliest porcelain manufactories turned to graphic sources for inspiration. They combed printed books for woodcuts of flora and fauna that could easily be translated onto dessert services and used reproductive engravings of popular paintings as designs for figural groups. What is less well known is that the same individuals incorporated a host of other material traditions into their work, most notably textiles. In this paper, I will examine the various intersections that developed between the textile and porcelain industries in Europe over the course of the long eighteenth century. I will begin with a consideration of how samples of the latest dyes and weaves were collected and stored at porcelain manufactories with a view towards providing artisans with a repertoire of colors and patterns that could be incorporated into the decoration of figurines. I will then turn to a more pointed discussion of how certain techniques used in the production of textiles, such as the application of mordants to help bind colors to the fibers of the fabric in question, were adapted by the makers of porcelain, as they searched for innovative solutions to the high firing temperatures required by their material of choice. In my conclusion, I will discuss some of individuals that helped to facilitate this transfer of technical knowledge, particularly the chemists, whose expertise was being simultaneously sought at both kinds of manufactories. Proverbial "go-betweens" they helped to interweave the seemingly disparate, but in fact closely related worlds of textile and porcelain production.

3 - **Suzanne Marchand** (Louisiana State University, USA)

Chemists and the Origins of Mass Production in the Porcelain Industry

As the other papers for this session demonstrate, chemistry has always been critical to the operation of a successful porcelain manufactory. In the eighteenth century, artisanal chemists were the ones who developed and owned (as a trade secret) the Arcanum, the recipe for making and firing hardpaste white porcelain. As every locality was blessed with slightly different clay, water, and mineral resources, and as competition made the development of new glazes and pastes mandatory, an 'arcanist' had to be

maintained on staff, at a very high salary; many were the actual or defacto managers of the factories themselves, but master painters and modelers, too, commanded similar respect and salaries. By the 1820s, however, this rough balance of power between the artistic and scientific sides of porcelain making had collapsed, as the manufactories' ministerial minders forced down the wages of the artists, and increasingly chose universitytrained chemists to head the manufactories. Evidently they had concluded—rightly—that the chemists were more likely to share their focus on efficiency and sales than the artists, who overvalued their own tastes and creative powers. It would be chemists, not artists, who would steer the manufactories as they entered the age of mass production. This paper, drawn from the author's book-length treatment of the history of the porcelain industry in Central Europe (due to be published in June 2020), traces the changing function of chemistry in this important semi-luxury industry in the years between about 1710 and 1850. By focusing on developments in this semi-luxury industry, it illuminates relations between science, the decorative arts, and the state in the little-studied early years of German industrialization.

Pause from 16.45 to 17.00

Wednesday 2 September 17.00 - 18.30

Round Table

The Digital Life of Objects and Images: Challenges and Perspectives for the History of Science

Due to the current pandemic scholars and museum curators have been forced to spend a significant amount of time on-line to do research, teach, disseminate, communicate with each other, attend seminars, consult digital resources. Since museums, archives, and libraries are closed, and the teaching is online, we had to deal with a new digital space of knowledge. The digitization of records for objects and documentary data is not new. Indeed, it's been a while since we began using digital resources and institutions have started to digitize their collections of objects, books, and archival documents. But there is no doubt that the move towards the digital space accelerated in the last few months, forcing scholars and institutions to question the theoretical challenges and implications of these new circumstances. We invited six scholars and museum people to discuss ongoing digital projects and future perspectives for our community.

Chaired by **Elena Canadelli** (University of Padua), with **Jessica Bradford** (Science Museum, London), **Paolo Galluzzi** (Museo Galileo, Florence), **Massimo Mazzotti** (University of California, Berkeley), **Francis Neary** (Darwin Correspondence Project, Cambridge), **Laura Ronzon** (Museo Nazionale Scienza e Tecnologia "Leonardo da Vinci", Milan), **Dagmar Schäfer** (Max-Planck-Institute for the History of Science, Berlin).

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Thursday 3 September, 9.00 - 11.00

Room 1: ~~S60 - Visualizing Races. Practices, tools and objects in the depiction of human diversity since the late 19th Century~~ [CANCELLED]

Convener: **Luc Berlivet** (French National Centre for Scientific Research - CNRS France), **Francesco Cassata** (University of Genoa, Italy)

One hardly needs to stress the role played by visuals in the objectification and classification of human groups into races. The expansion and popularization of photography were contemporary with the institutionalisation of anthropology, and it is therefore not surprising that photographs swiftly found their way to scientific publications. Both art historians and historians of science have shed important light on the standardization of photographic practice by prominent anthropologists such as Rudolf Martin, as well as the manifold uses of racial photography as evidence. However, photographic portraiture was only one among the many visualisation techniques put forth by scholars in their attempts to explore human diversity and, all too often, draw racial boundaries. Although painting almost disappeared from scientific publications, drawing remained a way for the more talented to document encounters in the field. Despite its practical difficulties, plaster casting was favoured by some anthropologists for its ability to capture facial traits in a most realistic way. Then, one also needs to take into account the different kinds of diagrams and related visual techniques used by scholars to draw alleged genealogical links between human populations. The session pursues three interrelated aims. First, to explore the complexities attached to the parallel, joint, or competing uses of all these different visual tools by "racial researchers" since the late 19th C. Second, to analyse the complex interplay between visual objects and statistical, analytical data in scientific practice, including publication strategies. Third, and finally, to shed light on the material aspects of visualisation, which go far beyond the sole practical and technological dimensions of the various visual tools to encompass the techniques and infrastructures necessary to the classification, archival, conservation, publication, etc., of the different visual objects.

1 - **Francesco Cassata** (University of Genoa, Italy), ***Dante's Bones. From phrenology to forensic anthropology (1865-2009)***

This presentation examines the anthropological studies of Dante's bones, from 1865 to 2009. It is articulated into three parts, related to three different waves of scientific interest in Dante's remains. The first part explores the 1865 anthropological investigation, carried out by the doctors Giovanni Puglioli and Claudio Bertozzi. The focus of this study was the phrenological analysis of the brain as well as the search for correspondence between the surface morphology of the skull and images in art. The second part shows how fascist Italy transformed Dante into an icon of the "Mediterranean race" against Nazi attempts to "arianyze" the poet of The Divine Comedy. Central figure in this process was Fabio Frassetto, head of the Institute of Anthropology at the University of Bologna. In his researches (1923, 1933, 1938), Frassetto combined photographic reproductions of art with line drawings of Dante's skull in order to verify the scientific objectivity of Dante's iconography. Furthermore, he used his data to model the "true" bust of Dante, a sculpture supporting his claim that Dante epitomized the "Mediterranean type". The third part is dedicated to the reconstruction of Dante's face by virtual modelling and forensic anthropology techniques, carried out between 2006 and 2009, by a multi-disciplinary team from the Universities of Bologna and Pisa. This research corroborated a press campaign

which combined science popularization and public history, repackaging Frassetto's 1920s-1930s data in a new "humanistic", de-racialized framework. The presentation sheds light on two fundamental issues concerning the relationship between anthropology and visual culture in Italy: first, it explores how Dante's icon was racially constructed by shifting from numerical visualizations of the brain to three-dimensional visualizations of the racialized body; second, it analyses how Dante's icon mirrored, from 1865 to 2009, the changing disciplinary status of anthropology, in a constant tension between art and science.

2 - **Luc Berlivet** (French National Centre for Scientific Research - CNRS France), ***Mixed Methods. The Interplay between Visual and Analytical Tools in Interwar Italian Racial Science***

Since the 19th century, the objectification of racial groups has hinged on a series of distinct tools. Some were numeric in nature, such as anthropometrics, and drew on a broad range of descriptors, including height, arm span length, cranial measurements, etc. While others were visual tools, used to capture the physical characteristics of human races and racial admixtures. The increasing part played by photography in anthropology since the 1850s has long attracted the attention of historians. However, other techniques, such as 'plaster casting' (the fabrication of plaster casts on living models), that also dated back to the 19th century, have been less studied. The aim of this presentation is to shed further light both on the joint use of different visual tools, and on the integration of visual and anthropometric data in racial sciences in the interwar period. For that purpose, I draw on a case study, namely a series of scientific investigations undertaken by a tiny group of scientists in the 1930s, under the umbrella of the Italian Committee for the Study of Population Problems. In order to study both the degeneration of different human races and the formation of new races through admixture, the Committee (which had been established in 1928 under the headship of Corrado Gini, the famous statistician and advisor to Benito Mussolini) endeavoured to document as extensively as possible the state of twelve key human populations. Italian scientists and their foreign correspondents drew on a broad range of research techniques including demographic questionnaires, anthropometric measurements, medical examinations, photography and, in some cases at least, plaster casting. Their work therefore provides a unique opportunity to analyse the combined use of both numeric and visual data in the characterisation of human races and their evolution.

3 - **Amir Teicher** (Tel Aviv University, Israel), ***From Visual Perception to Racial Classification: SS Racial Cards and the Nazi re-Shaping of European Population***

Visualization was central to Nazi culture and racial theory. At the same time, the Nazi state relied heavily on anthropometric measurements to determine racial affiliation. In particular, a select group of racial experts from the SS Race and Settlement Main Office (RuSHA) developed methods for diagnosing, according to certain physical markers, one's different racial components. At first, they applied these methods to assess new candidates for the SS and their spouses; later, the same methods were mobilized to sift the population of occupied territories in order to identify Nordic and racially-related blood and ward off alien racial intrusion. Millions of individuals and entire families throughout Europe were either "Germanized", left to toil their lands, or transported to concentration or labor camps in the east, according to their ability to meet the required racial standards and prove their socioeconomic utility. How precisely did the SS racial experts determine one's racial affiliation? What role did the visual impression, resp. anthropometric measurement, of a sorted individual play in determining that person's fate? No satisfactory answer has yet been given to these questions, which were pivotal to the Nazis' mass classification project and fateful for its subjects. In my talk I will reveal preliminary results of my investigation into the classificatory algorithm applied by racial experts, based on a statistical and historical analysis of hundreds of racial cards used by the SS experts to determine racial affiliation. These cards, combined with new archival findings, open a window onto the relation between the experts' 'mental image' of each race, the individual appearances they encountered, and the official racial dogma of the Third Reich, and onto the interaction between racial stereotyping, contemporary ideals of beauty

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and social biases. Their analysis furthermore provides insights into the intricate links between measurement, visualization, perception, facial recognition, and sorting methods.

4 - **Marianne Sommer** (University of Lucerne, Switzerland), ***Tree-Thinking and Tree-Building in Anthropology***

Physical anthropology is inherently a visual science, and in my talk, I focus on the phylogenetic tree. Since Ernst Haeckel's figurative tree that has been inscribed into our cultural memory, the tree structure has conveyed human descent and diversity in a great variety of forms. In interaction with evolutionary tree-building in biology, the technology has also become paradigmatic in other scientific branches such as linguistics. This connection between biology and linguistics consists up to the present in human population genetics. In the second half of the 20th century, genetic, molecular, mathematical and computational tools have been developed to objectively analyse the blood samples collected from all over the world and to visualize the resulting human population history and kinship. Despite the multi-layered and sometimes highly specialized knowledge that informs phylogenetic trees, due to the icon's cultural history, they seem readily understandable. Treebuilding is far from a neutral scientific tool, however; it does not simply make visible natural connections otherwise hidden to the eye. In my talk, I will build on my previous work on visualizations in the history of anthropology and further investigate the formative power of the phylogenetic tree in creating human groups, in linking but also disconnecting and distancing them from each other. What are the assumptions, theories, and narratives that inform seemingly self-evident phylogenetic tress? And what does it mean that the same general structure has been used to convey widely different understandings of human evolution and kinship?

Room 2: T24 - Agriculture and Genetics

Chair: **Ilaria Ampollini** (Università di Trento)

1 - **Matthew Holmes** (University of Cambridge, UK)
A Poultry Affair: Genetics, Graft Hybrids and the Struggle for American Agriculture, 1900-1911

At the dawn of the twentieth century, farmers and breeders in the United States were confronted by competing heredity theories. Biologists such as William Bateson and Charles Davenport were among those to vigorously promote Mendelian genetics in the United States. Yet in 1906 Charles Claude Guthrie, an American physiologist, claimed to have used organ transplantation to create hybrid chickens. Guthrie believed that these "graft hybrids" demonstrated that Mendelian genetics was not a complete explanation of heredity. This paper argues that the public denouncement of Guthrie by leading geneticists was a moment of deliberate scientific theatricality. Mendelians frantically sought to counter Guthrie to preserve their tenuous hold on breeding practices in American agriculture. This paper will examine why Guthrie's hybrids provoked such anxiety among geneticists and why they ultimately failed to transform theories of heredity. In an agricultural context where practical results were prized above coherent heredity theories, the materiality of Guthrie's hybrids posed a serious challenge to the growing supremacy of Mendelian genetics.

2 - **Olga Elina** (Russian Academy of Sciences, Russia)
Modernising Soviet Agriculture: Science, Technology, and Art at the All-Russian Agricultural Exhibition, 1923

In this presentation, I will discuss the relationship between science and visual arts during the organisation of the All-Russian Agricultural, Handicraft and Industrial Exhibition, which took place in

Moscow in August-September 1923. The exhibition was inspired by the ambition of the Bolshevik government to demonstrate the 'Revolutionary achievements' in agricultural science and technologies, as well as the results of cataloguing natural resources. The exhibition's primary goal was to convince the local public, mostly the peasantry, in the urgency of science-based agricultural modernisation. The other target was the global audience: more than 600 foreign companies and institutions were invited to participate as exhibitors and trade partners, thus confirming the intention of the Bolsheviks to renovate agricultural industry. First and foremost, the expositions were focused on innovative technologies in agronomy – from plant breeding and pest control to mechanised farming and husbandry. The second crucial task was to display the environment and biodiversity of Soviet Russia (after December 1922 – of the USSR). These tasks were entrusted to a group of highly esteemed scientists: S.K. Chayanov, A.V. Chayanov, N.I. Vavilov, V.I. Kovalevsky, N.M. Tulaykov and others, and also to numerous artists, sculptors, architects, and litterateurs, such as A.V. Shchusev, I.A. Golosov, K.S. Melnikov, V.I. Mukhina, A.A. Ekster, V.V. Mayakovsky. In particular, I will study teamwork of the ScientificAgronomy department (Sokrat Chayanov) and Construction-and-Art department (chief architect Aleksey Shchusev) in the expertise of scientific core and design of the expositions. 1.5 million visitors, mostly the peasantry, saw the exhibition in two months. Public interest was fueled by a combination of valuable scientific exhibits, on the one hand, and style and decorations of the pavilions, on the other. The exhibition became an essential instrument in the propaganda of the modernised agriculture, and simultaneously the space for avant-garde art experiments in Soviet Russia of the 1920s.

3 - **Sotiris Alexakis & Stathis Arapostathis** (National and Kapodistrian University of Athens, Greece), ***Chemical Politics in the fields and beyond: Knowledge, Experts and the Chemicalization of Agriculture in Greece***

The aim of the paper is to provide a historical reconstruction of the chemicalization of Greek agriculture in the interwar period. We focus on the co-production of knowledge communities, industrial interests and state policies in a period of political turmoil and severe ideological conflicts in the Greek political scene. The study argues that the absence of state fertilizer policy, provided the space to specific scientific networks of agronomists and chemists, mostly associated with the private chemical industry, to shape, promote and configure a specific policy as the dominant national policy. The latter established the use of high-ratio phosphorus fertilizers while concurrently established the dominance of the Hellenic Fertilizers Company in the Greek market. The paper shows that there were alternative technoscientific solutions that were introduced by politically weaker scientific networks. In the 1930s an emerging community of soil scientists questioned the dominant scientific theories and advised practices. The use of nitrogen fertilizers was promoted as a viable alternative based on a different understanding of the physical processes of the interaction of the soil with agrochemicals. This was an approach that would become epistemologically and politically powerful after WWII yet the study shows that it emerged and started nudging the dominant approach since the early 1930s. In order to understand the material politics of the dominance of phosphorous over nitrogen, the paper studies the circulation of knowledge and the role of networks of farmers in the data creation and the social legitimization of epistemic statements that functioned in favor of phosphate fertilization. Corporate and state archives along with scientific journals and popular press have been analyzed. The research is part of a larger research project that studies the role of technoscientific networks in the making of Greek Agriculture until the present day.

4 - **Mike Buttolph** (University College London, UK)
Recruiting cognitive commitment: Mendelism as a thing of beauty

A primitive form of genetics was constructed in the early Twentieth Century from ideas traced to the work of Gregor Mendel forty years earlier. At the outset, the new Mendelism was not beyond doubt; it represented a radical departure from the prevailing paradigm; the experimental evidence that Mendel had published in 1866 was open to challenge (and was contradicted by the results of his own further

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experiments published four years later); and the testing of Mendelian predictions required large-scale breeding experiments continued for several years. Yet over the first ten years, more than 100 individuals each published one or more research papers disclosing a commitment to Mendelism. These early-adopters seem to have perceived sufficient promise in the new theoretical framework to justify the expenditure of their time and other resources to test, modify and extend it. Furthermore, they committed themselves at a point in time when there was only meagre and conflicting evidence that the new theory had significant predictive power. A close reading of the encomia of the first Mendelians discloses that many of them were swayed by another epistemic virtue; they saw Mendelism as beautiful by virtue of its great simplicity. Traditionally epistemic simplicity has played a walk-on role in many classical narratives of theory construction, in decision-within-discovery. But the instantaneous recognition of epistemic fitness in a theory newly-constructed in one's own mind is essentially similar to the recognition of fitness in a theory conceived elsewhere and newly-encountered in a book or a lecture. In that way, epistemic simplicity was a significant factor in recruiting the cognitive commitment of the first Mendelians; and of course it may well have played a role in the reception of other theories.

Room 3: S45 Re-Mediating Science: The material projection of knowledge from 2D to 3D

Convener: **Ion Gabriel Mihailescu** (Federal Polytechnic School of Lausanne, Switzerland), **Simon Dumas Primbault** (EPFL - LHST, France)

Though scholars have only recently started studying the roles of 3D models in the sciences, their work has already produced a rich and diverse understanding of the media and techniques of modelling, and the complex relations between 2D and 3D representations. New lines of inquiry are now dealing with the many materialities of either side of this topological divide as well as to the process of flattening 3D into 2D through various methods of projection. Nonetheless, scant attention has been paid to the converse problem of "material projection" from 2D to 3D and to the material and intellectual operations that govern this process of translating scientific knowledge from one medium to another, that is, of remediating science. In this symposium we aim to explore the asymmetry between the projection of a 3D object onto a 2D surface and the inverse "material" projection. While the various methods employed to project 3D objects onto 2D surfaces have been inextricably connected with mathematical theories, the inverse problem of constructing a 3D object from a 2D drawing has mostly been an "art" rather than a "science". Our concept of "material projections" helps us to shift the focus from the media (and the singular focus on the work with the media, either paper or 3D objects), to the translation and mediation between media.

Chair: **Jérôme Baudry** (Federal Polytechnic School of Lausanne, Switzerland)

1 - **Marie Thébaud-Sorger** (French National Centre for Scientific Research - CNRS, France)
The Flow of Paper: From Instructions to Montgolfières, and Back

This paper explores the challenges faced during the Age of Enlightenment of translating paper instructions on how to build montgolfières into working 3D models. While these instructions borrowed from different fields of theoretical and practical knowledge (geography, geometry, architecture, sculpture) to describe how the spherical shape of a montgolfière could be built by readers, they found few resources for conveying how the motion of the machine was to be created. The upward force which moved the machine was determined by the precise balance between the weight of the materials and the amount of gases enclosed by them. Building such a machine also required a specific know-how for accurately molding materials (by sewing, gluing, varnishing) into a shape that could appropriately react to the surrounding atmosphere. Translating a 2D description into a flying machine required one to

integrate sensitive and physical notions such as temperature and pressure, which then led to the design of other tools (charts of proportion) and cutting-edge solutions for how to deal with strength, elasticity and airtightness of the materials. Following this translation process will highlight that the making of 3D prototypes is a work of "composition" and "assemblage" which entails the convergence of people, disciplines and practical skills. Such activities could take place only if fostered through the collective involvement of mathematicians, chemists, but also craftsmen, architects, and amateurs of all kind. This process of translation initiated a double dynamic: instructions (written or drawn) were used for dozens of small 3D experiments, the latter playing in return an important role in the rationalization of aerostatic techniques, which appeared as a new "art" and as a new field of knowledge from the late eighteenth century onward, and soon after found a place in pedagogical books, dictionaries and treaties.

2 - **Stefano Gulizia** (Polish Academy of Sciences, Poland)

Mechanizing the Kunstkammer: Astronomical automata and the legitimation of early modern knowledge through a translation across media

This paper takes a fresh look at the production and exchange of demonstration models between 1570 and the 1640s, by taking as a reference point the Kunstkammer collections from Central Europe and their scholarly role within the republic of letters. It is not a study of artisanal epistemology in a specific court, nor a mere invitation to discover the anamorphic marvel of these cyberspaces, although both of these elements are present. Rather, the aim is simply to suggest that astronomical automata should be evaluated as a special 'epistemic genre' in the history of science, both as teaching tools and display objects. Three aspects are of particular interest here, and will be treated in turn. First, Tychonic globes and automata operated a translation across different media within the late Renaissance astronomical community; and indeed, they were materially enabled by paper projections. This point is made by the case study of an instrument-maker, Jost Bürgi. Second, they played a significant part in the intellectual communication of astronomy, a feature illustrated by epistolary disturbances in Tycho Brahe's career, the Baltic exchange between Comenius and Hevelius, and renewed attention to a patronage-broker active in a variety of fields, Heinrich Rantzau, the governor for the Danish crown in Schleswig-Holstein. Third, their ability to represent a world-system mechanically foreground persuasion and the kind of ludic mathematical knowledge advocated by Reviel Netz. This final part of my argument invokes Peter Ramus's call for an astronomy without hypotheses and Kepler's appeal to practical geometry in his 1611 treatise on the six-cornered snowflake. By linking automata to 3D models and to such figures as Tycho, Rantzau, Ramus and Kepler, this paper presses on the necessity to study early modern astronomy via a history of communication that emphasizes paper technology and essentially textual phenomena like humor and metaphors.

3 - **Simon Dumas Primbault** (EPFL - LHST, France)

"Transplanting the human mind into inanimate matter": Leibniz's Reckoning Machine Seen from a Media Perspective

Between 1672 and 1694, the German mathematician Gottfried Wilhelm Leibniz (1646-1716) attempted to design a reckoning machine that would be able to perform the four basic arithmetic operations on multiple-digit numbers. Working closely with the French clockmaker Monsieur Ollivier, Leibniz eventually failed at producing a working prototype. This failure is usually attributed either to their time's technology – supposedly not advanced enough to craft Leibniz's wheel –, or to communication problems between the mathematician and the artisan. Yet, the rediscovery of Ollivier's last model in 1879 showed that it needed a different mechanism to work than the one worded and depicted in Leibniz's instructions. Indeed, along his correspondence, Leibniz left a bounteous collection of texts, drawings, and schematics dedicated to the technical specification of his envisioned machine. In his own words, this "arithmetic instrument" aimed at "transferring all the labour of the mind into wheels", thus performing an operation of re-mediation. Following the distinction between the history of technology and the history of mathematics, it could be argued that Leibniz's arithmetic is software while his machine

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would be hardware, that there could exist a lossless translation of information from one support to another – a possibility supported by Leibniz's own metaphysics. However, this leaves wide open a gap between technology and mathematics, as well as between media, that this paper aims at bridging. Can we account for Leibniz's failure by arguing that his way of thinking was so inextricably entwined with paper that it could not be translated into another medium? From the spatial organisation of Leibniz's working papers, to his schematics and drawings, and finally to Ollivier's prototype, I will try and trace the very step-by-step process of re-mediating reckoning into a mechanical device.

4 - **Ion Gabriel Mihailescu** (Federal Polytechnic School of Lausanne, Switzerland)

Casting States of Matter: the construction of thermodynamic 3D-models at the end of the 19th century

Though graphical representations of numbers were widely spread in the mid-19th century, physicists struggled to extend these to the third dimension. Unruly materials, lack of instrumentation and reduced accuracy have generally discouraged the use of three-dimensional models for quantitative rather than just qualitative analysis. This talk will show why thermodynamic models (i.e. three-dimensional representations of the variation of quantities such as pressure, temperature and volume) flourished at the end of the 19th century despite such challenges and drawbacks. While the graphical manipulation of curves on paper was part of formalized disciplinary practices (descriptive geometry, graphical statics etc.) and relied on well-established instruments (autographs, planimeters, drawing instruments), the construction of three-dimensional models was carried out through a bricolage of techniques and informal tinkering. Thermodynamic models could be constructed by joining sections of wood (according to the methods followed in a shipbuilder's modelling-room), or by moulding a plaster-cast. Some physicists, like James Clerk Maxwell, traced curves of equal pressure and temperature by placing the model in the sun light such that "the rays just grazed the surface", or would "spread a film of grease on a sheet of glass and cause the sheet of glass to roll without slipping on the model". While engaging with the challenges and drawbacks encountered in the construction of thermodynamic models, this talk will focus not on the objects, but on the movement between one media to another. It will be shown that the thermodynamic models were neither alternatives nor simple complements to paper diagrams. Instead, their role and value were given by the ease with which one could move from paper to model, and then back to paper.

Room 4**: T7 - Sciences and New Worlds**

Chair: **Luca Tonetti** (University of Bologna, Italy)

1 **- Gianamar Giovannetti-Singh** (University of Cambridge, UK)

Archaeology, Astronomy, or Hermeneutics? The Jesuit China mission and different ways of knowing the deep past in Europe

In 1658, as the Trento-born Jesuit missionary Martino Martini (1614-1661) was making his second journey to China, his "history of the great Empire," Sinicae Historiae Decas Prima, was published in Munich. In this work, just a few pages after reassuring his European readers that "[o]ne can have full faith in Chinese chronology," Martini claimed that through his erudite study of Chinese historical annals he became "convinced that this extreme part of Asia […] was populated before the Flood." Martini's work generated lively debate amongst European scholars of different disciplinary backgrounds over what forms of evidence best established the credibility of distant antiquity. Some, following the approaches of Athanasius Kircher, searched for ancient Chinese material "monuments." Others attempted to figuratively interpret the Yijing, equating its contents to narratives from the Old Testament. However, the most popular method of convincing other Europeans of the verity of ancient

Chinese events was by using records of astronomical observations as an ostensibly culture-independent marker of historical events. By examining these three different methods used between the mid-seventeenth and mid-eighteenth centuries to establish historical facts, and their interactions with one another, this paper re-evaluates what Alexander Statman recently called the "first global turn" of European practices of history. It argues that the supposedly secular nature of Enlightenment world histories such as Voltaire's Essai sur les moeurs et l'esprit des nations (1756) was largely contingent on the outcome of this three-way controversy.

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2 - **Dimitri Bayuk** (Financial University Moscow, Russia)

Imperial Border Visualised, or Cognitive Compensation for the Defeat at Nerchinsk

Peter the Great ascent to the throne was followed by dramatic changes in the whole state. Some of these changes were launched in the previous times, but Petrovian rule and especially the transition of his state from tsardom to empire in 1721 marked a creation of completely new imperial institutes. The installation of an imperial academy of science was one of them. And even though the official opening of the academy took place only after his death, he made essential efforts to bring the project to life. Among first academicians personally invited by the monarch there was an astronomer, Joseph-Nicholas Delisle, who also became the head of the first Russian cartographic bureau. The rise of the astronomy in Russia is usually considered as related to the needs of see navigation, but the connection of the astronomy with the cartography opens a different perspective. Faraway borderline was also among imperial initiatives of Peter the Great. The meeting of Cossacks with Manchu military men in the region of the Amur River eventually resulted into founding of the longest border between two nations in the history of the humankind. It was the border between the Russian Empire of Romanov and the Chinese Empire of Qing, or, somewhat later, between the Soviet Union and the People Republic of China. The history was also long: it lasted from 1689, when first efforts to establish the border were made, to 2005, when all disagreements on its position were ultimately removed. The first diplomatic meeting of official representatives of Kangxi, the first Qing Emperor, with those of Peter the Great took place in the Siberian town of Nerchinsk in 1689. At that time Russia experienced a rapid and noticeable expansion, best studied part of which is generally referred to as "hacking a window to Europe," whereas the Asiatic part of this large-scaled military trend stays so far much less studied. While Russian troops just prepared to annex vast territories of Western Europe, less numerous groups of Cossacks were establishing fortified settlements beyond Lake Baikal. There existed no established borderlines, no administrative governance, and Cossacks themselves could not realize that the rare military troops that attacked their settlements had been somehow related to the Chinese Empire. After the Treaty of Nerchinsk was signed, the trade with China became for Russia much smooth and dynamic. The official relationships had also other positive economic consequences. But overall the mission results were considered at the St. Petersburg court as a major diplomatic defeat. Peter the Great's government who invested into the mission continued the expenditure which included not only further diplomatic efforts, but also scientific exploration of the region and some deep changes of the methodology itself of such an exploration. New relations with members of Catholic missions in Beijing were also a part of the efforts which demanded significant investments. To what extent were those investments economically justified? The answer to the question could not be simple. On the one hand, the expansion of the controlled territory and the conversion of the state to imperial form led to the growth of the economic efficient of the nation. On the other hand, the desire to spread the power over the Amur River region was fed by political rather than economic intentions. The related political intentions had important cognitive implications. The region in question was not only far away from the metropolitan and populated parts of the empire. Its geographic characteristic had been studied neither. The exploration of the region relied upon new

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methods which included map making and other visualization technics. It is here and in this connection that the practice of astronomical observations for cartographical needs came into use.

3 - **Tracy Wietecha** (Leopoldina National Academy of Science, Germany)

German Scientists, their Observationes, and Institutional Ties to the New World in the Seventeenth Century

Most global histories concerned with the knowledge production between the New World and Europe usually focus upon the achievements of the Spaniards and Portuguese. Yet, this production went far beyond the Iberian boundaries in Europe and extended to German surgeons and physicians. One example is Jacobus Lachmund, a German surgeon from Hildesheim, who seems to have traveled in an official capacity to the Americas with the Portuguese. His travel notes, which record his own observations of diseases and indigenous remedies, were published by his son, Friedrich Lachmund in the Miscellanea Curiosa Medico-physica Academiae Naturae Curiosorum of 1673/1674. Historically speaking, it is noteworthy that a German physician travelled to the Americas as early as 1624, which seems to point towards a much earlier date of German global networks than usually ascribed. Systematically speaking, it is indeed not insignificant that the Miscellanea Curiosa titles Lachmund's publication as Observatio. As G. Pomata has shown, observationes emerged as a unique epistemic genre between the 16th and 17th century, became standard medical textbooks at universities fairly quickly, and entertained a quite distinct understanding from medieval Aristotelian views of experientia and medieval medical writings, such as the genre of experimenta. Yet what epistemic values made an observatio different from the medieval medical experimenta? Lachmund's accounts display more shared epistemic values with medieval medical experimenta than distinct ones. My paper thus focuses on the prevalent knowledge networks between the institutions of Mexico, Peru, and Brazil and German physicians in the seventeenth century. It investigates how German physicians made, understood, and received reports of observations of new diseases and medicines from their own travels and other travelers in the New World.

4 - **Inês Gomes & Dulce Freire** (University of Coimbra, Portugal)

Paving the way for integrated research in the history of science and the rural history: seeds and travels between the Iberian Peninsula and the New World

The history of science has been analysing the flows of people, ideas, objects, animals and plants between the New and the Old World from the 1500s onward. The role of naturalists describing a Mundus Novus has been approached and related to new trade routes and the circulation of agricultural and medicinal products. The importance of those naturalists -as well as the one of physicians or 'agronomists'- and their descriptions, collections and detailed drawings, have not so much been taken into account when studying the cultivated seeds and the transformation of the European agriculture since the 16th century. In the context of the ReSEED project -an ERC funded project-, which aims to contribute to bring fresh data to examine agrarian changes in Europe connected with the transcontinental movements of seeds and their local environmental and social impacts, this paper purposes to discuss how travel chronicles, medical or agricultural treatises, floras or naturalist drawings can enlighten the dynamics that links botanic, cultivation and consumption, giving a glimpse of how new seeds have changed the landscapes in the Iberian Peninsula, from the 15th and 16th centuries. Identifying the plants and seed varieties mentioned in those historical sources is the first step to understanding what was cultivated, at a given time, in a given place. However, sources present a number of obstacles to modern researchers' interpretations, including the reliability of the material, issues of translation and classification, and lack of systematization. These wide methodological challenges will also be discussed. This interdisciplinary research wants to dialogue with the recent trends which try to bring history and reveal its relevance at finding solutions to the current challenges of preserving agrobiodiversity and associated landscapes. The history of science has, indeed, a role to play in this sphere.

Room 5: S69 - From Places to Milieus of Knowledge: Toward an Ecology of Savant Practices

Convener: **Paul-Arthur Tortosa** (European University Institute / University of Strasbourg, France)

In this panel bringing together early-career European scholars involved in a collective research project, we will investigate sensorial and material cultures of knowledge by studying milieux of knowledge understood as social milieus and physical environments of situated scientific practice. Historians and scientists alike can only understand these milieux through the study of media such as maps, reports, drawings, objects, etc. Recent developments in media studies emphasized the role played by mediation, conceiving of a medium as what lies in between two alterities and that at once enables and constrains, materializes and shapes our perception, understanding, and manipulation of what there is. Therefore, media cannot be studied out of visual and material cultures of knowledge, considering the fact that their very materiality engages the scientist's lived body, interacting with a fluid object. Moreover, shifting from materiality to materials (Ingold, 2011), we endeavour to account for the ever-changing nature of media and milieux of knowledge. Thus, rather than bluntly taking things as the material, yet passive, repository of human intentionality only, we intend to focus on the never-ending efforts for savants to crystallize things into immutable objects of knowledge – liable to circulate 2 without being altered. This acceptation calls for an ecology of savant practises redefined as the study of the media and the practices of re-enactment that allow for the crystallization of things into objects of knowledge, and of milieus into places of knowledge. Such an ecology of savant practises should be attentive to the meshwork of the becomings of media and milieus, rather than to a network of already given, objects and places of knowledge. At the crossroads of the visual, spatial, practical and material turn, several case-studies will investigate the paradox of science engaging with ever-changing milieus through supposedly immutable media. The use of the concept of milieux of knowledge helps us analysing scientists' attempt to accommodate a home for science.

Chair: **Émilie d'Orgeix** (EPHE - PSL, France)

1 - **Emanuele Giusti** (University of Florence, Italy)

From the Field to the Bookshop: Shaping the Image of Persepolis in the Early Eighteenth Century

At the end of the 17th century, the ruins of Persepolis and Naqsh-e Rostam in Iran were famous throughout Europe. Although almost everybody agreed about their importance for the knowledge of the history of Persia and the ancient world, their historical interpretation was up for discussion. Unsatisfied with the information available, European savants asked for ampler, clearer representations. Three travellers – Jean Chardin (1643–1713), Engelbert Kaempfer (1651–1716) and Cornelis de Bruijn (1652–1727) – accepted the challenge and published illustrated descriptions of the monuments between 1711 and 1712. The authors tried to overcome the difficulties of fieldwork in order to reproduce in print the reality of Persepolis: they used instruments to enhance the senses while observing and measuring the ruins, carried with them modern editions of ancient sources to try and understand their identity and meanings, took notes on their diaries and made sketches on the spot. Once they got back, they reached out for savants, publishers and engravers to discuss their finds and communicate them to the public. The ruins, conceived of as material objects of knowledge, an initially subjective and fluctuant milieu de savoir, underwent a process of crystallization into a fixed and objective lieu de savoir, encapsulated in an illustrated book, throughout a series of material operations and intellectual negotiations undertaken by a set of manifold actors. However, social, material and environmental factors influenced the travellers' observations on the field as well as the transformation of their notes and sketches in books and engravings designed for the public. The travellers' claims to truth – particularly strong in the case of de Bruijn – were put in jeopardy not only by the nature of

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Persepolis as an unstable environment for the development of a historical knowledge, but also by their very efforts to crystallize it through mobile material supports.

2 - **Paul-Arthur Tortosa** (European University Institute / University of Strasbourg, France)
Smelling disease, tasting medication: inspecting military hospitals during the campaign of Italy, 1796-1797

In this paper, looking at reports written during the first campaign of Italy (1796–1797), I will study the sensorial culture of military physicians, showing the importance of taste and smell in their comprehension of their material environment. Most narratives of the first Italian campaigns emphasize the military prowess of a young General: Napoléon Bonaparte. Yet, that victory was not primarily about individual leadership, but rested instead on medical success. Indeed, throughout 18th -century conflicts, microbes killed more soldiers than gunshot wounds. Since eighteenth-century medicine stated that most diseases came from the vicious influence of the environment, hospitals were conceived as therapeutic spaces, that is to say places whose physical settings were meant to cure. The ability to supervise field medicine from Paris constituted the main administrative challenge, since French health officials could not check directly if the new hospitals complied with military laws or indeed followed medical prescriptions. This is why they sent a health inspector to Italy, Pierre Groffier, who wrote long and detailed reports about field hospitals. These reports can be understood as a paper technology aimed at making the hospitals' very materiality controllable by remote observers. They also show how the scientists' concern about the material conditions of their practice was translated into an administrative text that circulates from the war zone to the capital. Indeed, Groffier personally tastes the food served at the hospital as well as its wine for it was considered a medication. He also strictly recounts each hospital's smell for diseases are thought to spread through miasmas as well as smelly exhalations. Finally, Groffier's inspection transcripts are meant to be literary virtual tours. Indeed, if 'medical geography' was popular in the eighteenth century, it did not use maps nor plans. Therefore, military medical culture is paradoxically deeply engaging with senses but radically a-visual.

3 **- Beatrice Falcucci** (University of Florence, Italy)
The Empire of Things. Colonial museums in Fascist Italy

With the rise of Fascism, the consolidation of the Libyan colony, and eventually, the conquest of Ethiopia and the proclamation of the Italian Empire, colonial museums develop in conjunction with other political imperatives. In Mussolini's totalitarian state the colonial collections, displaying raw materials and natural history specimens, as well as ethnographic collections, were part of wider political contexts; they provided comforting ideas of supremacy and control, and through them the Empire came to be understood by people less as something "out there", and instead, it came to have a palpable, material presence all over Italy. Through objects visitors were able to glean information about diverse people's culture and climates, make assumptions about their relative positions in socioevolutionary hierarchies, and justify their own political and economic subjugation of such people. As a precious instrument of propaganda for the fascist regime, the declared type for the Italian colonial museum were the Museum Volkenkunde in Leiden, the Congo Museum in Tervuren, and the Musée d'Ethnographie Trocadero in Paris. Although only one museum in the entire country was indicated as "coloniale", the Museo Coloniale di Roma, over 70 museums disseminated in the Italian Peninsula housed (and are still housing nowadays) colonial collections. A heterogeneous group of colonial collections disperse in the Italian suburbs, and incorporated into natural history museums, army museums, medical museums and so on. The Museo Maria Fioroni in Legnago, the Museo della Guerra in Rovereto, the Museo Etiope Guglielmo Massaia in Frascati, the Museo del Risorgimento di Faenza are only a few examples of museums housing colonial collections, highlighting the pervasive presence of artefacts and specimens from the Italian colonies in the peripheries. The aim of this study, rather than reinforcing the traditional dichotomy between "colonial periphery" and "metropolitan Italy" is to underline the existence of a dialogue between peripheries (of the Empire and of Italy), in which the transmission of knowledge, objects and

materiality between the two is rather intense and powerful, impacting and shaping the colonial consciousness of the Italian people.

4 - **Lea Delmaire** (SciencesPo Doctoral School, France)

A situated home for science: The Istanbul Antituberculosis Training and Demonstration Centre as a milieu

The foundation of the Istanbul Antituberculosis Training and Demonstration Centre by the WHO, the Istanbul Antituberculosis League and the Turkish government in 1951 marks a turning point in both the practices of the fight against tuberculosis and the knowledge of tuberculosis in Turkey. This centre embodies the WHO and Turkish experts' wish for a home for science based on medical practice. The plans of the building demonstrate this intention: it is at the same time a laboratory, a dispensary, an epidemiological centre, a meeting venue, an education and administration centre and a library. Studying how these different floors interplay as different layers in the process of the creation of knowledge sheds light on a paradox that has existed since the beginnings of the centre. Its creators conceive it as a neutral place of knowledge, where universal – meaning Western – medicine can be exercised and taught, and as the heart of the diffusion in the Middle East of a standardized scientific visual culture based on West European productions, both for propaganda and scientific purposes. However, the Centre is entangled in local social, economic and political questions that directly impact the medical work in its materiality: living conditions, accessibility of villages, number of doctors, medical equipment, … differ from most of Western Europe. Considering the centre as a milieu challenges the mainstream narrative of westernization: the Centre is not just a place of 'training and demonstration' but also of scientific knowledge production, where interactions between Western European and Turkish scientists/medical staff and patients are two-way. The influence of this milieu on the subjectivity of the scientists and on the science they produce is often – but not always – dismissed by its very actors, who take for granted they share a universal scientific culture and act in the realm of pure, abstract science.

5 - **Émilie d'Orgeix** (EPHE - PSL, France), commentator

Room 6: **T27 - Geometry and Algebra**

Chair*:* **Karine Chemla** (CNRS / University of Paris, France)

1 - **Benjamin Wilck** (Humboldt University Berlin, Germany)

Hidden Messages in Greek Mathematics: Style and Philosophy in Euclid

By providing the first self-contained study of Euclid's practice of definition in the Elements, I argue that these definitions display philosophical encryptions, marked by syntactic regularities. My argument relies upon a very close reading of all of the definitions given in the Elements. Euclid systematically distinguishes metaphysically different kinds of mathematical object by syntactically different types of definition. Some of the syntactic differences that Euclid applies in formulating his definitions can also be found in pre-Euclidean contexts (especially Aristotle), while some others seem to originate with Euclid. These syntactic markers are visual features in Euclid's text, and they serve as metamathematical markers of his metaphysical commitments. One might ask why there is a metaphysical theory encrypted in Euclid's Elements. It is possible that Euclid, besides being a mathematician, also held philosophical beliefs about definition and the ontology and metaphysics of mathematical objects. It might also be the case that at Euclid's time (shortly after Aristotle), mathematics was not yet fully emancipated from philosophy, so that mathematicians still felt the need to underpin their mathematical practice by reputable philosophical theories. On the other hand, Euclid's Elements is likely to be a compilation

of different pre-Euclidean sources, including the Platonic Academy. This too might explain why there are philosophical layers to the text of the Elements. The safest explanation of the Elements' metaphysical encryptions seems to be that Euclid adopts a traditional standard of formulating definitions that might have originated in philosophical concerns.

2 - **Ladislav Kvasz (**Czech Academy of Sciences, Czech Republic)

On the constitution of algebraic symbolism

Algebraic symbolism is a complex semiotic system containing several symbols, the use of which follows many different syntactic as well as semantic rules. It was created mostly in the XVth, XVIth and XVIIth centuries. Historians of mathematics discriminate between rhetoric, syncopated, and symbolic algebra. In the paper I will analyze in a systematic way various algebraic symbols and will try to reconstruct, how the different symbols came together to form a functioning symbolic system. For that reason I will for particular symbols discriminate: 1. the indicator of its identity; 2. the indicator of its degree; 3. the indicator of its scope. This allows us to follow, how these indicators changed from a verbal form, through a syncopated one to an arithmetical or a symbolic form. For instance we can say that in the Cossist symbolism the unknown lacked an indicator of identity while Viète introduced a symbolic indicator of identity and a verbal indicator of degree. I will further investigate how the different rules that govern the use of the particular symbols depend on the particular (verbal, syncopated, symbolic, or arithmetical) form of the particular indicator. I hope to be able in this way to characterize in an objective way the differences as well as the common features of the various algebraic systems. One of the main focuses of the paper is to try to understand the various rules of Viète's symbolism in order to be able to compare it with the Cartesian notational system.

3 - **Davide Pietrini** (University of Urbino, Italy)

The three-dimensional representation meets the geometrical representation: a new way to divulge the mechanics

Since the dawn of time, the drawing was a valid support to describe and to represent the meaning of the words. But due to the appearance of the moveable type, the drawings assumed a strategic role to transmit the knowledge, in particular in the field of the so-called mixed sciences like architecture and mechanics. The reasons were various. Surely, the most important one was a progressive cultural emancipation of the "intermediate cultural layer", that quickly realised the importance of the printing. This group included architects, merchants, artists and engineers. They, on the hand, were used to assimilate technical data "stealing with their eyes", so the three-dimensional representation of the object was the principal source of knowing; on the other hand, most of them began to esteem the utility of Euclidean geometry, Archimedean science and mechanics of Hero as useful means to plan buildings and machines, therefore the geometrical representation was becoming a new way to support both the text and the three-dimensional representation. In this talk I would like to discuss the use of representations within a fundamental treatise of Sixteenth Century: Mechanicorum Liber by Guidobaldo del Monte. This is an important, and maybe unique, example where the author uses the visual culture belonging to the practical world and the theoretical geometry to illustrate a same object.

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4 - **Alexandru Liciu** (University of Bucharest, Romania)

Robert Hooke's Lectures for Improving Navigation and Astronomy: "practical Geometry", "mechanical Algebra" and the Search for Longitude

In the past decades, there have been a series of attempts to integrate Robert Hooke's interest for mathematical practices in the larger framework of his natural philosophy (Simpson 1989, Bennet 1989, Bertoloni Meli 2006). Thence, in this talk I want to discuss a facet of Hooke's use of mathematics, emphasizing its relationship with a branch of material culture, i.e. the culture practical mathematics in 17th century England. Thus, I will focus on Hooke's involvement in solving practical mathematical puzzles with major natural philosophical impact, such as the problem of longitude. My approach will be twofold. Firstly, I will show that Hooke inscribed himself in the tradition of practical mathematics. In his Lectures for Improving Navigation and Astronomy (Waller 1705), Hooke reviewed several possible ways of solving the issue of longitude, from the "astronomical method" to the "magnetical" one, in the end arguing for a more enigmatic "hodometrical" procedure. What Hooke insists upon is that the "practical navigators" calculating the longitude using rhumb-lines did not achieve the desired degree of precision. My working hypothesis is that Hooke's attempt at devising a more precise method led him towards the reformulation of the domain of practical geometry, thus arguing for the translation of the 'Pythagorick Tetraetys" from the traditional Euclidian geometry in rather radical terms, giving physical dimensions to magnitudes. Secondly, I will show that another enigmatical mixed discipline enters the scene: Hooke proposed a "mechanical Algebra", which should be the "Art of Invention" that will lead to the discovery of longitude. Such a discipline would allow for, for example, "the use of Springs instead of Gravity for the making of a Body vibrate in any Posture", probably a reference to a timekeeper that would work at sea (and will thus be useful for calculating the longitude).

5 - Xiaofei Wang (Chinese Academy of Sciences, China)

With or without diagrams: Geometry in the teaching of Analysis at the Ecole Polytechnique around 1800

The Ecole Polytechnique was established in 1794 to train engineers for the service of the nation. As designed by its founders, especially by Gaspard Monge (1746- 1818), Analysis and its applications were the core of the training for the students of the school. From 1795 to 1809, the course of Analysis of the Ecole Polytechnique took shape, illustrating the essence of the project. However, during this period, both the contents and the ways of teaching Analysis varied depending on the professors. This talk aims to show the place of Geometry in the teaching of Analysis as given by the first institutors of the school, who included Joseph-Louis Lagrange (1736-1813), Gaspard de Prony (1755-1839), Joseph Fourier (1768-1830), Jean-Guillaume Garnier (1766- 1840) and Sylvestre-François Lacroix (1765-1843). Through an investigation into the structures and the nature of the various related materials, from published textbooks to manuscripts, we will examine how and why Geometry was in turn taken and rejected in these texts, as a result of, or for the use of, teaching. The different attitudes of the professors towards the use of diagrams in their teaching reveal that, in spite of a trend towards separatingAnalysis from Geometry, and displaying Geometry as an application of Analysis at the time, Geometry offered as a visual tool appreciated in the illustration of the teaching of Analysis.

Room 7: **S31 - Visualizing the history of knowledge: Methods and epistemic implications of digital humanities' visual techniques**

Conveners: **Roberto Lalli** (Max Planck Institute for the History of Science, Berlin, Germany), **Dirk Wintergrün** (Max Planck Institute for the History of Science, Berlin, Germany)

The last few years have seen an exponential growth of humanities projects based on digital tools. The increasing availability of digitalized historical data as well as of processing power has allowed the emergence of what has been called “the second wave of quantitative history” characterized by the emergence of fields such as historical network research, quantitative micro-history and new approaches to provide longue durée perspectives. The history of knowledge has benefited enormously by the developments in digital humanities, as can been seen by the variety of fascinating projects based on digital methods, from the Darwin Correspondence Project, to the Skillnet project, up to the recent emergence of the field computational history of science. One of the major opportunities as well as challenges offered by new digital humanities approaches is given by new ways to visualize our past and the role of knowledge in it. Network representations, word clouds, statistical graphics, geo-historical mapping, representations of texts, interactive timelines have become increasingly common as tools to explore and understand complex historical processes, as well as synthetic ways to communicate such complexity to a broad audience. By bringing together scholars actively working in the development and employment of cutting-edge digital techniques in the history of knowledge, the symposium provides a venue to present these novel visual tools and discuss their epistemic implications. In presenting the more recent advances and their applications to projects in the history of knowledge, the speakers will discuss the specific roles of these techniques in their historical scrutiny, including the balance between the potentiality of these methods as tool for understanding and the possible risks of misrepresentation.

Chair: **Marieke M. A. Hendriksen** (Royal Netherlands Academy of Arts and Sciences, Netherlands)

1 - **Charles van den Heuvel** (Huygens Institute for the History of the Netherlands, Netherlands)
Of Patterns and Patches: Visualization Methodologies for a Digital History of Knowledge

Peter Burke opened his seminal What is the history of knowledge with the statement: “if the history of knowledge did not already exist, it would be necessary to invent it, especially to place the ‘digital revolution’ into perspective”. Apart from very brief references to “future”, “big” and “deep” historians of knowledge, potentially interested in the cognitive sciences (p. 124), Burke does not problematize what the study of history of knowledge requires in the digital era. Nevertheless, both “big” and “deep” histories (big data, deep maps/networks) are studied with digital methods. This paper explores the questions: 1) what is digital history of knowledge, and 2) what kind of analytical visualization methods and tools do we need to represent result of research in the history of knowledge. Anthony Grafton stated as early as 2007, that the digitization of written records (we include here visual records as well) will result in a “long series of new information ecologies, all of them challenging, in which readers, writers and producers of text (and image) have learned to survive”. These ecologies live in “a patchwork of interfaces and databases.”I’ll argue that a combination of pattern recognition enriched with layered “patches” of information for contextualization might bridge scientific and hermeneutic modes of investigation and be beneficial in the development of a digital history of knowledge.

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2 - **Shih-Pei Chen** (Max Planck Institute for the History of Science, Berlin, Germany**) & Hou Ieong (Brent) Ho (**University College London, UK), ***Visualizing the Knowledge Organization of 4,000 Chinese Local Gazetteers***

The Chinese local gazetteers (difangzhi) is a genre in historical China at least since the 12th century for recording bureaucratic knowledge about localities: cities, prefectures, provinces, and sometimes geographical regions of other importance. Through the 800 years of its development, the local gazetteers maintained a relatively consistent structure that there are roughly 20 to 100 categories persistent in most of the gazetteers across the long period of time and the vast space of China. While there were indeed topdown guidelines issued by the central or provincial governments for editors to follow when compiling local gazetteers, it is not crystal clear for historians of China about how individual editors decided on what to keep, what to add, and what to leave out. In this presentation, we will report our experiment on analyzing the section headings of 4,000 local gazetteers. By employing a bottom-up approach to look at the actual section headings used, it is then possible to see the negotiation process between the center and the locals about what to record in the gazetteers and to understand whether there are general patterns of determining knowledge categories in the gazetteers. In order to visualize the 4,000 gazetteers in a high-dimensional space composed of 12,000 normalized section headings, we used TensorFlow's Embedding Projector, which reduces high-dimensional data to two to three dimensions for easier observation. Our preliminary result shows that there are temporal and geographical patterns in the section headings used, which require closer examinations together with historians.

3 - **Heiner Fangerau, Thorsten Halling & Gerhard Müller** (Heinrich-Heine-University Duesseldorf, Germany), ***SoNAR (IDH) - Interfaces to Data for Historical Social Network Analysis and Research: Reflections on an on-going project***

The analysis of relationships between agents is key to understanding and explaining social phenomena. In historiography a lack of knowledge about the availability of suitable data, but also of relevant analysis technologies are frequently factors restraining the study of past events. In the last decades, cultural heritage organisations have produced an abundance of machine-readable data: (bibliographic and archival) metadata, full text collections, and sets of authority records contain multitudes of implicit and explicit statements about social relations. SoNAR (IDH), Interfaces to Data for Historical Social Network Analysis and Research, will examine and evaluate approaches to build and operate a research technology environment supporting Historical Network Analyses. Project partners from various fields – historiography, information visualization, artificial intelligence, information and computer sciences – work on this topic from their respective perspective. Our contribution will focus on requirements from a research perspective. We will introduce into test research cases, which are the starting point for a reflection on research questions as well as on challenges of both data gathering and the application of social science methods in history. In our project context, we will discuss some latest approaches in the field of Historical Network Research and try to outline causes and benefits of information visualization and network statistics as a mean in historical research. Does, looking at this the other way around, visualization supports the study of the past or is it, at least, a beautiful representation of a textual narrative? We will answer this question referring to the research infrastructure to be established by SoNAR.

4 - **Dirk Wintergrün & Roberto Lalli** (Max Planck Institute for the History of Science, Berlin)
Interpreting complex data in the history of science: visualization and quantification in socio-epistemic networks

"Big data" has recently become an ubiquitous expression in the historical discipline. However, historians have always been dealing with complex, large and unstructured data in their research. Therefore, methods about how to select and structure historical data are under development since long before digital methods could be applied to process big data. Traditionally, visualization has been one of the most employed of these methods. Digital methods extend this approach, especially by introducing interactive elements and by combining quantitative and qualitative elements to dig into historical data by visual means. In some fields, digital methods allow deeper and new insights going beyond older approaches. One of these fields concerns the use of concepts and tools of network theory for historical research. Research in this field explores social relations as well as interchanges of material goods and immaterial objects. Building on this approach we have developed a conceptual and methodological framework called socio-epistemic networks, aimed at exploring the emergence and development of complex interconnected networks in the history of knowledge. In this framework, visualization is a powerful tool to represent the complexity and dynamics of socioepistemic networks. But visualization strategies always involve complexity reduction by the projection of higher dimensional problems onto lower dimensional spaces or by selecting only subsets of the available data. Thus, visualization is always linked to analysts' interpretation. To overcome these issues, one of us (DW) built interactive tools that brings together quantitative and qualitative data to explore complex networks. These tools aim at opening up the possibility to check interpretations based on visualization by easily going back to the original data. In our talk we will show how this has been realized in two case studies. The talk will focus on how to organize an interdisciplinary research process for quantitative data analysis in the history of science and present some of the new insights that were found in this process.

Room 8: **S91 From technical practice to the visual representation of the features of the Earth: travels, tools, fieldwork - 1**

Sponsored by INHIGEO - IUGS / IUHPST International Commission on the History of Geological Sciences

Conveners: **Maria Faccioli** (University of Insubria, Italy), **Claudia Principe** (Italian National Research Council - CNR, Italy)

Chair: **Ezio Vaccari** (University of Insubria, Italy)

Geological research is characterized by a dual study approach: on one hand, field work is needed, on the other, the data collected in this first phase of practical research must necessarily be treated and analyzed and then translated on a theoretical level. Starting from these premises, cognitive progress in modern history of geology has been possible thanks to the fieldwork practices and the improvement of specific tools and instruments adopted by the new geo-scientific disciplines, also thanks to the development of the techniques for exploiting the underground (mining, quarrying, collecting) and for representing the features of the Earth's surface (drawing, cartography, photograpy, modeling). As geology can be considered one of the sciences whose results are often and necessarily expressed in graphic form, the contributions of this session aim to show how the development of various techniques connected to geological research has produced more refined forms of knowledge and representation of the Earth and

its features, from a merely graphic but especially from the conceptual point of view. In particular, the session will be focused on the evolution of the forms of representation in stratigraphy, geomorphology, volcanology, geological cartography, as well as on the important role of mineralogical and petrographic samples collected in the field and then assembled in considerable collection or used as building stones of historical value.

1 - Maria Faccioli (University of Insubria, Italy)
The evolution of the representations of the Earth: some examples of graphic forms of stratigraphic column in the eighteenth century

The stratigraphic columns and sections are indispensable tools for the geological representation of the nature of a portion of soil and subsoil. The birth and the development of this particular visual language went through several phases since the eighteenth century. In 1669 Nicolaus Steno in his De solido showed a diagrams composed of six sequential figures, that illustrated, for the first time, the core stratigraphic principles of original horizontality and superposition. Later, William Smith was credited as the "father of stratigraphy", because he produced - in 1815 - probably the first modern geological map, showing rock strata in England and Wales. However, the first ideas that would have led to this result were produced already in the eighteenth century. One of the the most significant contribution was proposed, for example, by Antoine Lavoisier: in the Atlas Minéralogique de la France - published in 1780 by his collaborator Jean-Étienne Guettard - Lavoisier showed alongside of the mineralogical maps some lithostratigraphic sections of quarries and mines, as well as mountains. In Italy a very important contribution for the history of stratigraphy came from Giovanni Arduino: one of his drawings, depicting the Pesciara of Bolca in 1740, can be considered one of the first geological sketches made for scientific analysis purposes. The study of the area around the city of Verona, very relevant for its geological features, allowed also a little known scholar such as the cleric Gregorio Piccoli - to contribute to the visual history of stratigraphy through interaction with the stonemasons in the limestone quarries, in order to elaborate the "peculiar" graphic form of an early stratigraphic column. The purpose of this paper is to highlight some of the most relevant stages that led to modern methods of graphical representation of geological nature, such as terrestrial layers and sections.

2 - **Daniele Musumeci** (University of Catania, Italy)**, Stefano Branca** (INGV Catania, Italy), **Luigi Ingaliso** (University of Catania, Italy), ***The history of volcanology in Catania in the twentieth century***

The history of volcanology in Catania in the twentieth century is marked by two figures: Gaetano Ponte (1876-1955) and Alfred Rittmann (1893-1980). The first, born in Palagonia (Catania, Sicily), followed most of the eruptions of Etna in the first half of the 1900s, until his death. As the first professor of Volcanology of the Royal University of Catania (1919), he devoted himself mainly to the observational-descriptive study of eruptions and their explanation. Thanks to his managerial skills he undertook the reconstruction of the Etnean Observatory on Etna and established the Volcanology Institute of the Royal University of Catania in 1933. After Ponte's death, the Swiss Alfred Rittmann, president of the Association International de Vulcanologie and innovative geoscientist famous all over the world, was called to the direction of this Institute in 1958. His arrival in Catania marked the transition to a multidisciplinary approach to volcanology and related disciplines; the monitoring of Sicilian volcanoes was consequently conducted with the establishment, in 1960, of an international volcanological and geophysical research institute, still active today. It is possible to follow the development of theories and monitoring of Etna from Ponte to Rittmann through their drawings on the volcano's activities, the description of dykes and conduits, the schemes on the evolution of eruptive phenomena to explain the eruptions and the detailed maps they compiled.

3 **- Maddalena Napolitani** (ENS Paris, France)

Visual representations of graphite's exploitation: JeanPierre Alibert's (1844-1857) Siberian expedition between art and science

In 1844, Jean Pierre Alibert (Montauban 1820- Paris 1905), a fur dealer with close ties to the imperial court in Saint Petersburg, is charged by Tsar Nicholas I to make an inventory of the Siberian mineral deposits. Alibert thus becomes the head of the expedition that will discover, in 1847, a deposit of graphite near the Mount Botogol. With the help of the locals he builds up a mine that is remarkable in several ways: it immediately has great economic success in Europe, exploits the largest known deposit of graphite on the continent, and provides particularly progressive working conditions for the time. Alibert, himself not an expert on mining nor a geologist, was accompanied in his expedition by artists, who painted a watercolor album relating the trip, the characteristics of the mining site and the landscapes. Considering the lack of written sources, this album should be considered as the most important one related to the expedition and its results. Upon his return, Alibert exposed the album during several Great Exhibitions, alongside with samples of graphite that he had sculpted into "trophies" in Saint Petersburg. These highly complex sculptures, awarded in such occasions, aimed to present Alibert's mining activity in a concrete and immediate way. The aim of this study is to highlight the tight link between fine arts and technological and scientific aspects of a geological expedition, since its results are finally and mostly presented trough their visual representations, and entrusted to fine arts.

4 - **Francesca Gambino** (University of Turin, Italy), Alessandro Borghi, Anna d'Atri, Luca Martire, Marco Giardino, Luigi Perotti & Mauro Palomba, ***Tourinstone: the application of the geo-history of Torino (NW Italy)***

The chain of the Piemonte Alps surrounding the city of Torino (Piemonte Region, NW Italy) encompasses a rich variety of geo-tectonic settings resulting from a long and complex geologic evolution. These mountains provided a wide variety of ornamental stones used in the city, over the centuries, for both esthetic and structural reasons. In fact, stone has strongly characterized the architectural identity of the city of Torino with more than 100 varieties. It is a significant richness at the national level. The materials used for the facades, statues and even for pavements represents a historic and geological heritage important to preserve and enhance. The links between construction stone materials, their geographical provenance, geological origin, physical and chemical properties, superficial finishing, the architecture and the history of a city or a region, are very interesting topics that need to be highlighted. Geology and Conservation Science cross all these aspects and can be therefore useful for educate people about the architectural "geo-heritage", and its tangible and intangible value. Tourinstone is an application for mobile phones that allows geotourists to walk in the centre of Torino, where the visitor can find Alpine rocks used in palaces and historical monuments as witnesses and concrete symbols of the city. In this app the visual communication is essential; through the macroscopic images of the rocks it is possible recognize the stones in the architecture context. Cartography is another important aspect because the geological maps allow to the localization of quarries. In fact, the ornamental stones used in Turin comes from historical quarries and were exploited with different historical mining techniques. Free download of the mobile application is provided by the Apple Store or Google Play websites, respectively for Apple and Android devices.

Room 9: **T30 - Psychology and Epistemology**

Chair: **Luigi Traetta** (University of Foggia, Italy)

1 **- Leonardo Capanni** (University of Parma, Italy)

The two senses of synesthesia: An exploration in midnineteenth century France

Despite the many controversies that persist in contemporary debate, scholarly opinion is pretty consistent that we must trace back the scientific and cultural origins of synesthesia (the involuntary, automatic, and nearly permanent association between different sensory or cognitive-sensory streams) to the last two decades of the 19th century. Good reasons have been provided to support this view, but the historical picture stills remains incomplete, and often a bit vague. France, for example, has undoubtedly played a key role in the matter, but references are frequently restricted to the line connecting Baudelaire's and Rimbaud's work: the theory of correspondances of the former (written in the late 1850s) to the Voyelles sonnet of the latter, which started all the attraction for "coloured letters" (Ghil), "visual music" (Favre), "scented theatre" (Roinard) and so on, in the 1880s and beyond. In my contribution, I would like to draw attention on the medical background that connects these two periods. The late 1860s and 1870s in particular, when physiologists like Alfred Vulpian, Mathias Duval, Charles Richet, etc. used to talk of synesthesia in a slightly different sense, as a "reflex of pain" shifting from its original site to another; or alienist like Prosper Despine regarded it as a form of hyperesthesia underlying the phenomena of somnambulism. These first attempts to explain "synesthesia" – usually in terms of nervous irradiation – are also of great interest to understand the subsequent controversies over its description as an exceptional (degenerative) or a widespread (in some cases visionary) manifestation.

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2 - **Anna Dadaian** (University College, UK)

Jung's Psychological Types and the 'Visual'

In this paper, I am going to explore the role of 'visual' and 'sensory' approaches in Carl Gustav Jung's psychology by looking at his theory of psychological types as outlined in his book titled Psychological Types (Psychologische Typen), originally published in 1921. I am going to look at Jung's theory of psychological types as a psychological meta-epistemological theory – a theory that attempts to explain how people arrive at particular epistemological positions through psychology. From the perspective of Jung's writings in Psychological Types, the history of human thought, philosophy and science (the 'scientific method') itself are seen to supervene on particular psychological attitudes. The 'visual' and the 'sensory' approaches, then, can be seen as representations of particular psychological attitudes as well. In particular, two of Jung's psychological functions—sensation and intuition—are especially interesting to look at in this context. According to Jung's theory, sensation and intuition are two kinds of perception and are seen as irrational (as opposed to feeling and thinking that are rational). Sensation is 'that psychological function which transmits a physical stimulus to perception' and 'is, therefore, identical with perception' (Jung 1923:585). Intuition, on the other hand, 'is that psychological function which transmits perception in an unconscious way', and hence can be described as unconscious perception (ibid.:568). In addition to this, sensation and intuition can be both extraverted and introverted, resulting in four distinct psychological types, and hence, distinct meta-epistemological attitudes: extraverted sensation, introverted sensation, extraverted intuition and introverted intuition. Finally, in this paper I am going to look at a broader concept of 'images' that forms a key element of

Jung's ontology in his Psychological Types and, hence, show how Jung himself utilised the idea of the 'visual' to conceptualise his theory of psychological types more generally.

3 - **Winifred E. Newman** (Clemson University, USA)

The Neuroscience of Beauty and Gorillas

In his 1923 Kunstgeschichtliche Grundbegriffe (Principles of Art History) German art historian Heinrich Wölfflin introduces an idea of the perception of beauty he calls 'imaginative beholding' (Anschauung) where he focuses on the imaginative capacity of an embodied observer. For Wölfflin, the art historian determines style in relation to characteristics of beauty only after considering the basis of the ode of imaginative processes before him or her in each individual case: "It goes without saying that the mode of imaginative beholding is no outward thing, but is also of decisive importance for the content of the imagination, and so far the history of these concepts also belongs to the history of mind." Almost a hundred years later, neuroscientists Semir Zeki and Tomohiro Ishizu approach the same question concerning the neural properties of beauty in their now seminal article, Toward a Theory of Beauty. A group of 21 subjects listened to music or looked at a series of paintings while their brains were scanned using functional magnetic resonance imaging (fMRI). Seki and Ishizu conclude "as far as activity in the brain is concerned, there is a faculty of beauty that is not dependent on the modality through which it is conveyed but which can be activated by at least two sources–musical and visual...that has led us to formulate a brainbased theory of beauty." Their arguments echo art historians like Wöfflin, his teacher Johannes Volkelt, and others. But rather than 'imagination' the mechanics of brain-based perceptions of beauty are for them biological. This paper looks at the brief pre-history of the history of beauty in 19th century psychology and philosophy compared to contemporary analogues in neuroscience and neuroaesthetics and asks –what are the terms of a neuroscience of beauty?

4 - **Dana Jalobeanu** (University of Bucharest, Romania)

Emblems as magic tools and heuristic devices: Bruno, Bacon and Culianu. An exercise on perspectival contextualism

The general purpose of my project is to invite reflection on the benefits of alternative historiographic frameworks when dealing with questions regarding how to read, interpret and contextualize early modern texts. I begin by reconstructing a problem regarding the heuristic use of emblems in early modern science. I will start by asking some questions, such as: Why did early modern philosopheres used such a vivid imagery to talk about discovery? Why did they appeal to the language of the ancient fables to discuss matters pertaining mainly to epistemology? What functions did they attribute to the poetic images they used? I will then show how this problem is currently posed in the secondary literature and what are the benefits of looking at it from another angle. For this exercise I will make use of an interesting, under-discussed (albeit quite popular) book, Ioan Petru Culianu's Eros and magic in the Renaissance. I show that Culianu's non-linear narrative of the Renaissance can provide an alternative historiographic framework with can help seeing my problem in a different light. I also show that we can use this alternative historiographic framework to contextualize in a different way two early modern sets of texts which were, so far, never treated together: Francis Bacon's reflections on the arts of discovery and Giordano Bruno's phantasmatic magic (as displayed in the Italian dialogues). More generally, my demonstration will argue for the benefits of what I tend to call "perspectival contextualism." Perspectival contextualism is an attitude of methodological tolerance which allows the reader to shift between different historiographic frameworks, an exercise which, I claim, discloses interesting novel possibilities of reading and interpreting texts in new contexts.

5 - **Havelok Symes** (Independent Scholar, UK)

Cartesian Dualism: Kepler, Pauli and the Epistemological Break

Between 1932 and 1958 psychoanalyst C.G Jung and physicist Wolfgang Pauli corresponded at length. What started as a relation between patient and doctor soon turned into a collaboration that culminated in the publication of The Interpretation of Nature and the Psyche in 1952. Pauli's main contribution, the essay 'The Influence of Archetypal ideas on the Scientific Theories of Kepler' explored an archetypal basis for scientific expression by contrasting the approaches of Johannes Kepler (1571-1630) and Robert Fludd (1574-1637). These two historical figures seem irreconcilable, the former a representative of Enlightenment rationality, the later a proponent of magical thinking. But Pauli frames their discourse in relation to the divide between the self and the world of investigation. He came to view Kepler's adoption of the Copernican model as an archetypal mode of expression linked to his desire to represent the Trinity. Thus, Kepler's celestial model also represents a powerful visualisation of his psychological worldview, a mandala which expressed his notion of cosmic harmony. Crucially for Pauli, Kepler's mandala lacked a symbol for time. By treating space and time separately Kepler's world view is static, indicative of the shift in agency from object to the subject which took place during the scientific revolution. Scholarship on Jung and Pauli's collaboration has largely focused on its importance for the history of quantum mechanics and psychology while Pauli's study of Kepler has been neglected. This paper utilises the text to explore the history of sensory approaches to scientific objects through an investigation of the line which divides subject from object. It argues that through a deeper reading of this text we are able to understand the origins and developments of the epistemic attitudes towards visual, material and sensory cultures which were established during the Enlightenment.

Room 10: T15 - Scientific Communication

Chair: **Francesco Paolo De Ceglia** (University of Bari, Italy)

1 - **Hugo Silveira Pereira** (Nova University of Lisbon & University of Évora, Portugal)

"Progress" and the illustrated press in Portugal (1878-1914)

From 1850 onwards, Portugal began in its mainland and colonial territories an ambitious modernising programme based on technoscientific grounds, including the construction of railways, harbours, and different public buildings, the acquisition of locomotives and weaponry, and the participation in international exhibitions. From the late 1870s onwards, this programme was advertised in O Occidente, an illustrated journal that published several drawings of original photographs. In the beginning of the twentieth century, with the development of the halftone, the publication of photos became possible. Newspapers like O Occidente and Illustração Portugueza became famous for their profuse use of photography. In this paper, I analyse the imagery of science, technology, engineering, and medicine based on pictures published in Occidente and Illustração Portuguesa. I argue that by printing engravings or copies of original photos, those periodicals borrowed some of the alleged objectivity attributed to photography and increased its trustworthiness amongst its readers (Martin, 2006: 43-44). Contrariwise, photography was a profoundly subjective activity that concealed an opaque mechanism of representation (Mitchell, 1986: 2). By using a methodology that combines semiotics with photojournalistic analysis (Benetti, 2007: 112-113). I claim that these pictorial practices brought together Portuguese readers as members of a group (Beegan, 2008: 21-24) sharing a common image of Portugal as a modern, technoscientific and imperial nation.

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2 - **Evgeniya A. Dolgova** (Russian State University for the Humanities, Russia)

From cultural to popular science films: popularization practices of scientific knowledge in the 1920-1930s

The Soviet cultural films accounted for a specific popularization practice of scientific knowledge in the 1920-1930s. This type of film further developed in the genre of popular-science films. On the one hand, their appearance was aligned with the world cinema trends and, on the other hand, gained relevance and significance in the context of the Soviet reality. Cultural films became a point of interaction between the authorities and the scientific community in solving social problems of the post-revolutionary years. The first films were dedicated to medicine and disease prevention including the popularization of vaccination: "Asian guest" 1919, "Children is the flowers of life" 1919, "Victims of basements" 1919, "Scarlet fever" 1924, "A simple story" 1930. Specific (sexually transmitted) diseases often became the subject matter of such films: "The truth of life" 1925, "For what?" 1926, "Gonorrhea" 1927, "Too embarrassing to tell" 1930. Cultural films "Abortion" 1924 and "I do not want a child" 1930 are dedicated to the problem of high female mortality. The cultural film "Cheers" 1929 describes the problem of alcoholism. The cultural film "Shattered nerves" 1929 told about the methods of fatigue treatment: electrotherapy, phototherapy, and strict daily regime. Having assumed the function of popularizing science, cultural films proved to be invaluable in the creation of the accessible and positive visual image of science, for both national and international audiences. The films of the so-called "Pavlov series" became an important part of cultural life in the 1920-1930s: "Mechanics of the brain" (directed by V. I. Pudovkin) 1926, "Physiology and pathology of the higher nervous activity" 1936, "Rose and Raphael" 1936, "Pavlovo" 1937. They popularized the theses of the conditioned-reflex theory developed by the physiologist Ivan Pavlov. Scientists representing various fields, but mainly physiology, were also involved in film production, e.g., in developing shooting schedules. The films were screened to be shown in movie theaters across the Soviet Union and to be distributed overseas. Sometimes films were devoted to the most fantastic and even anti-scientific subjects. A utopic idea of immortality became the basis for the popular-science film "Experiments in the revival of organisms" 1940 directed by D. Yashin. The film popularized experiments in artificial maintenance of vital activities of organisms carried out by the Soviet physiologist Sergey Brukhonenko. The film gained popularity not only in the USSR but in other countries as well: in 1943, it was even featured in "Time" magazine. This example of a popular science film and its representation showcases an important domain of existence for popular science, one having special functions and its own laws. The message transferred by these films was no longer centered on relating scientific facts, but rather on visualizing science as a transformative force. Thus, the myth of science was created in intellectual discussion and then broadcast to the nation.) Cultural films as well as the first popular-science films intrinsically combined theory and practice. Although they were not absolutely commercially successful, they explained the most sophisticated scientific issues 'to the masses', or average viewers. They allowed scientists to captivate the attention of the largely uneducated audience. At the same time, they became an optimal instrument for "importing" scientific ideas and presenting academic achievements of the USSR to the international community.

3 **- Antoni Malet** (University Pompeu Fabra, Spain)

The Public Image of Science in Francoist Spain, 1939-1959

The present paper analyses the Franco regime's (1939-1975) public discourse on science and technology through some influential paper media. We focus on the period 1939 - 1959, between the end of the Civil War (1936-1939) and the deep reorientation of the country's economic policies in 1958-59. In that period the regime promoted applied science and technology mostly with a view on fostering the country's industrialization. Yet it is well known that the regime promoted science and technology in idiosyncratic ways, as compared with the rest of European countries. On the other hand, science and technology were not value-free in the tightly controlled ideological arena of the Franco regime. Traditionally, Spanish right-wing parties and thinkers had been at best uninterested in science policy, but open hostility towards science on philosophical and social grounds was not unknown among them. Open hostility was certainly the norm among the Spanish Roman Catholic Church, a powerful actor in social and political terms before, during, and after the Civil War (1936- 1939). In this paper we wish to analyze the ways in which the regime construed a public discourse on science to serve its political, ideological and economic interests. We will pay particular attention to two major newspapers, the Madrid-based ABC and the Barcelonabased La Vanguardia Española. The two of them were privately owned, but also broadly identified themselves with the regime's dictatorial agenda, which makes them a particularly useful source. We will pay particular attention to the ways in which science was incorporated into the nationalist ideology of the regime, how it was used to buttress political stability, and what values were associated to it.

4 - **Nicolas Rasmussen** (University of New South Wales, Australia)

Picturing Prescription: Scientific Rationale and Visual Representation in Pharmaceutical Advertising since the Second World War

Modern pharmaceuticals are paradigmatic products of rigorous science, and a keystone of the medical profession's social authority. Unsurprisingly, advertisements for prescription drugs aimed at physicians heavily feature scientific claims - the quality of which has long attracted government regulation and, recently, critical analysis from the Evidence Based Medicine field. The visual content of drug advertisements, however, has attracted little analysis beyond the field of medical sociology, and historians especially have been discouraged by the routine removal of advertising pages by medical libraries upon journal binding. Using a newly created, fully representative database of advertisements in the Journal of the American Medical Association (JAMA, the leading US journal) drawn from libraries on three continents, I analyse the relationship between scientific language and visual images in ads for three different drug classes since 1945, arguing for far greater continuity in physician perception of patients and illnesses over time than text alone would suggest. I further discuss the range of research questions in history of medicine opened by this and similar database systematically cataloging visual materials from the past.

5 - **Giulia Bovone** (Italian Academy of History of Pharmacy, Italy)

"I treat them like dinosaurs" the unwritten history of pharmacy hidden in the design of vintage pharmaceutical boxes and bottles

The design of an object can say a lot, and this is particularly true of the packaging of old drugs between the end of the nineteenth century and the present day. Not only do they often represent the only trace of the commercial passage of many medicines, but they tell unwritten stories, such as the level of education of the people for whom the drug was intended, their economic possibilities, and their way of relating to the medications and disease. Furthermore, design was a very powerful commercial weapon, which can explain how some pharmaceutical brands, such as Magnesia San Pellegrino, Pillole di

Catramina Bertelli or Ferro - China Bisleri, have imposed themselves on a market of hundreds of identical products. Sometimes, on the other hand, having a name or appearance similar to the best-selling branded drug on the Italian market could have been a successful market camouflage strategy, making the product a cheaper and more convincing alternative for customers. Bioplastol Agnoli bears witness to this, whose name was very much based on the famous Bioplastina Serono, one of the most common tonic in the first half of the twentieth century. Just as times change, drugs also had to change their appearance to make themselves "palatable" in a market where appearance mattered more and more, telling a story of extraordinary evolution. Some medicines have been able to adapt and have thrived being on the market up to the present day, others have established themselves in very crowded "phylogenetic branches" dominating the market, some have changed their name or composition and many have become extinct. Examining their boxes or bottles extrapolating useful information to reconstruct their history is exactly like working with fossils, and for this reason, I treat them as dinosaurs.

Room 11: **S74 - Greco-Roman Science in Dialogue with Culture Representations, Materials, Sensations and Feasts**

Convener: **Daniele Morrone** (University of Bologna, Italy)

This symposium shall address the subject of Greco-Roman science by showing some of its links with its broad cultural context. From the Hellenistic period onwards a process of specialization is observable for the ancient sciences, leading to extraordinary results in the fields of mechanics, astronomy, medicine, etc. Although these sciences were becoming increasingly independent from the broader framings of all-encompassing philosophy and sapiential wisdom which originally included most of them, they maintained a constant dialogue with philosophy and the many cultural practices and concerns which today would normally be seen as 'extra-scientific'. Always focusing on visualizations, materiality or sensoriality, each paper in this session will shed light on an instance of inter-relation between science and culture, contributing to a small-scale representation of the varied spectrum of the uses, contexts and objects of Greco-Roman science. Liba Taub, by considering a number of visual representations of mathematics in ancient Greece and Rome, will offer a picture of the role of this discipline in various non-technical contexts, which would be indiscernible by working on only textual sources. Raquel Martín Hernández, focusing on ancient medicine, will frame it in magical rituality, explaining the relevance of the healing gemstones' materiality to their therapeutic uses, as well as their scientific systematisation in lapidaries. Michiel Meeusen will discuss the role of the symposium as a context for the advancement and communication of ancient science, giving relevance to the material and sensorial stimuli it provided specialists and laymen with. Daniele Morrone, approaching ancient science from non-specialized philosophy, will present an overview of Plutarch's scientific treatment of flavours and investigate the reasons of the limited relevance of a sensory approach to the philosopher's explanation of these perceptibles.

Chair: **Daniele Morrone** (University of Bologna, Italy)

1 **- Liba Taub** (University of Cambridge, UK)

Representing Mathematics in Ancient Greece and Rome

Mathematics was part of broader culture and society in antiquity, not confined only to specialists. Ancient Greek and Roman visual and material representations of mathematics—including activities involving mathematical skills, as well as individuals identified as mathematicians—will be considered here. Various visual representations of mathematical practices survive, produced using a variety of

media, including vase paintings, coins, mosaics and stone reliefs. For example, we see men depicted with an object or tool used for counting, measuring or calculating. Some of these visual representations of mathematics no longer exist (if, indeed, they ever did), but survive in verbal descriptions. In some cases, verbal descriptions are intended to guide the imagination in picturing mathematical objects and practices. Mathematics is represented as having different uses: practical (including measuring and calculating) and theoretical, as well as recreational (involving games, such as dice). Some visual depictions of mathematical practices are seemingly mundane (for example, using an abacus); others point to special achievements. These diverse visual representations signal that mathematics itself, in antiquity, incorporated a broad range of types of knowledge and skills. Furthermore, they illustrate the importance of visual and material objects in mathematical practices. And, taken together, ancient visual and textual representations of mathematics provide a richer picture of the place of mathematics in ancient culture than we would otherwise have, relying only on verbal evidence.

2 - **Raquel Martín Hernández** (Complutense University of Madrid, Spain)
The Material Expression of the Persuasive Analogy The Medical Use of Gemstones in Greco-Roman Times

The texts of the lapidaries from the Greco-Roman period as well as the engraved gems that have come down to us from Antiquity show how popular their use was for therapeutic and curative treatments. Especially important was the use of the engraved gemstones for haemorrhagic diseases and for the healing and prevention of wounds, especially those caused by snake and scorpion stings. In this paper the material characteristics of some gemstones (colour, shape, name, geological properties) and their engravings (textual and iconographic elements) will be explored to point out how the persuasive analogy, typical of magical thinking in Antiquity, worked for healing purposes and was understood in scientific works. The technical texts of Greek and Latin lapidaries and similar sources will be put in dialogue with the preserved gems to show which mechanisms of ritual analogy were found to be effective and to point out the deep relationship between magic and medicine in Graeco-Roman Antiquity.

3 - **Michiel Meeusen** (Gerda Henkel Foundation, Belgium)
Imperial Science and Sympotic Culture Performing Knowledge at the Feast

This paper will look at the mediating role that the material culture of the symposium played in scientific debates during the High Roman Empire (1st –2 nd century CE). As is shown by a wide variety of sources, the physical reality of consumption at the symposium fostered much lively debate concerning topics relating to the origin, physical qualities, and cultural value of sympotic staples and tools (such as wine, bread, water, fish, meat, vegetables, vessels, musical instruments), which could then ramify into the investigation of broader natural and cultural phenomena. I shall provide a number of case-studies to demonstrate the cultural prominence of this ancient scientific practice with specific attention to its material and sensory aspects. For instance, the serving of giant truffles in Plutarch's Table Talk 4.2 provides an incentive to question the popular belief that they are produced by thunder, which then serves as springboard for deeper natural philosophical contemplation. Some of Hero of Alexandria's mechanical devices (e.g., the one that 'turns' water into wine: Pneumatica 8) can be surmised to have served as technological tools to enliven the debate at symposia and to establish the scientific prowess of the host. In Lucan's epic Civil War (10.172-333), we find Julius Caesar discussing the age-old conundrum of the summer flooding and sources of the Nile with an Egyptian priest at Cleopatra's symposium in Alexandria. Studying such diverse sources requires a number of guiding research questions: In which ways does the material/physical context of the symposium influence the scientific content of the debate? How are scientific experts/expertise staged at such events? How were 'technical' scientific issues ideally communicated? By investigating questions such as these, this paper will offer the

first overviewing study of 'sympotic science' in the High Roman Empire in terms of its underlying material, sociocultural and intellectual dynamics.

4 - **Daniele Morrone** (University of Bologna, Italy)

Explaining Taste Without a Taster. The Chemistry of Flavours in Plutarch's Scientific Reflection

It is unsurprising that Plutarch directed his attention towards the explanation and taxonomy of flavours, knowing that his scientific interests —as evidenced by the variety of themes that appear in his Causes of Natural Phenomena (QN) and Table Talk (QC)— involved every sub-field of natural philosophy. However, considering his Platonic heritage (he regarded himself as a Platonist), it might come as a surprise that in his accounts of taste he rarely refers to a perceiver or a sensory organ. In fact, while Plato, in Timaeus 59e -60b , illustrates the perceptual differences among flavours by referring to the interaction of different taste-'juices' (khumoí) with specific parts of the body, Plutarch generally only mentions the properties and chemical transformations of the 'juices' in themselves, giving the impression of detaching a sensory-specific theme from its expected, sensorial, explanatory framework. The explanations given in QC I 7, one of the few places where the tasting organism is taken into account in relation to the flavours' qualities —although not focusing on their taxonomy— attests to Plutarch's reliance on the Timaeus for his understanding of taste perception. In contrast, the flavours are subject of independent treatment in QN 5 ("Why do we observe that only one of the flavours, which are eight in genus, namely the salty, is not produced by any fruit?"), where they appear as specific substances subject to chemical alterations, and, as in many other loci, are completely identified with the 'juices' and accounted for in isolation. In this paper I will give an overview of Plutarch's scientific treatment of tastes by connecting all the bits of information scattered around his corpus. Then, also by comparison to Plutarch's accounts of other sensations (especially smell), I will give a measure of the limited relevance of 'tasters' in the passages mentioning flavours, and propose a possible explanation for it.

Pause from 11.00 to 11.15

Thursday 3 September, 11.15 - 13.15

Room 1: T26 - Archaeology and Material Culture

Chair: **Maria Paula Diogo** (Nova University of Lisbon, Portugal)

1 - **Fedra A. Pizzato** (University of Verona, Italy)

From Troy to the "Great Mediterranean". How archaeological materials influenced Giuseppe Sergi's theory on human origins

The discovery of Troy by Heinrich Schliemann and its announcement to the Western world in 1868 in his book Ithaka, der Peloponnesus und Troja ignited a hot debate on the origin of the Western civilization, which immediately spread all over the world. Somewhat surprisingly, this debate involved not only the archaeological sciences, but other human and natural sciences as well. Physical anthropologists, for example, were particularly interested in mapping the spreading of civilization in the European prehistory

and the discoveries in eastern Mediterranean impacted deeply in the discipline. In Italy, this debate contributed to the resurgence of the national myth of the Pelagic people and the origins of the so-called "Pelagic" or "Cyclopean architecture". In particular, draws, images and lithographs realized by Schliemann himself and many others archaeologists led many scholars to search for a connection between some ancient Italian buildings (such as the fortifications of the city of Norba near Rome) and the walls of Troy and Mycenae. Stimulated by this cultural climate, Italian anthropologists started to investigate more intensively the supposed relation between different Mediterranean people in prehistorical times. Giuseppe Sergi was one of them. Head of the Anthropological Institute in Rome, Sergi aimed to demonstrate a strong correspondence between similarities in archeological buildings and human populations. Eventually he proposed the theory of an ancient "Great Mediterranean" which, in his opinion, represented a "primordial environment" of the human evolution. In this paper I analyze Sergi's works. I aim to show the complex interplay between visual archaeological culture and physical anthropology in the last decades of the 20th century and to highlight the role of material remains and representations in the development of Sergi's theory of human origins.

2 - **Johannes Thomann** (University of Zurich, Switzerland)

The Earliest Arabic Horoscope and the Origin of the Square Horoscope Diagram

In publications on horoscopes in antiquity, the horoscope for 497 AD in the manuscript Florence, Cod. Laur. Plut. 28, 34 (11th century AD) with its rectangular structure was presented as an example of how horoscopes were designed in antiquity (e.g. Neugebauer/Van Housen 1959). This was called into question by the fact that there is no documentary evidence for this claim, and that all horoscope charts created in antiquity are circular with radial divisions. The special design in the Florence manuscript with square fields and diagonal divisions of the corner fields resembles a Chinese cosmological scheme (Thomann 2008). This paper presents further evidence that the Florence manuscript had an Arabic predecessor (9th century AD) with an almost identical design. An unpublished horoscope for 869 AD, the earliest Arabic horoscope to date, has the same open form as that of the manuscript of Florence, without a square frame, which otherwise became the standard. Because of its poor state of preservation and the cirsive script, its reconstruction was difficult, but the date could be determined with some certainty. The positions of the planets in the houses and the signs of the zodiac lead to the date 24 July 869 AD. Since it does not contain degrees for the cusps of the houses, the latitude for which it was calculated cannot be determined. But its papyrus material indicates an Egyptian origin.

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3 - **Mariana Sánchez** (University of Paris Diderot, France)

Material culture in El Escorial: Distillation devices

The monastery of El Escorial, as the center of knowledge of the Spanish court, was established during the seventeenth century as one of the most important places in the Hispanic world for pharmaceutical work. The medical needs of the royal family, of the Hieronymite monks who live and work in the monastery, and of the community established around the complex generate a large production of remedies, many of them of vegetal origin whose plants (of more than 70 species) were grown locally in the botanical garden. The importance of pharmaceutical production in El Escorial, incites interest in the material culture of the monastery laboratory. Distillation instruments are common in many laboratories in Europe, but the needs of the community make those instruments produce large quantities of oils and distilled water, among those instruments we find the Philosopher's Tower which is 20 feet high and

whose perimeter is such that three men holding hands surround the tower, it produces 200 pounds of distilled water in 24 hours. The main objective of this article is to present the descriptions and the use of three distillation devices from El Escorial described by Jean L'Hermite, Juan Alonso de Almela and Diego de Santiago: one of those instruments has 32 distillation glasses and that uses water vapor as a heat source, another is the Philosopher's tower that we described before, and finally another device, made of 26 connected distillation vessels, used for the distillation of oils, this one was created by Diego de Santiago but does not exactly correspond to the one that this author describes in his Arte Separatoria (there the distillation device is made of 72 glasses), but both represent an important technical advance that is to maintain heat through the constant circulation of a fluid.

4 - **Antonio Sánchez** (Autonomous University of Madrid, Spain)
The Tacit Dimension of Artisanal Knowledge in the Iberian maritime culture of the Early Modern Age

This paper starts from the principle that the knowledge produced by certain artisan cultures has true epistemic value. One of these cultures wasthe maritime culture (scientific practices subordinated to the world of navigation) that were developed in the Iberian world in the 16th century because of transoceanic travel and the large-scale construction of long-distance maritime networks. Following both the notion put into circulation by the Hungarian philosopher Michael Polanyi and some of his approaches, in this paper I will explore the "tacit dimension" of the knowledge produced by this maritime culture. According to Polanyi, tacit knowledge is associated with the synthesized idea that "we can know more than we can tell". It is a type of knowledge difficult to formalize, but at the same time, it is a central feature of our knowledge of the world, of our way of knowing. In this sense, there are two specific objectives. First, it is necessary to analyze why the knowledge produced in this context can be called tacit knowledge. To achieve this objective, it will be necessary to define the main characteristics of this maritime culture, such as the type of training that individuals belonging to that culture have and the type of practices they carry out. Second, it is necessary to detect the main mechanisms by which knowledge of the nautical, cartographic, oceanographic, meteorological, natural or geophysical world was tacitly acquired. For this, it will be necessary to attend to some artisanal practices such as the construction of nautical charts or the ways to standardize a sea route based on certain astronomical observations and experiences on board.

5 - Artur Neves (Nova University of Lisbon, Portugal), Maria João Melob, Maria Elvira Callapezc & Robert Friedeld, ***On the scent of Celluloid: an investigation of relevant industry practices***

Visual material, in this presentation, will focus on celluloid as a raw material and artefact, which sense of smell is very "visible". Celluloid, invented by John Wesley Hyatt in 1870, played a central role in the democratization of social identity. The production of a myriad of cheap products imitating luxury materials, such as ivory, with a degree of similarity that confused the senses, allowed lower classes to fulfill material desires and attain social status. The creation of this successful celluloid market was due to an innovative business strategy and technological improvements. John Henry Stevens, Hyatt's chief chemist, was investigating formulations for the chemical stability and economic viability of celluloid, for example, avoiding the smell of camphor. With a novel approach, combining the history of science and technology, conservation science and material culture on the analysis of 300 celluloid objects donated by an American private collector, we will explore which formulations became industrially relevant. This will be achieved by analysis of sources, e.g. Stevens' patents, and object characterization by Infrared and Raman spectroscopies and X-Ray Fluorescence. In Portugal, there was an attempt to improve the celluloid features by António Rio de Janeiro, the technical manager of the Portuguese Society of

Celluloid. He patented the first Portuguese celluloid production process in 1920, focused on camphor substitution. In this article, for the first time, we compare the USA and the Portuguese scientific and technological "momentum" to understand the Portuguese technological acumen and technical expertise in the celluloid industry. On the other hand, we´ll examine if the "olfactory experience" is a vehicle of knowledge and beauty.

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Room 2: **S94 - Libraries and Archives in the History of Sciences**

Sponsored by Scuola di Specializzazione in Beni Archivistici e Librari, Sapienza University of Rome

Convener: **Giovanni Paoloni** (Sapienza University of Rome, Italy)

The symposium will address different issues related to the use and enhancement of archives, manuscript funds and private libraries in the history of sciences within the Italian context.

Chair: **Giovanni Paoloni** (Sapienza University of Rome, Italy)

1 ~~**Livia Castelli** (Sapienza University of Rome, Italy)~~
~~From book shelves to bibliography and bibliophily: construction and reception of a sixteenth century 'spring advice book' in the Istituto delle Scienze of Bologna library collections' items~~ **[CANCELLED]**

The paper presents a case study concerning the edition of a sixteenth century thermal treatise, the Trattato delle fontane et acque di Ritorbio, In Lione, appresso la herede di Iacobo Gionti, 1577, 8°. Material objects with the function of informative support, the early printed books have for centuries developed and accompanied the elaboration and dissemination of scientific knowledge. At the moment of the mise en livre of a text, to the work of the author stands alongside that of the trades of the book : translators, editors, printers, publishers and booksellers. They create the concrete aspect of the book, which organizes the transmitted text allowing its reproduction and directing its fruition and reception. The study focuses on connection between the construction of the text and the material aspect of the Trattato delle fontane, of which a copy from the collection of Ulisse Aldrovandi (1522-1605) is now in the library of the Institute of Sciences in Bologna and a second copy is at the Archiginnasio public library, in the donation by Antonio Magnani, librarian at the Institute of Sciences (1743-1811). These two libraries of printed heritage in Bologna also preserve several sixteenth century printed books concerning thermalism, coming from local scholars and librarians' collections. Their presence illustrates the importance and interest of the theme in the modern age and allows to take a look at its reception in large private libraries.

2 - **Sandro Caparrini** (Polytechnic of Turin, Italy)
A peek at the desk of a nineteenth-century mathematician: the manuscripts of Giovanni Plana (1781-1864) in the Academy of Sciences of Torino

Among the wealth of documents at the archives of the Academy of Sciences of Torino are the Italian astronomer and mathematician Giovanni Plana's personal scientific notes. While today Giovanni Plana (1781-1864) has been forgotten except by specialists, in his time he was considered a leading

international expert in theoretical astronomy and mathematical physics. He studied in Paris, at the prestigious Ecole Polytechnique, and during his entire life he remained in contact with the chief exponents of French science. In his massive treatise Théorie du mouvement de la lune (3 vols., 1832) he was able to improve on some of Laplace's results. For these achievements, in 1834 he was awarded the Copley Medal by the Royal Society. Late in life, he was given the title of 'Baron' for scientific services rendered to the Kingdom of Sardinia. Since Plana had been a close friend of Stendhal in his youth, he also managed to carve a small niche for himself in the history of French literature. The Plana Collection consists of more than 5.000 pages of mathematical manuscripts. They are essentially Plana's notebooks. Up to the late 1980s, these documents were stored away, unknown to scholars, in the vaults of the Turin Academy of Sciences. Written over a period of about half a century, from about 1810 to 1864, they reveal the inner workings of the mind of a representative scientist, and the influences that shaped his thought.

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3 - **Elena Scalambro** (University of Turin, Italy)
Gino Fano's literary heritage

In the last twenty years, the conception of the 'material culture of science' has been gaining ground also in history of mathematics. One of the goals in this field is the study of mathematicians' book heritage. This historiographical perspective allows to focus attention on the dynamics of circulation of mathematical knowledge, taking into account the material dimension of this circulation. With this in mind, an interesting case study is provided by the analysis of the personal library and the collection of 5970 journals' excerpts of Gino Fano, which are now kept in the Special Mathematical Library [SML] 'G. Peano' of Turin University. In fact, Fano had donated most of his brochures to the SML and, upon his death, his family left all the mathematics books of his private library to the Institute of Geometry of Turin University. Moreover, the analysis of this literary heritage with digital humanities software, such as Palladio, will help to examine some aspects connected to Fano's international relationships. Starting from the analysis of Fano's heritage, this historiographical perspective will allow us to highlight some lesser-known aspects of this famous mathematician and pioneer in algebraic geometry.

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4 - **Francesca Nemore** (Sapienza University of Rome, Italy)
The "Archives of Science" project and website

Scientific documentation, in all its different formats, constitutes a significant part of Italian archival heritage. However, the discovery, or rather the rediscovery, of its existence and value is quite recent. Early studies and inventorying of science archives date back, in fact, to the late 1980s, when the intense work of recovery and conservation promoted in previous decades by the Accademia Nazionale delle Scienze, detta dei XL, gained support and technical backing from the Archival Administration. The first result of these projects was the census of 170 science archives which were held outside the Italian State Archives. This early research was the starting point for other initiatives that led in 1991 to the Convegno internazionale di studi "Gli archivi per la storia della scienza e della tecnica" (International Conference

on "Archives for the History of Science and Technology"**)**, organized by the Accademia dei XL and the Archival Administration in Desenzano del Garda. The main result of the conference was to bring the attention of archivists and scholars to the fundamental role science has had in industrial, social, political, and economic development in Italy. Since the 1990s, many steps have been taken to ensure proper preservation of Italy's scientific heritage, by using the opportunities offered by the Internet. Since then, projects and websites dedicated to science archives have taken considerable development: e.g., science institutions in the portal "Archivi del Novecento"**,** and the project **"**Voci della Scienza"**.** From the 1980s to present day, the census data on science archives have considerably increased. The number of identified archives is now approximately 2,000, from the Middle Ages up to the present. Part of them are kept in State Archives and others in different locations. The idea of launching a portal for the archives of science anf technology in Italy originated from this work. Bringing together over 30 years of inventories, studies and research on this documentation, the Accademia Nazionale delle Scienze detta dei XL, in collaboration with the Museo Nazionale Scienza e Tecnologia Leonardo da Vinci, set up the Portal for the Archives of Science and Technology in Italy, developed in collaboration with ICAR (Central Institute for Archives).

Room 3: **T25 - Scientific Travels**

Chair: **Dimitri Bayuk** (Financial University Moscow, Russia)

1 - **Maija Kallinen** (University of Oulu, Finland)

Keeping up appearances. Pehr Kalm and the selffashioning of an 18th-century travelling naturalist

Pehr Kalm (1716-1779) was a Swedish professor of oeconomia, who travelled to England and Philadelphia 1747-1751 to collect samples for his teacher Linnaeus, and “useful” plants which could be cultivated in Sweden. His botanical exploration of North America was a deeply social enterprise: Kalm was constantly making contacts and networking with all levels of the social strata both in London and in North America. In my paper I will discuss the ways in which Kalm was fashioning himself as a traveler and a naturalist, and how he came to be seen a credible scholar by his contemporaries. I will discuss both the scholarly and ethical qualities which Kalm emphasized in his image, and also the way he fashioned himself in expenditure and his own outlooks.

2 - **Edwin Rose** (Polytechnic University of Catalunya, Spain)

Joseph Banks, Georg Forster and the Visualisation of Nature in the Age of Revolutions

The publication of research was a pressing concern for many British natural historians during the eighteenth century and became more problematic with the onset of the French Revolution. In this talk I examine the case of Sir Joseph Banks (1743–1820), the President of the Royal Society, and his attempt to produce and publish a series of 129 large copperplate engravings designed to depict the plants collected by the naturalist and revolutionary Georg Forster (1754–94) on James Cook’s second voyage of exploration (1772–75) during the 1790s. The case of this book, known as Icones Plantarum, reveals how political commitment during the French Revolution influenced the physical construction of images and the distribution of a natural history book in Britain. Banks was careful to ensure Icones Plantarum conformed to a number of specific taxonomic conventions by rejecting the revolutionary ‘natural’ systems of classification developed in France during the 1780s in addition to circulating copies to a select audience. These approaches to constructing botanical images and publishing emphasised Banks’s loyalty to the aristocratic system of government and established social structures. Publishing this work was complicated by Forster’s association with radical politics and the revolutionary connotations attached

to the Pacific, the original locality of the plants depicted in Icones Plantarum. All of these factors played into Banks's loyalist political agenda, influencing British scientific practice, publication and diffusion of natural knowledge during the revolutionary age.

3 - **Agnese Ghezzi** (Kunsthistorisches Institut Florence, Italy)

Visualising anthropology: the observational struggle between closeness and distance

Anthropology was established as a discipline during the second half of the nineteenth century and from its first steps, the emerging community of scholars struggled in the definition of its scope and methodology. Theoretically, anthropology presented itself as a branch of natural sciences, looking at the empirical method that anchored knowledge to direct experience and the registration of measurable features. In the practice, however, the making of the new science was manifold. Anthropology was characterised by the distance between the centre of interpretation in the metropolis and the geographical periphery inhabited by 'primitive civilizations' that constituted the first object of anthropology (Edwards 2001). This detachment led to the separation between amateurs and travellers, who gathered information from the field, and scholars who studied and ordered data in museums, universities, archives (Kuklick and Kohler 1996, Jöns, Meusburger and Heffernan 2017). Detachment, study and order were the attributes of the scholar, while presence, direct observation, and the use of senses was delegated to another set of actors (Puccini 1998). The primacy of visuality in the making of positivist knowledge called for the use of images, and photography was promoted as the perfect tool to close the space between field and institutions and to assure the transfer of knowledge (Latour 1986, Gaston and Dalison 2015). Looking at the visual exchanges between periphery and centre (Castelnuovo and Ginzburg 1979), this paper will investigate the role of images in the making of anthropological knowledge, exploring how the materiality of pictures influenced the discipline. Through cases from the history of Italian anthropology between 19th and 20th century, it will consider how the separation between direct and indirect observation was regulated, how the reliability of pictures was built, how the sensory experience was mediated at a distance.

4 - **Anna Gustavsson** (University of Gothenburg, Sweden)

Montelius And Emilia-Romagna, Or How To Find People, Places And Practices Behind A Great Man´s Work

In 1871, Agda Montelius (1850-1920) participated at the International Congress of Prehistory (CIAAP) in Bologna, together with her husband, the famous Swedish archaeologist Oscar Montelius (1842-1921). This was beginning of their massive research activities in Europe, leading to the publication of Oscar Montelius´ large work "La Civilisation Primitive en Italie Depuis L'introduction Des Métaux", two decades later. Finds in Emilia-Romagna were of great significance for the development of prehistoric archaeology. Agda is mainly known for her engagement in women´s rights, but she was also an experienced traveller and amateur illustrator, and drew thousands of artefact sketches for her husband´s publication This paper takes the travel diaries of Agda as its starting point. It will discuss (net)work practices, such as the importance of travelling and physical meetings, the practice of drawing and documenting finds, and how it is methodologically possible to identify and reconstruct these, by drawing on a combination of archival sources, including letters and travel diaries. Agda´s notes are often the only source of information on how and when her husband met colleagues, and of their work in museum collections in Europe. Agda Montelius´ extensive travelling and her work alongside Oscar, documenting finds in European museums, might have been unusual at the time. However, more invisible female participation in research activities was common. By delving more deeply into the work of a "great man" like Oscar Montelius, it is possible to come to a more nuanced understanding of how the creation of networks and archaeological knowledge took place, and to highlight the collective effort represented by all such projects.

Room 4: **T5 - Scientific Institutions**

Chair: **Clara Florensa** (Nacional Autonomous University of Barcelona, Spain)

1 - **Victor Kupriyanov** (Russian Academy of Sciences, Russia)

Science, society and political power in G.W.F. Leibniz's projects of the organization of science

During his life Leibniz was engaged in various activities concerning organization of the academies of sciences. When he was only 21 years old, he drafted his first plan of the organization of science – the project «Semestria literaria» (1667) [4]. His activity for the sake of the organization of science in different European countries was a considerable part of his political biography [1]. His most notable projects include «Societas Philadelphica» (1669), «Grundriss eines Bedenckens von Aufrichtung einer Societät in Teutschland zu aufnehmen der Kunste und Wissenschafte» (1671) and, of course, the notes prepared by him on the occasion of the organization of the Berlin Society of Sciences and St. Petersburg society of sciences and arts (future St. Petersburg Imperial Academy of sciences). The external part of the question was already under the consideration of the researchers (see: [3], [4]). The scholars reconstructed Leibniz's diplomatic activity for the organization of the academies in Berlin, St. Petersburg, Wien and in Saxony (see [1]). However, the philosophical and even ideological aspects of his projects remain underestimated [2]. In my presentation I'll focus on the ethical and socio-philosophical dimension of Leibniz's projects in the context of the history of social utopia of the XVII century. I'll show that Leibniz' utilitarianism which we can find in all his projects is in rooted in his conception of justice understood by him as «benevolence of the wise man». Leibniz is concentrated on the idea that science organized in the academies is a moving power of state and rulers should pay attention to the support of science, which is aimed at the welfare of the mankind. Very important perspective of my presentation will be connected with contemporary contextualization of Leibniz' view on the organization of science. I'll show that basic and applied science are deeply intertwined in the organization of science. This idea is fundamental for Leibniz. This means that modern commercial science and modern academic capitalism represent totally new approach to the organization of science, which is alien to the institutional ideas of the early modernity.

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2 - **Carlos Fernando Teixeira Alves** (University of Lisbon, Portugal)

The introduction of chemistry (and the new discoveries) in two catholic universities in Southern Europe. The case of Salamanca and Coimbra at second half of the 18th century

In the second half of the 18th century, Europe witnessed a wave of university reforms that transformed several universities. One of the areas in which this new perspective was evident was the teaching of medicine and philosophy. This presentation aims to make a comparison between two distinct university projects, always seeking to respect a Christian matrix, but at the same time seeking to introduce new ideas in many scientific areas, including chemistry. The context in which this academic discipline was created, and the way in which the new discoveries were received, shape the new discipline of chemistry that was created after 1771/1772 in both universities until 1820. In this context it is important to remember the importance of the spaces created from the beginning of the 70s, I am referring to chemical laboratories. The creation of these spaces allowed students and teachers to interact in a controlled space and practice experiences. The interaction with various products and the realization of experiments meant an interesting stimulus to the sensory senses; and the use of prints linked to botany

also played an important role by substituting real plants for basic descriptive images. The books, authors and ideas related to the new discoveries of chemistry in the eighteenth century, were received with a very effective censorship – resulted of the national contexts - that defined what medical and philosophy students would learn. Thus, comparing this subject in two universities helps us identify how Iberian rulers followed and understood the scientific discoveries that occurred in the rest of Europe, and how they tried to replicate them in their higher education institutions. The sources I used to compare the subjects of chemistry in Coimbra and Salamanca were the curricula, correspondence, minutes and other documentation of teachers and other stakeholders in the reform process.

3 - **Sandra Klos** (Austrian Academy of Sciences, Austria)

'To see with your own eyes': Travelling and boundary work in personal CVs of members of the Academy of Sciences in Vienna (late 19th century)

Many members of the Academy of Sciences in Vienna have started their professional careers by travelling abroad. Descriptions of bodily experiences of danger on hiking trips, sensations of awe or bewilderment during expeditions into the 'orient' as well as identification with relics of antiquity are often an integral part of an academic CV in the late 19th century. These visual and sensory experiences are not seen as less valuable than conclusions drawn out of theoretical reasoning. Instead, they often function as 'coming of age'-rites or revelatory moments in life descriptions of scientists. The autobiographic descriptions in the archive of the Austrian Academy of Science in Vienna will serve as a basis for research on the subject of traveling in the context of the professionalization and formalization of late 19th century academia. Career paths and self-descriptions of accomplished professionals in the natural sciences and humanities reveal the importance of academic travelling prior to the First World War. Famous physicist Franz Serafin Exner deemed going abroad and learning "to see only through your own eyes" as such an essential part of growing up that he would have liked seeing it become a mandatory part of reaching an academic degree. Across academic disciplines, this sentiment was echoed. As traveling became increasingly accessible and affordable, however, a need for boundary work, delineating travel for touristic pleasure from travel for academic research, became evident. The CVs of the academy's archive represent a rich, understudied vault of source material on the importance and genesis of travelling as a scientific practice outside the library or laboratory. Interlocking forms of knowledge production and dispersion as well as various career tactics, rhetoric narrative patterns, and individual social positioning strategies will be addressed through the example of travel experiences in life descriptions. Special attention will be given to the demarcation of professional and touristic travel as well as sensory practices of "doing science" in the field.

4 - **Anna V. Samokish** (Russian Academy of Sciences, Russia)

The specifics of communication of the scientific and pedagogical community of Petrograd in the minutes of the meeting of the Society for the Dissemination of Natural History Education

The study of the scientists' interaction and their search for survival strategies during the critical periods of history is always relevant for historians. Choosing a source to describe these events is quite difficult. The official documentation is often incomplete due to external reasons, economic and political. Sources of private origin - whether correspondence, diaries or memoirs - require an even more careful approach, taking into account the peculiarities of the author's perception. The use of conditionally synthetic sources enriches the field of research. The Society for the Dissemination of Natural History Education was founded in 1907, acquired an independent status in 1918 and existed until the end of the 1920s. It brought together not only professional scientists but also secondary school teachers and popularizers, thus showing the proximity of these groups. Society meetings were held regularly and working with the minutes which have been preserved quite fully (especially since 1918), it becomes possible to establish a circle of closely interacting natural scientists, many of which did not intersect in other areas of their activity. In addition, we can single out a range of topics of interest to this community, going far beyond the narrow scientific field. Finally, these minutes show how and what scientists lived for during the

difficult periods of the revolution, civil war, NEP and the beginning of repression, how they adapted to changing conditions and developed in their field. This source can be defined as synthetic, since it was not intended for publication and forwarding to official institutions. Despite the formal features of an official document, the minutes contain a large share of subjectivity, the choice of individual subjects and the style of the secretary who composed them. Thus, this source, especially in combination with official reports and documents of private origin allows to work in sufficient detail with the topics being studied.

5 - **Vitor Bonifácio** (University of Aveiro, Portugal)
The early years of the Portuguese Association for the Advancement of Science (1917–21)
[CANCELLED]

The development of science and its communities in the 19th and early 20th century led to the establishment of several national Associations for the Advancement of Science. In 1911, Francisco Miranda da Costa Lobo (18641945) a Coimbra University professor of Astronomy attended, as the sole foreigner, the congress of the Spanish Association for the Advancement of Science held in Madrid. Previously known only locally, in the 1910 decade Costa Lobo, already in his forties, had the chance to travel abroad and gained international visibility due to the analysis of his 1912 solar eclipse movie. Contrasting with his previous endeavors from then on, we find him as an active player in forging several working international partnerships. He tried at least from 1913 to create a Portuguese Society modeled upon the Spanish one aiming both to develop Portuguese research and to increase cooperation between the two neighboring scientific communities. A long process ensued. The strong institutional support that led to the society creation in 1917 was powerless before the concept had a broader acceptance within the Portuguese scientific community. The planned 1919 congress occurred two years later then envisaged, in 1921. This first joined congress became nevertheless the basis of a lasting relationship between the Portuguese and Spanish associations. Well known associations have been already studied both within their national and international contexts. In this paper we bring to light the lesser-known Portuguese Association for the Advancement of Science (Associação Portuguesa para o Progresso das Sciencias). We chart its development from a 1913 idea, to its inception in 1917 until its first congress in 1921. We concluded that this process was defined more by individual actions than by political reasons or contemporary events.

Room 5: **T23 - Astronomy and Astrophysics**

Chair: **Adele La Rana** (University of California Riverside, USA)

1 - **Rheagan Eric Martin** (Warburg Institute London, UK)
Seeing Through: The Possibility of Transparency in Fifteenth-Century Printed Astronomical Texts

Within a 1478 edition of Sphaera Mundi printed in Venice, a single folio contains a diagram of the pre-Copernican orbit of the sun on the recto and a diagram of the moon on the verso. In the course of turning the folio, light is transmitted through the thin paper support, illuminating both diagrams at once. I propose that viewers could have compared the two diagrams through the paper and visualized overlaps in the orbits of celestial bodies. A later edition of the book published by Erhard Ratdolt in 1485 expanded the use of these “trans-foliate” diagrams to explore, for example, relationships between the positions of the planets and the zodiac. Through an investigation of transparency and luminosity in late fifteenth-century Venetian visual and material culture, I consider how publishers may have been prompted to mobilize technologies of print to exploit the material properties of paper; similarly, I examine how contemporary epistemologies may have led viewers to look through the folio. For instance, the transparency of oiled paper (carta lucida) had long been used to transfer images, including woodcut images of constellations printed in 1488. Furthermore, an image in the first printed edition of Ptolemy’s

Almagest depicts astronomers manipulating paper instruments to participate with natural light in order to produce new astronomical information. Beyond print, I consider how painted depictions delighted in the luminosity and transparency of materials, such as the reflections and refractions of light through a glass object in the painting of Luca Pacioli attributed to Jacopo de'Barbari (1459). At stake in this paper is an understanding of the material possibilities of the earliest printed astronomical treatises. By considering wider Venetian visual culture, this paper proposes a new appreciation for their materiality and, in turn, new means of producing knowledge and diverse modes of engaging with the printed book.

2 - **Suzanne Débarbat** (Paris Observatory, France)
Changing Looks: Observations of the Satellites of Jupiter from Galileo to the Space Age

Numerous astronomers were observing the four Jovian Moons after Galileo Galilei (1564- 1642) published his discovery (1609/10). An important reason for this was that, like the Moon, they allowed determining longitude. Galileo published typographic versions of his drawings showing the relative positions of the four satellites to be named later Io, Europe, Ganymede and Callisto. However, accurate predictions of their eclipses were needed to enable a proper observation. The first to provide this was Gio. Domenico Cassini (1625-1712) from Bologna, who sent his predictions in 1668 to Adrien Auzout (1622-1691), a member of the recently created (1666) Académie Royale des Sciences. Arrived in Paris and attached to Louis XIV's Observatoire Royal, created in 1667 under the responsibility of the Academy, Cassini pursued the observations, with his colleagues, all of them noting irregularities in the aspect of Io, the closest one. A very good and acute observer, Cassini enriched the positional data in his notebook with other descriptions. Other observers came later, including Pierre Bouguer (1698-1858), Jean-Paul Grandjean de Fouchy (1707-1788), Jean-Sylvain Bailly (1736-1793), closer to us (2000) Franck Marchis (born 1973). But it was only with the Space Age that the looks of the Moons of Jupiter changed dramatically. Technical representations are considered over centuries from Galileo's time.

3 - **Carlos Hugo Sierra** (University of Basque Country, Spain)
Dreams Of The "Artificial Retina". Objective Nature And Astronoetics In The Context Of The Mid-Nineteenth Century Technology Of Scientific Sight

The guiding intention of this paper is to expose some of the central and major ideas related to the epistemological transformations that occurred in the mid-nineteenth century astronomical iconography with the technological improvements of the "camera obscura" or dark chamber (as reflected in the images obtained by J. W. Draper, M. Berkowski, G. A. Majocchi, A. H. Louis Fizeau, to name but a few). In this sense, the public presentation by the French astronomer and physicist François Arago of daguerreotype (considered as an enhanced version of the "camera obscura") to a joint public session of the Académie des Sciences and the Académie des Beaux-Arts in Paris on August 19, 1839, symbolized a substantial and qualitative transformation of the dominant epistemological characteristics which they were historically attributed to pre-modern optical technology. On the one hand, the functional re-significance of the "camera obscura" (insofar as it passes from being a visual technology, especially during the seventeenth and eighteenth centuries that helped illustrators to represent a generalized -archetypal and idealized- image of sublunar and supralunar phenomena to an absolute self-restrained apparatus, -converted, by that time, into a camera obscura image chemically fixed by the photograph- that drives the epistemological constitution of the "mechanical objectivity" -as Lorrain Daston points out-) articulates a specific and unprecedented relationship with the subjective perception and judgement (understood thereafter as a distortion or a hindrance for scientific advance). As a consequence, this new image artefact and scientific medium becomes an "artificial retina" (in accordance with the physicist Jean Baptiste Biot), that is to say, a neutral eye that "makes nature to speaks for itself". Such new visual attitude constitutes the first step towards a development of a sort of centrifugal curiosity, in other words, a protoastronoetics (H. Blumenberg) which was to vertebrate the cosmological imaginary of late modernity.

4 - **Andrew Clive Davenhall** (Royal Observatory Edinburgh, UK)
Charles Piazzi Smyth and the Art of Scientific Illustration

During 1841 Charles Piazzi Smyth (1819-1900) wrote 'On the Art of Astronomical Drawing.' He was then twenty two years of age and Assistant at the Royal Observatory at the Cape of Good Hope. In this short essay, subsequently published in the Memoirs of the Royal Astronomical Society, he discussed the vexed question of how to draw, and reproduce in print, the faint, extended, diffuse luminous objects that the telescopes of the early nineteenth century were revealing, particularly nebulae and cometary tails. Piazzi Smyth was already an accomplished and prolific artist, and an experienced practical astronomer familiar with meridian observing and land surveying. He was also experimenting with terrestrial photography and designing novel instrumentation. He continued to pursue all these interests throughout his long life and career. Though principally an astronomer (he was Astronomer Royal for Scotland from 1846 to 1888) he also contributed to a number of other fields including meteorology and laboratory spectroscopy. In 1864/65 he conducted a survey of the Great Pyramid of Giza which was more accurate than any of its predecessors and he took the first photographs of the interior of the Pyramid. He travelled extensively and was a prolific author of both technical and popular works. This paper will consider how Piazzi Smyth used his skills as an artist and photographer in his scientific work and publications, and how this work reflects and illuminates the practices, conventions, constraints and limitations of scientific illustration throughout the nineteenth century.

5 - **Marina Rieznik** (University of Buenos Aires, Argentina)
Technical images in astronomy in Argentina since the late nineteenth century

This talk aims to understand the context of production and circulation of a set of photographic plates, graphic records and astronomical drawings made in Argentina between the end of the 19th century and the beginning of the 20th. I will consider not only the traditions of scientific work differentiated according to the rivalry between nations, but the problems of uneven and combined development of the participating nations in the framework of international astronomical work. I will examine two international scientific works that had astronomical records made in Argentina and that required the preparation of technical images. In 1882, French missions sent to Argentina for the observation of the transit of Venus took several photographs, made drawings and recorded chronograph on paper tapes as part of the data corpus of the event. In Rio Negro a total of 90 photographic plates were obtained, in Chubut 562 and in Santa Cruz 206. Five years later, the same working networks were promoting a photographic project in France, the Carte du Ciel, which would have the participation of both the Observatory La Plata as the Observatory of Cordoba in Argentina. I will show the fluctuating nature of the epistemic value of the different images (celestial maps, drawings, graphic records and photos) in the elaboration of the results of astronomical work networks of the time.

Room 6: **T28 - Mathematics**

Chair: **Erika Luciano** (University of Turin, Italy)

1 - **Clelia Vittoria Crialesi** (University of Toronto, Canada)
Picturing Numbers: Pandulphus Of Capua And The Hindu-Arabic Numerals In 11th-Century Italy

Manuscript Vatican Library, Ottob. lat. 1354, is the only witness of Pandulfus of Capua's De calculatione, edited by F. Newton in 1995. With this work, Pandulfus, an eleventh-century monk from Montecassino, aimed to explain the use of abacus to beginners by giving them a calculation device and a method. In doing so, he offered a very peculiar description of the shapes and values of the so-called Hindu-Arabic numerals. These are the nine digits (zero excluded) of the decimal place-value system, which reached

Spain via the Muslim empire already in the tenth century, as the so-called Codex Vigilianus and Codex Emilianus from the monastery of Albelda in Rioja attest. However, are Pandulfus' digits the real Hindu-Arabic numerals? In fact, a comparison of his numerals with both the 'Western' and 'Eastern' shapes of the numbers – including those described or used in Pandulfus' sources such as Gerbert of Aurillac, Heriger of Lobbes, Bernelinus, Garlandus the Compotist, and Lawrence of Amalfi – leads to the conclusion that Pandulfus probably invented or at least promoted a unique variety of Hindu-Arabic numerals in 11th century Southern Italy. Besides this issue, I would like to highlight Pandulfus' imaginative way of talking about the appearance and function of the nine numerals. First, he introduces the numerals by referring to their Latin names. Second, he groups the signs signifying numbers (signa numeros significantia) according to their geometrical forms – triangular, quadrangular, and circular. Third, he offers a way of memorizing the numerals by relating their shapes to their value, such as how many lines they have, the first and last letter of the name, or even the arithmological imperfection with respect to a superior number. In his De calculatione Pandulfus tries to provide verbal depictions of the numbers in order to present them to an audience that was unfamiliar with either the Hindu-Arabic numerals or the abacus. This text, hence, reveals a pedagogical strategy aiming at facilitating arithmetical understanding by means of memory and, most importantly, it gives us a remakable example of the role played by the imagination in the medieval scientific discourse.

2 - **Antonino Drago** (Federico II University of Naples, Italy)

Sensory Physics And Inertia Principle: The Case Of Nicholas Cusanus

From sensory and experimental data one wants to achieve a general knowledge of reality. For this aim, one has to add to such data some pre-suppositions. The problem of clarifying these pre-suppositions is examined in a historical case-study. According to most historians, the crucial event of the birth of modern science was the formulation of inertia principle. Present paper examines Cusanus' booklet De Ludo Globi about his anticipation of modern inertia principle, which I consider in its different versions. Cusanus' was biased by both his Platonist philosophy of mathematics and theological tenets. However, he anticipated inertia principle in a substantial way. The analysis of this study-case allows to identify the main two pre-suppositions of a theoretical representation of both the sensory data and the experimental data.

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3 - **Jane Amanda Wess** (Independent Researcher, UK)

Epicycloids and Epicycloidal Teeth: A Small Consideration of Mathematics and It's Technological Applications in the 18th Century

This talk is stimulated by the model of epicycloidal gear teeth in the King George III Collection of instruments for experimental philosophy, which was made by George Adams and dates from 1762. It is based on the instructions for drawing epicycloids in William Emerson's work of 1758, and the description of epicycloids in the English translation of Newton's Principia of 1729. The talk will explore the interaction between the treatment of these beautiful curves by the leading mathematicians of the day, and their application to widespread technology in the form of gear mechanisms. It will consider the extent to which these skilled craftsmen incorporated a working knowledge of mathematics into their products, and also consider the limits of mathematical demands which were thought proper or realistic for lay audiences. Clock and other gear mechanisms form a part of a more comprehensive project on the application of mathematics in the generations following Newton and Leibniz. It has been argued that

the physical situations facing the practitioners were not amenable to treatment by the new calculus for various reasons. On the other hand, the mathematisation of the work of various trades led to an increased familiarity with mathematics on behalf of a wider population. The talk will explore this particular facet of the application of mathematics, asking how working practices, limits imposed by construction, and mathematical influences combined to produce a widespread technology.

4 - **Gabriela Besler** (University of Silesia in Katowice, Poland)

Gottlob Frege's Correspondence with Italian Mathematicians as a Material Sign of Culture of Science

Gottlob Frege (1848-1925) collaborated for over twenty years with two Italian mathematicians interested in his scientific activity: Giuseppe Peano (1859–1932) and as well as his student, and later co-worker, Giovanni Vailati (1863–1909). Their letters have survived and now are treated as material documents of their collaboration showing European culture of science at the turn of the century. On the basis of the survived documents I will present the following topics: 1. Reconstruction of the timeline of Frege's collaboration with Peano and Vailati, from 1891 (or later) to 1906. 2. Peano's correspondence with Frege could have helped in publishing German translation of Peano's five articles in 1899. They appeared as five appendices to Genocchi (1899). A recently found Frege's letter written to Adolph Mayer in 1896 shows some more details about the collaboration. Peano was also in letter contact with another German mathematician, Felix Klein (1849–1925). Peano encouraged both mathematicians to publish in "Rivista di mathematica". 3. Vailati collaborated with Peano on the edition of Logique mathématique (1897), where Frege's laws are mentioned. Nevertheless, Frege and Vailati did not discuss mathematical logic but Hilbert's geometry. Their personal meeting in 1906 is the last documented Frege's contact with the Italian mathematicians. Both Frege and Vailati were philosophers while Peano was not.

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Room 7: **S80 - The international scientific conference: a visual, material and sensory history**

Convener: **Laura C. Forster** (Birkbeck University of London, UK)

International conferences are now standard features of scientific life. Their total number since 1851 is estimated at 170,000 (UIA International Congress Calendar 2017). For all their prominence, the history of scientific conferences and their role in the development of scientific culture has not been researched as such. Yet they are vital for understanding scientific practice, communities and such phenomena as internationalization, cooperation, and the links between the exchange of knowledge and the shaping of international relations. As public spaces, conferences are peculiar and paradoxical phenomena. They are open yet selective, localized yet claiming to transcend place, rooted in specialist expertise yet aspiring to make wide public impacts. Conferences combine material, visual, sensory and symbolic dimensions. They are both physical manifestations of expert communities and steeped in rituals that celebrate and define that community, such as openings, closings, dinner speeches, excursions. These cultural practices

are central to their functioning. This symposium is part of the new collective project The Scientific Conference: A social, cultural and political history, funded by the European network HERA. Using a range of historical and ethnographic approaches and focussing on different cases from the late 19th and 20th century it will explore the visual, material and sensory dimensions of conferencing and its significance for science in a transnational perspective. We aim to give the first rich depiction of what conferencing is and means to the history of science. We experiment with a range of approaches drawing from material studies, ethnography and sensory studies. We thereby offer a nuanced view of conferences as made and perceived by various actors with competing interests and visions of the conference including congress site builders, congress organizers and congress goers. We suggest that the conference's function exceeds the exchange of ideas among specialists but is also a locus for displaying science, identity and community formation, and the gathering and circulation of a range of ideas and individuals.

Chair: **Brigitte van Tiggelen** (Mémosciences, Belgium)

1 - **Thomas Mougey** (EHESS Paris, France),
Building the Conference Hall: the Material and Spatial Construction of the Scientific Conference at the Parisian Expositions, 1900 - 1937

Over the past century, the scientific conference has become a standard feature of scientific life. With the increased popularity and institutionalization of the conference over the first half of the 20th century, conference organizers grappled with what its material and spatial standards should be. The question of the setting became particularly pressing at universal exhibitions, which catalyzed the conference movement by hosting most of the international conferences organized between 1900 and 1937. Exposition organizers designed several models that did not only aim at tackling the physical challenge of hosting hundreds of congresses and accommodating thousands of conference-goers but also endorsed peculiar conceptions of the functions and symbolic meanings of the congress. In this paper, I will examine the role the conference setting plays on the definition and standardization of the practices associated to conferencing. These practices are in large parts enabled and shaped by the material and spatial setting in which they are enacted. I will do so by studying the different models that the organizers of the Parisian expositions of 1900, 1931 and 1937 devised to accommodate some of the largest conference programs of the exposition movement. More specifically, by dissecting the way the conference setting was designed I will shed light on how it structures the meeting and what public, political and scientific functions and meanings were conferred upon the practice.

2 - **Laura C. Forster** (Birkbeck University of London, UK)
Living the Conference: science and socialization in Interwar Britain

This paper is about the lived experience of the scientific conference. The international conference is a standard feature of scientific life, and has been so since the nineteenth century. Historians have well understood the importance of these conferences as sites of international cooperation, professionalization, and scientific progress. However, much less attention has been given to the lived experience of the conference - the settings, the sounds, the sentiments - and, importantly, how these lived realities influenced the outcomes of such meetings. This paper will use the World League for Sexual Reform's 1929 international congress as its case study. The WLSR was founded in 1922 to advocate for advanced sexological research and greater openness around sex. The 1929 five - day London conference was a meeting of medical practitioners, sexologists, and social reformers and included seventy speakers from across Europe and the USA. As well the formal papers and discussion the conference had an extensive social program. Delegates could partake in a visit to the Cromer birth control department; a performance of Miles Mallesons's play The Fanatics; a converzione in the Victoria ballroom at the Hotel Cecil; and a motor excursion to Essex. Along with various restaurants, hotels, pubs and train carriages, all of these conference sites and activities presented opportunities for delegates to carve out spaces for informal intellectual exchange and in doing so stretch the boundaries of the official conference.

Delegates met and discussed ideas in an official capacity, but they also made friends, shared intimate moments, ate, drank, laughed, performed rituals and socialized with each other. This paper will argue that these elements do not merely provide colourful detail to our understanding of international congresses, but rather they are instrumental to our understanding of the role of the conference in both the development of scientific ideas, debates and practices, and in intellectual community-building.

3 - **Georgiana Kotsou** (Maastricht University, Netherlands)

Periodic table manners: the materiality of rituals in international chemistry conferences

International scientific conferences are generally perceived as gatherings of scholars from different parts of the world with the aim of presenting their original work to their peers, discussing current advancements of their field and of making decisions regarding disciplinary issues. As a result, participating in scientific conferences mainly refers to communication and knowledge diffusion practices. The discursive aspect of participation is, however, enabled and formulated through the material settings that shape the experience of being a conference participant. Traveling scientists are abstracted from their familiar working, sleeping and eating habits and must discipline their bodies and behaviors in order to adjust to the new environment. Organized activities outside the scientific sessions like excursions, banquets and receptions and repeated rituals regulate the interactions of conference participants and the communication developed between them. In this paper, I will investigate the role that the material elements of conference activities and rituals play in identity and community formation. More specifically, I will examine the ways in which locations and objects such as food or furniture, obtain symbolic meanings and structure the conference experience of the participants. Special attention will be payed on the visual elements defining the self-presentation of conference participants including clothing, and positioning in space. As part of the larger European collaborative project The Scientific Conference: A Social, Cultural, and Political History, funded by the Humanities in the European Research Area (HERA) network, my research will focus on international chemistry conferences of the 20th century organized by the International Union of Pure and Applied Chemistry (IUPAC) and the Gordon conferences. Community formation was particularly significant in the discipline of chemistry, since it was characterized by a) disciplinary tensions, such as the ones between academic and industrial practitioners and b) international tensions surrounding WWI, WWII and the Cold War.

4 - **Charlotte Bigg** (French National Centre for Scientific Research - CNRS, France)

Performing and experiencing scientific conferences

Scientific conferences have become so established, so ubiquitous, that they have to an extent become invisible: they have not been seriously studied as such as the central facet of scientific practice that they are. While individual conferences, conference series or congresses often feature in histories of science, often examined from a disciplinary perspective (e.g. the chemical discipline's founding Karlsruhe Congress of 1860), the distinct forms and practices of conferencing have remained under the radar. Recent qualms expressed in academic corners about the high environmental impact of the culture of international scientific conferencing, caused in particular by air travel, implicitly ask: why is presence so important? do international conferences still take place in the age of new-fangled distance communication technology out of habit or because they fulfil a range of functions that cannot otherwise be addressed? The ongoing existence, indeed, continued growth of conferencing activity worldwide suggests that it is more than simply a platform for the communication of scientific results. They are rituals and forms of display, they are hubs of socializing and networking for a range of purposes. This paper will suggest that studying conferences as performances and as experiences by focusing on the visual, material and sensory dimensions of this particular kind of activity, including its apparently mundane aspects, can yield insights into the meaning and significance of conferences in science and beyond : as spaces of inclusion and exclusion of particular groups, as embodiments of idealized communities, as materializations, however imperfect, of the internationalization and internationalism of science.

Room 8: **S92 - From technical practice to the visual representation of the features of the Earth: travels, tools, fieldwork - 2**

Sponsored by INHIGEO - IUGS / IUHPST International Commission on the History of Geological Sciences

Conveners: **Maria Faccioli** (University of Insubria, Italy), **Claudia Principe** (Italian National Research Council - CNR, Italy)

Chair: **Ezio Vaccari** (University of Insubria, Italy)

1 **- Guido Roghi** (Italian National Research Council - CNR, Italy)
The unpublished Compendium Faunae et Florae fossilis Bolcensis of Abramo Massalongo

In several paleontological papers Abramo Massalongo (1824-1860) announced his intention to publish a Compendium Faunae et Florae fossilis Bolcensis, a study on fossils from Bolca, one of the most famous fossil lägerstatten of Italy. This project, as many others, did not see the light because of his premature death in the 1860. In the Library of the Botanical Garden of Padova University there are twenty original plates that would have served to illustrate the Compendium. They illustrate landscape and most different animals and plant fossil specie sas marine plants and worms, feathers of fossil birds, arthropods, brachiopods, foraminifers and coprolites. The age of printing such lithographies is indicated in the cover page where is write: "Compendium Faunae et Florae fossilis Bolcensis auctor A.B.D.P. Massalongo 1854". In the next two years (1855 and 1856) Massalongo used separately some figured fossils species illustrated in these plates. The very interesting first four plates are lithography made by Penuti, a lithographer of Verona, and show landscape around Bolca village representing, in a natural and bucolic overview, the main aspects of the area. In fact, it is possible to see the basalt column of the Purga di Bolca mountain and the famous "Pesciara", in a natural environment without any specific scientific detail. It's a visual representation not in harmony with a so studied and famous geological and paleontological locality which has a long iconographic tradition dating back to the XVII century.

2 - **Gianbattista Vai & Stefano Marabini** (University of Bologna, Italy)
Original visual imaging in Marsili's (1658-1730) geology

Bologna was the birth place of the word Geology by Aldrovandi (1522–1605) in 1603, and of visual imaging of geologic outcrops and landscape by Marsili's (1658–1730) works, having the only forerunner in Leonardo (1452–1519). Count Marsili in his youth joined courses of math, astronomy and natural sciences in Bologna and Padua, followed by trips on-land and off-shore through Europe, collecting a wealth of observations and materials. From 1682 to 1704 he served the Emperor Leopold I as military-genius engineer in the Danube campaign against the Ottomans, addressing his many scientific interests. Disappointed from his military career, devoted his full life to science organization (Bologna Institute of Sciences and Arts, 1711), and beginning publication of his immense collection of MS and notes. A wide use of visual graphics and imaging characterizes his entire production, especially in geologic fields, possibly under the influence of a tradition beginning with Aldrovandi and peaking with Malpighi's (1628–1694) teaching and anatomical works, ending in detailed drawings, as done also by Malpighi's friend Steno (1638–1686), a (re)founder of geology. Marsili's early visual geologic representations, such as the gypsum structures in the quarries and caves of the Bologna hills (1698), or the profiles across the Swiss Alps (1705), or the subterranean bedding in the Romagna sulphur mines (1717–1718) show his intent to dissect the geological bodies observed through Europe as he was thought to do with human bodies. Such an original aesthetic scientific design approach in geology grew in Marsili's maturity far beyond Steno's teaching attempts, as shown in Marsili's major treatises on Danube and oceanography and in his monumental archive, that was open to all scientists working in the Bologna Institute.

3 - **Johannes Mattes** (Austrian Academy of Sciences, Austria)
Surveying, Mapping and (Dis)Trusting: Knowledge and Visions of Earth in Early Modern Cave Maps

This paper examines natural cavities and their visualization in map format as unique spaces of knowledge, which legitimized and authorized early modern cultures of perception, scholarly practices and concepts about the earth. Faced with the challenge of limited vision, mapmakers 9 combined empiricism and imagination in an experimental setting and developed specific translation strategies to deal with the hybridity of underground objects and the shifting boundaries between known and unknown. In deconstructing this type of subterranean cartographic representation, which has barely been studied, this paper provides new insights into the long-term processes by which visualizations of underground space became powerful devices in scientific reasoning, all while their makers struggled with the inexact nature of visual observation. The variety of maps used for this study includes both archival and published sources by scholars such as Nicolaus **Steno or Gottfried Wilhelm Leibniz.**

4 - Andrea Candela (University of Insubria, Italy), commentator

Room 9: **T19 - Scientific Education**

Chair: **Simone Turchetti** (University of Manchester, UK)

1 - **Robert Middeke-Conlin** (University of Copenhagen, Denmark)
Education and professional practice in the Old Babylonian city of Lagaba

A group of texts housed primarily in the University of Leiden presents an image of economic activities in the Old Babylonian city of Lagaba during the reigns of Hammurabi and Samsu-iluna. First edited by Leemans in 1960, then published by him in 1964, and supplemented especially by Tammuz in 1996 and Dalley in 2005, this group of texts offers details into land tenure, date cultivation, barley production, brick construction, trade and transport, and much more. Sixteen texts from this city give the impression that they are economic documents – the administration of agricultural production, lists of works, silver and grain expenditures, etc. However, the appearance of these texts on round type IV tablets shows that they are part of a professional education. This presentation will present a renewed look into these texts. It will examine both the lenticular, educational texts, as well as related texts of professional practice when available. Through this presentation, an image of numeracy and document literacy within the Old Babylonian city of Lagaba will become apparent.

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2 - **Ilaria Ampollini** (University of Trento, Italy)
Science-themed board games and card decks in the Modern Age

This contribution aims to offer a preliminary overview on science-themed card decks and board games designed, sold and circulating between the XVIIIth and the XIXth century in Europe and to bring to focus

historical issues and historiographical questions linked to the topic. As many scholars have well demonstrated in the last few years (Seville, 2019; Levy, 2017), games are to be considered "part of a larger cultural narrative", as O'Bryan (2017, p. 17) puts it. Nevertheless, the studies in the field have never specifically analyzed the design, the circulation and the success of science-themed games, which surely deserve a closer look. On the one hand, we have a wide corpus of primary sources still largely unexplored, such as the deck of cards The elements of astronomy and geography: explained on 40 cards, by Abbé Paris (London: 1795) or the board game An arithmetical pastime: intended to infuse the rudiments of arithmetic, under the idea of amusement (London: 1798), created and printed, like many others, by John Wallis. On the other hand, many questions are yet to be answered, such as, for instance, which publics did they address to? Which ones did they actually reach? Where did they circulate and what kind of knowledge did they convey? Can we really draw a line between educational and recreational games? Games are not a game, we may say to conclude. Rather they are boundary objects (Star, Griesemer, 1989), which have been crossing times and places, social classes and cultural contexts, so that today they challenge the notion of "popular" culture and they easily pave the way for the study of the mutual changes between "élites" and "people" and low and high cultures. They also give us the opportunity to discuss once more the fortunate expression "knowledge in transit" proposed by Secord (2004).

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3 - **Rosanna Evans** (University of Leeds, UK)

Problem solving: hand- and home-made objects in the Science Museum's English school science teaching collections, 1944-1988

Despite a resurgence in interest, the impact of learning experiences on scientific culture remains underestimated. Historiographies of science education, initially formed in the 1970s, have considered policy change and educational structure. This logistical and political history informed us of what ought to have happened rather than examining classroom or "grassroots" interactions and endeavouring to gain a democratic comprehension of the impact of learning about science. There is a dearth of research exploring how educational occurrences were actually experienced by young people. A tentative resurgence of work on education has looked to university teaching collections and textbooks, frequently examining education systems forming during the 19th century. Yet what of modern schools and educational techniques? For in Britain, as well as in many other countries, compulsory school experiences now affect almost every citizen. If school is one of the first times a person is exposed to material manifestations and sensory experiences of science, these experiences are likely to be hugely impactful on later engagement with science. Here, material culture is a valuable asset. Scientific apparatus, equipment and models live on as material indicators of students' physical and sensory learning experiences. This paper will investigate genuine teacher behaviours and student experiences by employing object biographies to elucidate information about relevant educational structures, networks, and regulations and gather authentic information. The Science Museum in London holds over 1200 teaching objects: many collected from schools or donated by teachers, many constructed by science teachers for specific purposes. By investigating these hand-made objects - the motivations for their construction, use and donation; their design; the materials used in construction; and evidence of use; authentic evidence can be gathered about formative experiences of science.

4 - **Isabel Malaquias & João Oliveira** (University of Aveiro, Portugal)
Thinking outside the immediate sensory box: cathodic rays and X-rays

Doing science involves frequently an immediate sensory experience: visual (titration fluorescence), hearing (Helmholtz sound resonators), touch (measuring), and smell (amines in fish, perfumist profession). However, there are situations in which there is no immediate sensorial experience (gases manipulation, certain types of radiation, mainly with the higher energetic ones) or the immediate sensorial experiment does not match yet to the final perception of the occurring phenomena, such as cathodic rays and X-rays. The introduction of these new subjects in the official curricula of physics and chemistry in the upper Portuguese secondary schools and college level, in the period ranging from early fourties to the seventies of the twentieth century, had the purpose to keep abreast with modern research and subjects circulating in the scientific community. Among these new subjects, appears the introduction of electromagnetic and corpuscular radiations both at theoretical and demonstration levels. In this presentation, we will focus on different kinds of discharge tubes (Crookes and Xray tubes) then present at secondary schools and still existing today. Some textbooks dealing with these subjects, in use in the period above mentioned, will be revisited. Moreover, we will devote our attention to gain a deeper understanding of the history of these instruments in the context of teaching and the circulation of scientific knowledge considered as relevant at different stages of science and society (physics and medicine).

5 - **Christian Sammer** (University of Heidelberg, Germany)
Health on Display: Clarity Lost and Regained in German Health Education Exhibitions during the 20th Century

Exhibitions have facilitated the public communication of health, anatomy, and physiology since the beginning of the 20th century. Stemming from the First International Exhibition of Hygiene in Dresden in 1911, the Deutsches Hygiene-Museum (DHM) developed into a major international actor in health education during the 1920s. Its travelling exhibitions were equipped with specially designed and produced preparations and showpieces and were touring Europe and the United States until the end of World War II. Already in 1946, the museum started to renew its exhibition design, soon complemented by its West-German offspring, the Deutsches Gesundheits-Museum (DGM). Both institutions defined a critically acclaimed style of health education exhibitions until the 1960s when major conceptual shifts in health education rendered its exhibitions less popular. But this decline was not irreversible: in the 1980s the Hygiene-Museum regained its expertise in making knowledge systems of health literally palpable by novel exhibition designs and 'edufacts'. Against the backdrop that health education has been framed as a trading zone of knowledge popularisation where the visual culture of medicine materialise (Serlin 2010), it is quite surprising that the history of health education, in general, and that of both German museums of health education, in particular, have gained little attention (Brecht/Nikolow 2000). In my talk, I will try to fill this gap by analysing the vast visual material from the collection of the DHM focussing on the evolution of its exhibition displays. In this way, I will elicit a more complex story of a development of science display than that of an ascent of interactive exhibits.

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Room 10: **S89 - Is historical epistemology a political epistemology? The case of knowledge from below**

Conveners: **Charles Wolfe** (Ca' Foscari University of Venice, Italy), **Gerardo Ienna** (Ca' Foscari University of Venice, Italy)

Historical epistemology in its different variants (notably French and German) has been an object of much discussion and conferences in recent years (cf. Braunstein et al. 2019). But it has not yet been evaluated as a possible contribution to a 'political epistemology' of science (Omodeo 2019). In fact, Canguilhem, Bachelard, Meyerson and others at first glance seem surprisingly indifferent to the social context of scientific practice, compared to the groundbreaking work of Hessen, Zilsel, Fleck and beyond (eg Hessen 2017), and later, the emergence of the theme of 'knowledge from below' in cultural history (e.g. E.P. Thompson and earlier, Gramsci, e.g. Thompson 1965), as well as subaltern studies. It is not that the history of science has not sought to integrate a dimension of knowledge from below, a.k.a. a 'people's history of science' (Conner 2005). It has. But the tradition of historical epistemology has not. Or if it has, it is in the form of a secret history, a counter-history, a subterranean history. In this symposium we seek to excavate and reconstruct a narrative in which historical epistemology is, or could be, a political epistemology, and one which engages with material, sensory and experiential dimensions of the triad of science, craft and technology. We examine figures including Cassirer, Foucault, Canguilhem and Bourdieu (in his little-known reflections on science and historical epistemology), and historical cases including the status of vernacular practitioners such as 'empiricks'.

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Chair: **Charles Wolfe** (Ca' Foscari University of Venice, Italy)

1 **- Sascha Freyberg** (Ca' Foscari University of Venice, Italy)

Ideals vs. Dispositifs? Cassirer and Foucault on the political dimension of the history of knowledge

This talk argues, that despite their differences and particular receptions, Cassirer and Foucault share a basic concern and motivation for writing the history of knowledge in a specifically historical-epistemological key, which is precisly a political one. While in Foucault's case this has been discussed from early on, in Cassirer's case this motivation was ruled out and has never been taken into account until recently. However, even if they share a political concern and a common interest in historical apriori, the question remains: are their approaches compatible or in contradiction? This question will be discussed along the lines of basic concepts. In Cassirer these are the ideals of knowledge (Erkenntnisideale). In Foucault these are epistemes and dispositives. The leading thread of the discussion will be the question, in how far and to what end they work out the parallel between structures of knowledge and social formations, symbolic and social forms.

2 - **Giulia Gandolfi** (Ca' Foscari University of Venice, Italy)

Science and technology as epistemology: Canguilhem on the 'pre-scientific'

This paper aims to analyze the role of technology in Georges Canguilhem's philosophy. Canguilhem examines the relationship between science and technology as a material approach to life considering

the political consequence of the production of knowledge. Should technology be considered as a prescientific moment? Or rather as a consequence of a methodical and rational approach to materiality itself? Canguilhem (like Claude Bernard) refuses to conceive technology as a mere application of knowledge. Technology is the human being's way of adapting to the "milieu" and to create new norms. The most important characteristic of technology is the possibility of improvisation, that would be nullified if we considered technology as the mere application of pre-existent knowledge. Like Bachelard's phenomeno-technology, Canguilhem theorizes a technology that is pre-scientific (his examples include medicine, agriculture and Descartes' Dioptrics and the production of glasses). The role of technology as a prelogical space enables a reflection on politics and an opening onto ecological theory. I argue that Canguilhem's way of considering the human being as part of nature and technology allows us to conceive technology as a vital "elan," distinct from knowledge but complementary. Perhaps, I suggest, technology gains a political framework if, with Canguilhem, we understand it being as the primary human modality of creating norms and establishing values.

3 - **Gerardo Ienna** (Ca' Foscari University of Venice, Italy)
Bourdieu: how to write historical epistemology from below

The well-known sociologist Pierre Bourdieu is rarely interpreted as a key thinker of historical epistemology. Yet as a disciple of Georges Canguilhem and heir of the Bachelardian tradition, he was in fact largely involved in the so-called tradition of épistémologie historique. The first aim of this paper is to locate Bourdieu in this tradition and justify his presence therein, and at the same time show how his sociological tools are constructed on the basis of solid epistemological reflection. The second aim of this paper is to highlight how his toolbox could be used in the history of science in order to construct "a vision from below". In particular, through a comparative reading of Gramsci and Bourdieu it is possible to bring to light how science can be considered as an ideological and symbolic battlefield strictly linked to cultural hegemony, thereby integrating the so-called cultural turn in history of science but in an explicit political framework. I take the example of how we might reread and differently integrate the historiographic debates on the 'Scientific Revolution' after the cultural turn.

4 - **Charles Wolfe** (Ca' Foscari University of Venice, Italy)
"La médecine empirique a existé de tout temps" (T. Bordeu, 1764): medical empiricism as knowledge from below

The history of science has taken many a turn in recent decades, a practice turn, an instrumental turn, an engagement with material practices (and before that, with the body), and a renewed recognition of the role of 'craft knowledge' or 'artisanal knowledge' as non-separable from the organized discursive constellations of 'science itself'. Curiously, all of these important turns and déniaisements of history of science seem absent from historical epistemology inasmuch as it tends to study 'forms of knowledge'. But aren't forms of knowledge also 'knowledge practices'? In this paper, focusing on the case of early modern medical empiricism, I seek to tie together the aforementioned turn towards the study of vernacular knowledge and the ambitions of historical epistemology, in order to study (and reconstruct) the possible theoretical armature of the non-academic 'knowledge from below' of the 'empiricks', whose chief characteristic seems to be that their 'artisanal knowledge' is unwritten. How to write the history of unwritten medical empiricism: that is the broad aim of a necessarily programmatic paper.

5 **- Pietro Omodeo** (Ca' Foscari University of Venice, Italy), commentator

Room 11: **S66 - Arabo-Islamic Science & the Manipulation of Nature**

Convener: **Lucia Raggetti** (University of Bologna, Italy)

Along with their theoretical systems and constructions, many pre-modern sciences and crafts of the Arabo-Islamic tradition aim at the concrete manipulation of nature in order to derive practical advantages and benefits. Medicine, for instance, derives its palette of simple drugs from the natural world for the sake of healing; alchemy, from more or less the same set of ingredients, wishes to produce dyes and artificial substances; countless are the properties ready to be exploited in plants, animals and minerals; many talismans are devised to influence weather and agriculture. A gallery of case studies may concretely exemplify this double bond between nature and sciences: first sciences and craft find in natural objects the material starting point of their practice, then they turn to the active manipulation of nature thanks to the very products that derive from it.

Chair: **Lucia Raggetti** (University of Bologna, Italy)

1 - **Liana Saif** (The Warburg Institute, UK)

The Scientific Philosophy of Talismanry: The Case of Kitāb alNukhab attributed to Jābir ibn Ḥayyān

The scientific foundations of Jabirian thought are largely discussed in relation to alchemy. The K. al-Nukhab ('The Compendium', also known also as K. al-Baḥth ('The Investigation') is an erudite text on talismanry that has been left out from the discussion on Jābir and his thought, despite the fact that it delivers one of the most comprehensive and influential scientific explanations of the causes underlying the methods for constructing talismans and their effects. This centres on a repeated definition of talismanry: "to make artificial actions in the likeness of natural actions". This is achieved on three levels: first, employing Aristotelian theories of generation and corruption especially through the "astrologisation" of these theories in the works of Alexander of Aphrodesias; second, the "magicalisation" of these theories through the works of the Arabic Apollonius of Tyana; namely, Sirr al-Khaliqa ('The Secrets of Creation') and his Kitāb Ṭalāsim Balīnās al-Akbar ('The Great Book of Talismans'); and finally by adding a quantitative aspect to his study through the application of the 'Science of Balance' for determining the material needed for making talismans. In my presentation I will introduce this fascinating text and these theoretical tactics, highlighting the magical side of the Jābirian scientific program.

2 - **Robert Sieben-Tait** (University of Bologna, Italy)

Cheering the soul: Badr ad-Dīn al-Muẓaffar ibn Qāḍī Baʿalbakk and his physiology of happiness

The Mufarriḥ an-nafs ('The soul-cheerer'), attributed to Badr ad-Dīn al-Muẓaffar ibn Qāḍī Baʿalbakk, who served under the Ayyubids as the Chief Medical Officer of Damascus in the mid-13th century, was written as a comprehensive guide for physicians to the secrets of cheering the soul. While featuring a traditional pharmacological approach on the basis of simple and complex drugs, the work additionally sets out to describe how the soul is affected by outside stimuli through the mediation of the bodily senses - hearing, sight, smell, taste, touch. This physiology of happiness suggests to the medieval physician new ways in which to compliment pharmacological treatment to cheer the soul, and to us a more complex understanding of how Arabo-Islamic science related to nature.

3 - **Masayo Watanabe** (University of Bologna, Italy)
Making Talismans in the Graeco-Arabic Tradition

In one work of the Ǧābirian corpus, the Kitāb al-baḥṯ ('The book of investigation'), talisman (ṭilasm) is defined as "an imitation of natural effects by artificial ones". Not all of the artificial imitations, however, are talismans: what makes them different from other artificial imitations is said to be the celestial observation (al-raṣad al-falkī). The Arabic manuscript tradition, however, preserves other treatise on talisman making, often characterized by a more concrete approach. This presentation will compare some points of the Jabirian talisman theory to the talismans attributed to other authorities —namely Apollonius of Tyana and ʿUṭārid ibn Muḥammad— stressing common traits and peculiar features.

4 - **Maryam Zamani** (University of Tehran, Iran)
Two Explanations for one Demonstration related to Mercury anomalies in the Almagest

Ptolemy in the Almagest, the main source in history of astronomy, has taken advantages of figures and diagrams to convey his meaning. For clarity, some commentators on Almagest have enhanced figures in their works. Taḥrīr al-Majisṭī (Exposition of Almagest) by Ṭusi is one of the detailed commentaries on Almagest in Arabic, written for advanced students. Aside from lengthy books, there are some short notes dealing with one or two unclear descriptions. Of these works, Muqaddima fī tashīh burhān al-shakl al-rabiʿ min tāsʿat al-Majisṭī (Introduction on Explanation of the Demonstration of the Fourth Proposition of Ninth [Book] of Almagest) by Muʾayyad alDīm al-ʿUrdī (d. 1266) is a short manuscript on Mercury model. He was one of Ṭusi fellow astronomers in Maragha observatory. Tusi also has discussed the proposition in his book. Shedding light on demonstration of Ptolemy, ʿUrdī and Tusi improved the demonstration by altering the related illustration in Almagest from their perspective of view. I am going to show their methods in comparison with Ptolemy's own demonstration.

5 **- Lucia Raggetti** (University of Bologna, Italy), commentator

Pause from 13.15 to 13.45

Thursday 3 September, 13.45 - 15.45

Room 1: S44 - Aesthetic representations of scientific knowledge

Conveners: **Elisabete Pereira** (Nova University of Lisbon & University of Évora, Portugal), **María Alejandra Pupio** (National University of the South, Argentina)

Chair: **María Alejandra Pupio** (National University of the South, Argentina)

The history of science has been concerned with the study of spaces, materials and actors in scientific practices, including interest in visual culture as a working object of science (Daston, 2014). Especially in fields such as archaeology and paleontology, twodimensional as well as three-dimensional devices stand out. In addition to the epistemic value, with the production of these, the intersections between traditionally antagonistic categories are observed: art and science (Wise, 2006). These images manifest the interface between the recording, interpretation, theories and communicative capabilities of visual rhetoric (Van Reybrouck, De Bont and Rock 2009). In this sense, they articulate communication between professionals, between them and lay audiences. The material devices can be the product of the academy, as well as of amateur scientists, artists, taxidermists, as a consequence of the acquisition, classification and communication of objects. At this Symposium we invite you to present papers that highlight the representational and material dimensions of the images, as well as the factors that intervene in these scientific practices. Research is expected to analyse the aesthetic and epistemic value of these material rhetorics. It is interesting to highlight the community of practice involved in its realization: academics, amateur scientists, illustrators, artists. Finally, we invite you to discuss the hearings between those who circulated and for whom these visual devices were produced.

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1- **Cecilia Simón** (National University of the South, Argentina)
Rational visual devices in the discussion of the antiquity of man in the Río de la Plata (Argentina, the decade of 1910)

From 1910 onward, there was a subtle but significant change concerning the debates of the antiquity of man in the Río de la Plata, which had occupied much of the international academy in the previous decades. Around the problem of the tertiary man or his predecessors, at this time, a new way of analyzing, producing, and communicating images is observed. New developments in the realization of visual devices linked to technological innovations are evident. The images became more rational, corresponding with mechanical objectivity as a new epistemic value. These could require the use of complicated equipment, such as optical microscopes, or be developed using simple elements like the skull guide or a stake and plaster. In any case, they indicated a standardized and passable practice of being reproduced in other laboratories. These changes are also observed in the production of these devices that tend to rationalize the author's signature, the revelation of protocols, and practices, and care to achieve good results. At the same time is registered the survival of traditional conventions of scientific representation, such as the preponderance of illustration for lithic technology and the use of

scale and compositional model in photography. This paper will discuss how these innovations in the realization and production of visual devices influenced the presentation of archaeological evidence and what role they played in the academy's discussions that took place both in the field visits and in the holding of international congresses.

2 **- María Alejandra Pupio** (National University of the South, Argentina), **Elisabete Pereira** (Nova University of Lisbon & University of Évora, Portugal), ***Object of objects": paintings and sculptures of archaeological objects from a comparative analysis between Portugal and Argentina, the first half of the twentieth century***

In the scientific practice of archeology in the first half of the twentieth century, there are included amateur scientist from small and medium scale cities in geographies as different America and Europe. Despite laws that regulate who and with which mechanisms archaeological sites and objects could be manipulated, the participation of amateurs in this period is registered. These had interference in different stages of production and scientific communication. This paper compares the practice of this science in Portugal and Argentina, examining the design of visual devices that amateurs create for communicating academics and the public about their findings in the field. They are unique and irrepressible paintings because their composition was made whit original objects, arranged according to its morphology, color, and size, in geometric designs whit straight and curved lines. These devices were made for being displayed in local museums, family houses, or schools with the double intention of providing information and aesthetic pleasure. These devices allow the discussion about visual conventions for scientific evidence, at the same time being aesthetic objects, for enjoyment and decoration. Amateur production helps deepen the study of the visual rhetoric of science, as they formed a community of practitioners on both sides of the ocean, without establishing networks of apparent relationships.

3 - **Ana Margarida Ferreira** (Civic Museum Santos Rocha, Portugal)
Didactic and artistic strategies of communication at the Municipal Museum of Figueira da Foz, Portugal (1894-1910)

In the 20th century dealbar, Figueira da Foz was a commercial port and bathing city with about 6000 inhabitants. A bourgeois, wealthy and cultured elite ruled the municipality. Within this elite comes a leader, António dos Santos Rocha (1854-1910), lawyer, mayor and archaeologist (1886-1910). He digs, sects a museum (1894), creates an archaeological society and edits a scientific journal. * The museum is archaeological and ethnographic. The provision of the collections complies with strict scientific criteria according to the highest canons of the time. The collections are presented with elegance and good taste, patent in the artistic disposition of objects, sometimes in the form of panoply, sometimes on armed fabrics, as can be confirmed in descriptions and photographs. Charcoal drawings made by Francisco Ferreira Loureiro, a member artist of the Archaeological Society, illustrated the prehistory section, with didactic purpose. ** This communication aims to systematize and make known the expository strategies of the Santos Rocha Municipal Museum in Figueira da Foz from 1894 to 1910, covering two distinct facilities, the first provisional exhibition in a historical building called Casa do Paço (1894-1899) and the permanent exhibition in a building built from the root to serve as Council Palaces, museum, library and archive (1899-1910).

References:

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4 - **Quintino Lopes** (University of Évora, Portugal)

An Experimental Phonetics Laboratory, between science and art

In the history of Experimental Phonetics, the work carried out by Armando de Lacerda, a 20th century Portuguese phonetician, is very important. A specialist in Experimental Phonetics at the Phonetics Laboratory in Hamburg and the Institute of Phonetics in Bonn from 1930 to 1933, Lacerda established the first laboratory of Experimental Phonetics in Portugal, in Coimbra in 1936, whose "splendid technical facilities", along with the international prestige of its founder and director, attracted countless foreign scientists. In this paper, we highlight the discovery of some important scientific material used at the laboratory, recently unearthed in the reserve collection of the University of Coimbra Museum of Science, including documents, instruments, photos and draws, some of them produced by Lacerda. While producing knowledge in Experimental Phonetics, the scientific practices of this laboratory also contributed to the production and preservation of information that intersects linguistics, anthropology and art.

5 - **Maria de Fátima Nunes** (University of Évora, Portugal), commentator

Room 2: T9 - Renaissance and Early Modern Medicine

Sponsored by SISUMed - Società Italiana di Scienze Umane in Medicina (Italian Society of Humanities in Medicine)

Chair: **Maria Conforti** (Sapienza Università di Roma, Italy)

1 - **Viktoria von Hoffmann** (University of Liège, Belgium)

Vidi et Tetigi. Touch, Sight, and Anatomical Experience of the Body in Renaissance Italy

The senses of touch and sight were at the heart of the new anatomical program fostered by late fifteenth and sixteenth-century anatomists such as Benivieni, Carpi, Massa, Vesalius, Colombo, Falloppio, all prominent advocates of human dissections that would soon flourish in Renaissance Italy. To foster knowledge of the inner body, these medical practitioners relied heavily on their hands and eyes, while documenting everything they had touched and seen in their postmortem records and anatomical treatises (ego vidi et tetigi). The fact that these perceptions were not only experienced but written down and publicized suggests an important epistemological value of touch and sight in the production of early modern knowledge of the body. Yet if the importance of sight, observation, and visual experience in the development of Renaissance anatomy is well known (Kusukawa), the part played by touch in this process has only been cursory examined, notably in recent studies exploring medical technè (Klestinec, Stolberg). This paper thus aims to further explore the part played by touch in anatomical settings, while questioning the interaction between haptic and visual experience: what happens to touch at a time famously known to have transformed western relation to visuality?

References

Klestinec C., “Touch, Trust, and Compliance in Early Modern Medical Practice,” in A. Whitehead *et al.* (eds), *The Edinburgh Companion to the Critical Medical Humanities*, Edinburgh, EUP, 2016, 209-224. Kusukawa S., *Picturing the Book of Nature. Image, Text, and Argument in 16th-Century Human Anatomy and Medical Botany*, Chicago, UCP, 2012. Park K. and Daston L. (eds), *The Cambridge History of Science*, vol. 3 *Early Modern Science*, Cambridge, CUP, 2006. Stolberg M., “Bedside Teaching and the Acquisition of Practical Skills in Mid-Sixteenth-Century Padua,” *Journal of the History of Medicine and Allied Sciences* 4 (2014), 633-661.

2 - **Ariella Minden** (Kunsthistorisches Institut Florence, Italy)

Creating the Scientific Image: The Case of Berengario da Carpi's Isagoge Breves (1523)

The early sixteenth century was a moment of invention and change in the production of European medical illustrations. Their yet uncertain role led to dynamic conversations among artists, printers, and medical practitioners who were attempting to negotiate the place of the image. The evolution of such discourse can be traced through a comparative analysis of three works by the surgeon Berengario da Carpi: his commentary on Mondino de' Luzzi's Anatomia, and the two editions of his more concise anatomical manual, the Isagoge Breves (1522, 1523). In this paper, I will consider how the new woodcuts commissioned for the second edition of the Isagoge better reflect Berengario's approach to the anatomized body and made illustration increasingly central to scientific communication. Although the shift from Berengario's exhaustive commentary to his much shorter manual resulted in an increased density of visual material, the precise function of the woodcuts were the subject of debate and even discontent. While the captions for each image work to affirm their centrality, the text itself and the history of their reception present a less straightforward narrative. Jacques Dubois vehemently condemned the illustrations for their frivolity, and even Berengario himself left room for doubt noting in the caption to a woodcut of the spine that it was not an accurate rendering. It is only in the manual's second edition that a drastic shift in illustrative strategy occurred, where most of the earlier woodcuts were replaced by more detailed representations of specific anatomies, including a rectified woodcut of the spine including a detail of a single vertebra. The case of Berengario's texts, all published with direct oversight from the surgeon himself, provides a unique opportunity to study the anxieties and attitudes towards medical prints and to address the question of what constituted a scientific illustration in the early sixteenth century.

3 - **Joana Balsa de Pinho** (University of Lisbon, Portugal)

Renaissance hospitals in Portugal: from visual to material culture of science

Hospitals, in the transition between 15th to 16th centuries, constituted a very important social, cultural and scientific network due to the role that they played in the society. One of the most interesting topics, but less studied, is to discuss hospitals material culture, in relation with architectural and artistic aspects exhibited by the buildings, which in turn are related to the function of the building itself. Mainly from the middle of the 16th century, hospitals claim themselves as space of science in general and space of medicine in particular; and the architectural design of hospitals and the objects adapted to this specific function and evolution. Using some cases studies, this paper intend to make this analysis resorting to both hospital buildings still existing in Portugal and to historical object and documental sources, include iconography, that provide information on the different spaces of these buildings, their use and daily dynamics, highlighting the fundamental scientific issues.

4 - **Barbara Di Gennaro** (Yale University, USA)

The Materiality of Theriac in Seventeenth-Century Bologna Standardizing Compounds through Sensory Evaluation

At the beginning of the seventeenth century, theriac—the legendary compound Andromachus created in the first century CE—enjoyed a new peak in popularity, both in medical literature and on the market. In Bologna, the medical college passed a wave of legislation intended to control apothecaries and their productions. Some historians maintain that quality control over complex compounds such as theriac or mithridate was based solely on the supervision of the production process. Indeed, the making of theriac was celebrated publicly to ensure the quality of the compound. However, archival evidence shows that collegiate physicians were also trying to establish sensory guidelines to discern what a good theriac should look, feel, taste, smell, and even sound like. In 1604, the Bolognese Protomedico, the magistrate in charge of the medical professions, started a procedure against apothecary Giacomo Domenichino. During one of the customary inspections, protomedici found dubious theriac in Domenichino's shop.

Protomedicato called several apothecaries to assess the compound asking them to evaluate three jars with different theriac. Protomedici's questions in the trial show that they were keen to establish a single standard bringing the apothecaries to agree on how to recognize a good theriac. The answers of the apothecaries show how apothecaries understood differences between compound drugs, as well as their practices. Both apothecaries and physicians understood medicines in terms of sensory experience. The Domenichini trial is a rare example of in-the-making standardization through intersubjectivity, that is through a shared agreement on subjective judgments between physicians and apothecaries. Such approach was rooted into apothecaries' manuals at least since the Middle Ages, but there are few instances like the Bologna trial that show this process in the making.

Room 3: **S48 - A Scientific Encounter: Artists responding to and engaging with research collections and museum objects**

Convener: **Richard Talbot** (Newcastle University, UK)

This symposium proposal relates specifically to a visual arts research project titled 'A Scientific Encounter' that took place at Montpellier University in 2017. Eleven artists from the UK, France, Canada, Macedonia and Germany, were invited to make art works in response to objects in the various research collections, libraries and archives belonging to Montpellier University. The project took the anthropologist of science Bruno Latour's idea of how objects interact and act on the world as its starting point – an idea he has labelled 'inter-objectivity'. The resulting exhibition was staged in the historic Medical Faculty buildings of Montpellier University and its original libraries, and drew on three hundred years of collecting by the institution. The exhibition paired artists with objects from its extraordinary collections of early-modern medical artefacts, natural history and other collections – as well as European Old Master drawings. The result was an experiment in what anthropologist Arjun Appadurai has called 'the social lives of objects'. It included, for example, one of the very first independent drawings of landscape by Annibale Carracci, shown alongside a contemporary photorealist image of an imagined future landscape, covered with four billion computer-created crystals, sculpted digitally: one for every alternate species on the planet. (Fig 1.) The artists chosen to take part in the project were intentionally very diverse in their interests and media of their practice, but all had a strong interest in objects, technologies and materials – old and new, and collections and museums. Responses took the form of drawings, 3D printed objects, videos, projections, photographs, and constructions. The symposium will be chaired by Dr Ed Juler (Art Historian), and the four speakers will be the curator of the exhibition, Alistair Robinson, and three contributing artists - Prof Richard Talbot, Irene Brown, and Prof Wolfgang Weileder. They will each discuss their particular approach to, and the questions arising from the project.

Chair: **Ed Juler** (Newcastle University, UK)

1 - **Alistair Robinson** (Harvard University, USA)
Post-Specimen

As the curator of the exhibition A Scientific Encounter, I aim to explore the question, 'What or who is a specimen?' How is an object rendered into a specimen, and as such a distinctive kind of 'thing'? The term 'specimen' carries connotations of scientific neutrality or objectivity, as though it were pan-historical rather than a relatively recent conceptual invention characteristic of one, particular idea of 'modernity'. For where even to begin with an idea that not only spans disciplines but is simultaneously redolent of scientific practice? A specimen might be understood, to borrow the term coined by Sherry Turkle, as an "'evocative object'; a class of things which act as 'companions to our emotional lives or as

provocations to thought". How could a specimen be anything but evocative, given its metaphorical embeddedness within scientific practice as exemplar, as evidence and as epistemological locus? This presentation is about specimens; or rather, it is about what happens to objects when they become 'specimens', which is to say when they enter museum or other collections. It is specifically concerned with how specimens can be re-imagined by visual artists. And it also leads us to ask if art objects, too, may be properly seen as 'specimens', or indeed as 'post-specimens'. The presentations that follow take that most paradigmatic of specimens – the objects stored or displayed in the science and medical museum – and ask how creative practice, whether written or artistic, can interrogate their scientific thingness, their epistemic objectivity, their ideological valence.

References
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2 - **Irene Brown** (Newcastle University, UK)
'Exploring the wonder of electricity'

My research explores the curiosity, wonder and even terror that accompanied scientific experiments from the seventeenth to the nineteenth centuries. In my art work, I explore the problem that the Enlightenment commitment to objective and universal truths, and to uncovering nature's 'secrets', were only ever partial, and perhaps accompanied by darker impulses. Those things invisible to us – the microscopic life and the stars beyond our sight, and the electricity that is invisible, inaudible, and untouchable – are not 'objects of knowledge' we can safely command. They are both 'Other' to us, and able to exert forms of power over us, rather than vice versa. For Montpellier, a reworked, condensed version of Phantasmagoria Electric is paired beside a Tiepolo drawing. Scientific thought could be perceived as being founded by curiosity for the natural world and the quest for the experience of the marvellous through its inexhaustible diversity and inventiveness. The creatures drawn by Tiepolo, in their swarming and their grimaces, can be regarded as the "dark Wildlife "of the diversity of species that science, philosophy, mythology and art attempted to describe and explain. They are the intense expressiveness of the satyrs or fauna of mythology, and were designed generations before the nightmares of Fuseli or Goya.

3 - **Richard Talbot** (Newcastle University, UK),
'Making Connections'

Given that the collections in Montpellier were research collections across numerous disciplines and therefore largely not mediated for public consumption, it created a situation where one could make free, anachronistic and poetic associations across the collections. I chose three seemingly unconnected objects – models of geological crystal structures, a piece of glassware involved in generating X-Rays and Francois Niceron's 17C treatise on Linear Perspective - La Perspective Curieuse (Curious Perspectives), 1652. The resulting work – a drawing, takes the form of a still-life depicting the chosen objects, and is akin to the elaborate tableaux found in perspective treatises such as Niceron's treatise – one of the selected objects. The drawing explicitly shows the mechanisms and expressions of Linear Perspective – projections, light rays, reflections and shadows, and the complex matrix ('a bundle') of lines used to construct (and connect) the visual phenomena and objects that are depicted. Thus the content and form of the drawing became, inadvertently and serendipitously, an embodiment of the act of choosing, of connecting, of making connections, and the processes of depicting. The stilllife theme was also repeated by the arrangement of the real objects in an adjacent vitrine.

4 - **Wolfgang Weileder** (Newcastle University, UK)
'Salon de Ledoux'

Weileder's response to the collections in Montpellier reflected his interest in the parallels between architecture and the structures found in nature. The work made for the exhibition can be read as a sculpture in itself or as a model of a project for a public monument. Weileder responded to the models of the circulatory systems of plants in the Montpellier collections and to Utopian visions of the neoclassical architect Claude-Nicolas Ledoux. The Ideal City of Ledoux provided a model for the movement of people where all parts of the 'political body' were in harmony. Salon de Ledoux engages with the formal and conceptual qualities of these science models to propose a new interpretation of utopian architecture, an architecture in constant flow and change. Weileder's model suggests that our scientific understandings and our social relationships go hand in hand and that the two can be subject to violent change.

Room 4: **S90 - Sensory experience in early-modern scientific writing**

Convener: **Felicity Henderson** (University of Exeter, UK)

This panel explores the processes by which sensory experiences are transformed into written accounts, and how these accounts are incorporated into scientific narratives, in the earlymodern period. The early experimental philosophers depended on accounts of sensory experience: observations of experiments and natural phenomena, tactile inspection of materials and specimens, and reports of peculiar or significant smells, tastes and sounds. Yet there was no established procedure for recording and processing such information so that it could be used as scientific data. What aspects of these narratives should be emphasised, and what might be suppressed? Did the identity and voice of the original witness matter? What existing literary forms might be used, or what new ones required? The papers in this panel explore the ways in which this challenge was approached by scientific men working across early-modern Europe. In doing so, they address the question of how individual, local, sensory experience could become part of the broader production of knowledge, through use of different literary genres, translation, and appropriation.

Chair: **Katherine M. Reinhart** (University of Wisconsin, USA)

1 - **Ivana Bičak** (University of Exeter, UK)
Versifying Experience: Early Modern Poetry Collections of Danish Anatomists

In its golden days in the late seventeenth century, Copenhagen's Anatomy House stood at the forefront of physiological and anatomical research in Europe. This paper will examine the neglected poetry production of the Copenhagen anatomists, in which they document and review their work. Michael Kirstein, a German physician and a research assistant at the anatomy theatre, dissected animals, bleached their bones, and mounted their skeletons on the walls of the theatre. He then furnished the assembled skeletons with witty Latin epigrams in which he contemplates life and death. Two decades after the publication of his Libelli III Epigrammatum (1645), Thomas Bartholin became chair of anatomy at Copenhagen and published his Carmina varii argumenti (1669), in which he similarly reflects on his own anatomical work. Just like Kirstein, he does not fail to include the sensory experiences of his research animals.

2 **- Giulia Rovelli** (University of Insubria, Italy)

Medical Case Histories and the Role of Personal Experience in the Popularization of Learned Medicine

Although medicine had been written in English since Anglo-Saxon times, the second half of the 17th century has been described as a key moment for the popularization of medical knowledge, as it witnessed the publication of an unprecedented number of vernacular medical books whose aim was that of rendering learned knowledge, which until that time had been mainly transmitted in Latin, accessible to a wider audience. While for the most part these texts represent strictly literal translations of their Latin sources, a variety of accommodating procedures was also sometimes employed in order to render them more comprehensible for and acceptable by an audience which was literate, but not university-educated. Among such strategies, one of the most significant from the point of view of popularization is represented by the inclusion of new material, which allows the translators to intrude into the text in order to accommodate it to their target audience. Medical case histories represent a particularly interesting instance of this procedure, as the personal experience of the translators, who mostly were irregular practitioners of medicine, is used to provide readers with concrete examples of the prescribed medical procedures and, most importantly, of their value. Following historical pragmatic and discourse analytic methodologies, the paper analyzes such added narrative passages in a corpus of 65 medical translations published between 1649 and 1699 in order to highlight their linguistic and textual features and better understand their role in the popularization of learned medical knowledge.

3 - **Lucia Berti** (University of Milan, Italy)

Sir Thomas Dereham: A scientific intermediary between Italy and the Royal Society

Thomas Dereham (1678-1739), baronet of West Dereham in Norfolk, was a Roman Catholic and Fellow of the Royal Society (1720), who took residence in Florence in 1718 and later in Rome. He is often mentioned in historical accounts on the history of the Royal Society and its correspondence networks, but overall very little attention has been given to his activity as a diplomat of the Royal Society and as man with scientific interests of his own. Indeed, Dereham sent the Fellows regular reports on Italian science informing them on the latest updates in all scientific fields. He would send books and papers for publication in England and diffused English scientific advances in Italy. To this objective, he also translated letters, papers, issues of the Society's Philosophical Transactions into Italian and of the Giornale de' Letterati into English. In a letter to Hans Sloane, dated 1734, he wrote that the (translated) Transactions "had so good an effect in these parts, that many curious Virtuosi here have learned our language". Dereham's correspondence with the Society's Fellows reveals a man who was devoted to science and to the Society's designs of a universal natural philosophy. By analysing his correspondence and consecutive publications in the Philosophical Transactions, the purpose of this paper is to bring Thomas Dereham to the forefront as a promoter of science and a key figure in English-Italian scientific relations.

4 - **Felicity Henderson** (University of Exeter, UK)

Silenced witnesses: everyday experience in scientific narrative

The records used by historians of early-modern science are largely those produced by experimental philosophers themselves: accounts of experiments and observations, diaries, the minutes of meetings, correspondence, notebooks and so on. In many cases, the writer is also the observer of the phenomena described. Woven through these scientific accounts, however, are the narratives of ordinary people whose experiences have been used as scientific evidence. How did they tell their own stories about what they saw, heard or felt? Is it possible to recover these original voices? How might their narratives have been re-worked for scientific use? What is emphasised, and what is suppressed? This paper will attempt to answer some of these questions by focussing on papers submitted to the Royal Society in London and

subsequently published in the Society's journal the Philosophical Transactions. In doing so, it will explore the ways in which individual sensory experience is transformed into scientific evidence.

Room 5: S68 - The practice of geometry in medieval Alfonsine astronomy

Conveners: **Samuel Gessner** (Paris Observatory, France), **Richard L. Kremer** (Dartmouth College, USA)

Alfonsine astronomy, widely prevalent in Latin Europe from the late 13th through the early 16th centuries, is generally thought to have been based on a set of tables commissioned by King Alfonso X of Castile and to have consisted primarily of tables used for computing eclipses and planetary positions for astrological purposes. ALFA, an ERC-funded, international, collaborative project launched in 2017, has been expanding this understanding of Alfonsine astronomy by finding, in the manuscript codices, scattered but richly diverse visual materials that supported astronomical practices extending beyond computation. This session will explore this visual culture by analyzing the interdependence of computation and the mathematical understanding of astronomical models in their visual, geometrical, or material realizations. Addressing the role of diagrams in canon texts, the use of geometric constructions for problem solving, the spatialization of quantitative data, and mechanical (i.e., in brass) expressions of abstract computational models, the case studies presented in the session will illustrate diagrammatic and material practices within Alfonsine astronomy. Including two speakers from ALFA and two external collaborators, the session will feature presentations by early career investigators coming from a variety of backgrounds (history of science, astronomy, mathematics, cultural history, history of philosophy, philology, history of the book and libraries) as well as comments and questions by more senior scholars.

Chair: **Matthieu Husson** (Paris Observatory, France)

1 - **Nicolas A. Jacobson** (Paris Observatory, France)

The justificatory role of diagrams in an anonymous set of fourteenth-century canons for the Alfonsine tables (Erfurt Q366 ff. 70v-73v)

In the middle of the fourteenth century, Johannes de Wasia (d. 1395), a master of arts and later a theologian at the Sorbonne, collected several sets of canons for the Alfonsine tables. One of these sets included diagrams designed to aid the user in finding the true positions of the planets. An extant witness to these canons has been preserved in a manuscript in Erfurt with the shelf mark UFB, Amplon. Q. 366, ff. 70v-73v. Scholars have thought it rare for canons in the Alfonsine tradition to contain diagrams treating planetary motion, as users could limit themselves to strictly arithmetic techniques when operating the tables to these ends. The Erfurt manuscript, however, provides clear examples of the integration of geometrical methods into the computational procedures of the canons. In this paper, I will present on a canon from this set that offers procedures for finding true solar positions. I argue that there are actually two parallel chains of exposition within the canon, the first of which instructs the user in purely arithmetical terms, while the second resorts to a geometrical demonstration with a strong reliance on the geometrical diagram. This format of presentation bears many similarities to that of the Theorica Planetarum of Campanus of Novara, which suggests that the diagram for the canon served a justificatory function of the efficacy of the canon's procedures. If I am correct that the geometrical element of the canon offers – to use Campanus's words – "the reasoning behind the mode of operation with tables," then it is also possible that this second portion of the canon gives the reader glimpses, not only into how tables were used, but also into the methods by which a table-maker constructed valid tables in the first place.

2 **- Laure Miolo** (EPHE - PSL, France)

Figuring and calculating eclipses at the end of the 15th century: Lewis of Caerleon and his geometrical canons

Lewis of Caerleon (d. c. 1495) was a physician trained in Cambridge, and perhaps also in Oxford. His case presents a striking example of astronomical practices in a troubled context, that is the War of the Roses. A physician of the Lancastrians, he was incarcerated for conspiracy by Richard III in the Tower of London in 1484. Released when Henry VII became king of England, in August 1485, he was appointed as Royal physician. In parallel with his career as a physician, Lewis of Caerleon was an expert in astronomy. During the 1480s he composed eclipse and parallax tables, eclipse canons and other short texts related to eclipse phenomena. He also performed a series of eclipse calculations ranging from 1481 to 1485. His incarceration did not stop his activity as he continued to compose texts and table in the Tower of London. Amongst several eclipse canons he composed, there is a canon for calculating eclipses geometrically: De modo calculandi eclipses geometrice sine tabulis. This text is preserved in two manuscripts, displaying diagrams for illustrating it. Canons for figuring geometrically an eclipse are quite common in the Medieval and Early Modern Latin tradition. Although Lewis of Caerleon's canons contains a part dedicated to this geometrical figuration, the main purpose is to calculate 'geometrically' the magnitude and duration of the eclipse in order to avoid the use of the tables, which is unusual. My paper will focus on this peculiar text. In that framework, I will explore Lewis of Caerleon's sources, vocabulary, and diagrams in order to better understand the aim of these canons as well as to situate them in context.

3 - **Angela Axworthy** (Max Planck Institute for the History of Science Berlin, Germany)

Geometrical models of the universe in the fifteenth century: the case of Prosdocimo de' Beldomandi

As a means to provide an insight into the ontological and epistemic status of geometrical models of celestial motions in fifteenth-century Alfonsine astronomy, this paper will consider the cosmological teaching of Prosdocimo de' Beldomandi (1370/80–1428), who was a professor of mathematics at the university of Padua and who contributed to the Alfonsine tradition by providing a new compilation of his predecessor Jacopo de Dondi's tables for Padua in 1424. As others before and after him, Beldomandi tackled the issue of the geometrical representation of the universe within a commentary on the Tractatus de sphaera by John of Sacrobosco, which he commented in 1418 and which was printed in Venice in 1531. Beldomandi was then addressing an audience of students, and above all of beginners in the field of astronomy, as was Sacrobosco in his time. But the extensive discussion of the content of the Sphaera by this Paduan professor, who was influenced by the fourteenth-century Parisian school of natural philosophy as well as by the work of his predecessors of the university of Padua, leads the reader quite far from the rather schematic teaching of the Sphaera and from what students were expected to know about spherical astronomy in this context. An overview of the parts of this commentary on Sacrobosco pertaining to the number, form and mutual relation of celestial spheres, the possibility of contrary motions in the celestial realm, as well as the ontological status of partial orbs, will enable to present Beldomandi's views on the role of geometry in the apprehension and the depiction of the celestial order and of planetary trajectories.

4 - **Samuel Gessner** (Paris Observatory, France)

The transposition of numerical data from tables onto the scales of instruments: Teorice novelle (15th c.)

Alfonsine astronomy included a practice of reworking tabular source material into new and often subtly clever formats. Besides novel types of tables, astronomers have also attempted to recast the tabulated quantities into diagrams, among which planetary equatoria. Poulle distinguished between 'geometrical' and 'mathematical' equatoria based on whether their shape materializes eccentricities and epicycles of the planets, or whether their configuration rather allows to 'seperately obtain the components familiar

to table users'. Within this second group, different ways to 'spatialize' quantitative data make their appearance during the Alfonsine period, including the special syzygy instruments with oblique lines from the 1440s, horoscopic instruments with "curvy" lines, both studied by Kremer (2011), and Petrus Apianus' and Philipp Imser's latitude instruments of 1540 and 1550s. This paper will look into the small corpus of Teorice novelle instruments established by Poulle (1980). This type emerges within astronomical circles in Erfurt and Leipzig and often comes with mean motion tables and user instructions. Directly examining the material realization of some instruments in parchment or paper allows tracking the problems the maker confronts when pursuing the simple principle on which they are based. Scrutinizing manuscript instructions for the Teorice Novelle provides hints at the mindset behind their conception. Together both approaches allow going a step beyond Poulle in characterizing the instruments' relationship with the tabular approach in astronomy.

5 - **Richard L. Kremer** (Dartmouth College, USA), commentator

Room 6: **S83 - Envisioning Mathematics - 2. Artistic Imagery**

Convener: **Tatiana Levina** (National Research University Higher School of Economics, Russia), **Anya Yermakova** (Harvard University, USA)

Chair: **Irina Starikova** (National Research University Moscow, Russia)

1 - **Tatiana Levina** (National Research University Higher School of Economics, Russia)
Symbol of Absolute Infinite: Visualising Georg Cantor's Idea

Is it possible to comprehend the 'Absolute Infinite' and could a world contain a symbol that helps people – philosophers or mathematicians – understand the absolute? For Georg Cantor an absolutely infinite sequence of numbers was the "appropriate symbol of the absolute". In the "Foundations of a General Theory of Manifolds" (1883) he adds that the absolute can only be acknowledged but never known. As Cantor's set theory has become the foundation of contemporary mathematics, it is essential to clarify the philosophical background that Cantor associated with it in order to elucidate his interpretation of the problem of infinite. Russian philosopher Pavel Florensky was influenced by Cantor's ideas and wrote the article "On the symbols of infinity" in 1904. In this paper he says that the transfinite mathematics of Georg Cantor is an example of a symbolic vision of God. Symbol, as Florensky wrote in his memoirs, was the most important concept in his own philosophy throughout his life. Symbol has a distinctive ontological mode of existence and its primary property is to be the reference for the higher being, namely God. Contemporary theologian Christian Tapp, who researched Cantor's interest in theology, doesn't consider the notion of symbol as important in Cantor's works. For Tapp, Cantor is saying that symbolic vision means 'not direct', therefore God cannot be understood and transfinite numbers cannot be connected with knowledge of the Absolute Infinite.

2 - **Anya Yermakova** (Harvard University, USA),
Rethinking 'scratchwork' for the global history of science: the case of Logic in the early 20th C Russian Empire

In 2011 Amir Alexander notoriously called mathematics the "skeleton in the closet" for historians of science. Made invisible (to non-experts) by its own merits of abstraction, mathematics as a science has remained on the sidelines of the visual, material, and sensory critical explorations. The history of mathematics' relation to logic, as was practiced at the turn of the 20th century Russian Empire, too is marked by substantial gaps in scholarship, though for different reasons. The intellectual work around

mathematics and logic, for various reasons, dissipated and was largely left unfinished following the 1917 Revolution. While such a gap may appear as a disadvantage, for a critical theorist mindful to expand our understanding of what constitutes mathematics, this case study of unfinished logical investigations opens up a fruitful territory. Namely, researching this history becomes as much about mathematics and logic as about methods for investigating incomplete histories and, with that, histories of intention. This paper presents archival 'scratchwork' from the notebooks of Nikolai Bugaev (1837-1903), Ivan Lapshin (1870-1952), Dmitry Grave (1863-1939), and Nikolai Lange (1858-1921). All polymaths, from differing disciplinary bases, these characters were investigating foundations of mathematics, with a particular interest in logic. A careful review of drawings and diagrammatic reasoning in this scratchwork elucidates various background assumptions and background intentions, which are noticeable in printed literature left by these scholars but never clearly explicated. These include: fluidity between the continuous and discrete spaces, dynamic ordering and sorting principles, metaphorical expansion from mathematical symbol to symbol-in-itself, and treatment of perspective in mathematical reasoning. Serious approach to 'scratchwork' for the purposes of investigating mathematical thought experiments thus extends the notion of mathematical conjecture (Mazur 1997) to include incomplete works, background assumptions and intentions, and even inscribed thought experiments formulated in ways other than in standardized Western notation. Moreover, for the case of the late Russian Empire specifically, careful investigation of visually informative material of the aforementioned characters serves to clarify similar preoccupations of other notable scholarship of the time, thus extending these visual improvisations into a sociality not otherwise historically obvious.

3 - **Tamara Caulkins (**Central Washington University, USA),

Geometry for Nobles: The Mathematics of SelfFashioning in the Age of Enlightenment

During the seventeenth and eighteenth centuries, geometric thinking captivated the popular imagination. Geometric lines and labels superimposed on pictorial images connected lessons from geometry to real-life problems in fencing, landscape design, and equestrian formations. Abstract graphic visualizations simplified complex information, standardized visual "languages," and served as instruments of reason to consider and communicate findings in mathematics, physics, chemistry, astronomy, natural history, and other scientific areas. Inspired by the explanatory power of geometric diagrams, Pierre Beauchamp (1631-1705), Louis XIV's choreographer and dancing master, invented a system of notation for court dance. Diagrammatic notation systems were also invented to map the movements of soldiers performing military drills. Court dance and military maneuvers were traditionally associated with the nobility. When these diagrammatic notations were used to describe movements associated with noble bodies, they divulged secrets of moving in an aristocratic fashion to aspiring elites. In contrast to Enlightenment narratives that assume that people became increasing individualistic over the course of the eighteenth century, geometric diagrams reveal groups of people moving together in increasingly coordinated ways in dance and drill.

4 - **Michele Emmer** (Sapienza University of Rome, Italy)

Parallels Stories in Mathematics and Art

Soap bubbles may seem only children's games, but actually, they have very clear applications in physics, mathematics and architecture among others. Stemming from art, where, in the sixteenth century they were depicted by many major artists, they have sparked the interest of scientists and mathematicians. In particular the works of Joseph Plateau and the form and laws of soap bubbles and soap films he discovered are the starting points of the modern theory of Minimal Surfaces and the Calculus of Variations. The advent of computer graphics opened new possibilities for the study of the geometry of soap bubbles that were completely unthinkable only a few years ago. The paper ends with the large exhibition "Soap Bubbles : The Forms and Utopia Between Vanitas, Art and Science" organized in Perugia, Palazzo dei Priori, March 16/June, 9, 2019, with works among others of Goltzius, Netscher, Bailly, Chardin, Beckman, Man Ray.

Room 7: **T1 - Sciences and Visual Arts**

Chair: **Koen Vermeir** (French National Centre for Scientific Research - CNRS, France)

1 - **Antoni Roca-Rosell** (Polytechnic University of Catalunya, Spain),
Teaching of drawing in the 18th century in France and Spain and the beginnings of technical education

In the XVIII century, drawing increased its relevance for many aspects of activity in the workshops, design cabinets, and factories. In Paris, in 1767, it was created an Ecole Royale Gratuite de Dessin in Paris for young boys of humble social extraction. In Spain, there was a free school of design in Barcelona, set up in 1775. The centre was supported by the local industrialists and tradesmen. Drawing had also a central role in the early training of architects and engineers. In this paper, we analyse the context of the establishment of regular teaching of design and drawing and the debates around its place in the renewal of industry and architecture.

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2 - **Alberto Vianelli** (University of Insubria, Italy)
From unique artworks to public reproductions in a scientific journal: the vélins and the first years of the Annales du Muséum d'Histoire Naturelle

It is often said that the period between the end of XVIII century and the beginning of XIX century has witnessed a "second scientific revolution". Certainly, it has seen the transition, among others, from natural history to the history (and science) of nature, as Giulio Barsanti has put it1 , as well as the birth of the "Scientific journal"(A. Csiszar2). The National Museum of Natural History in Paris, established in 1793, can indeed be considered a place in which these two threads were particularly intertwined via the publication of the periodical "Annales du Muséum d'Histoire Naturelle", founded in 1802 by the professors of the Museum themselves. The scope of this journal was indeed ambitious, not being limited to the publication of the professors' observations, and, according to the programmatic statements, illustrations had to play a key role. In my contribution, I will focus on the precious vellums (vélins) commissioned to the Museum's artists by Jean-Baptiste de Lamarck and on their transformation in engravings to be used in the journal's plates to illustrate the publication of his mollusk fossils classification work, which is thought to be one of the main factors leading him the elaboration of his evolutionary (in the current meaning) ideas. This story on one side tells the early use of the images by naturalists as "specimens of substitution" (M.Rudwick3) and of the shift of the very meaning of what a "good image" (P.Y.Lacour4) should be. On the other side, the material factors, including the economical ones, shaping the professors' effort to publish images, allow not only to propose a reconstruction of the journey of the images, but also a glimpse at the Museum's naturalists "strategy of communication" in this new era of scientific publication.

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3 **- Nelson Arellano-Escudero** (University Academia Humanismo Cristiano, Chile)
TSolar techs visual representations: science, technology and the governance of social value (1816-1976)

Since the XIX century and during XX c., most of the inventions, facilities or compounds related to solar energy technologies were extinguished and completely lost. Little debris or traces remain in places like Chile, Greece, Australia, the Soviet Union, among others. Connecting those loose memories, we are able to produce a narrative about discard, oblivion, endurance, and success of the relationship between solar radiation and artifacts. A collection of visual productions allows analyzing the appropriation, uses, and representations linking a network that integrates western and west, and north and south in their global geographies. For this paper were selected a picture by John Martin (1816), 5 photographs (1907, 1948, 1966, 1970, 1976) and a one-minute movie from a newsreel (1945). Interaction between technology and arts Technical and industrial design could be understanding from History of Science and Technology thanks to a contribution from Social History following the Peter Burke's proposition (2001) and Environmental History (León & Erviti, 2015). Thanks to visual narratives and the testimony of images we studied conventions, discourses, stereotypes, etc. of technical photographs, fine arts and their links with engineering social values. This visual journey open access to the discussion about the governance of social values which had little consideration into the field of innovation hitherto, and allow contribute to understanding visual, material and sensory cultures of science and technology.

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4 - **Xavier Calvó-Monreal** (Catalan Society for The History of Science and Technology, Spain)
The unknown work of art and the consolidation of a research group: The Department of Macromolecular Chemistry, according to Jordi Maragall i Mira

Portraiture is an important medium of building identities. It is not just the artist or the models. The institutions with which they are related must be considered. That is why, when examining the people portrayed, we must do so by considering the type of activity they carry out, because human actions take place in specific social contexts. When people or groups are interested in their public image, portraits can be used as a tool in order to forge personal or collective identities, revealing the status and value of these people or groups, not only in terms of composition, format and place, but also by its use. Considering the leitmotiv of the Conference, my intention is to focus on these aspects studying an example of the image of science and the consolidation of a research group, the Department of Macromolecular Chemistry of Barcelona, through the painting of the same name by Catalan artist Jordi Maragall i Mira . The group showed its cohesion, not only through their research program in Structural Molecular Biology, but also through a set of images that reflect this reality. I will mainly use Maragall's painting, but special mention will be made of a set of photographs by unknown authors who complement it and show this cohesion with realistic images in other situations than the research itself.

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5 - **Maria Concetta Calabrese** (University of Catania, Italy)

The Scientific Collection of Antonio Ruffo: Scientific Objects, Art Commissioning, and Material Culture in Early Modern Messina

Through a deliberate policy of cultural patronage, in the seventeenth century the Senate of the city of Messina managed to attract a host of remarkable individuals to the city. These included the Roman physician Pietro Castelli (1635-61), the mathematician Giovanni Alfonso Borelli (1639-56), the Bolognese Marcello Malpighi (1662-66) and Carlo Fracassati (1670-72), all of whom were strongly disliked by the local aristotelians. This flourishing was possible also thanks to the support of the local nobility, which was outward looking and well connected with what was going on in the peninsula. Among these noble families, the Ruffo can be singled out as particularly active on the cultural scene. Antonio Ruffo, Prince of Scaletta, is remarkable for the quality and breadth of his artistic and scientific and artistic collections. His Wunderkammer included beautiful paintings, tapestries, jewelry, rare and precious objects, corals, and even a 'unicorn'. In order to understand Ruffos's personality and tastes, it is important to investigate his relationship with Agostino Scilla, philosopher, painter, scientist and a leading figure within the seventeenth-century Sicilian intelligentia. Scilla, with his scientific and artistic interests and with his ingenious personality undoubtedly influenced Ruffo's taste and interests. Nobody could match Scilla for its interest in nature in all its rarities and particularities. This friendship explains better than any other Ruffo's own interest in natural history and in possessing rare natural specimens like precious stones and even a unicorn horn. Antonio Ruffo's Kunstkammer, which Francis Haskell defines as a "citadel of European culture" and recently defined by Paula Findlen, along similar lines, as one of the most stimulating and cosmopolite "visual laboratories" of the seventeenth century demands that we examine with renewed attention this Sicilian patron, around whom much of the intellectual, scientific and artistic elite gravitated. This paper will examine neglected aspects of Ruffo's patronage, trying to reconstruct not only the artistic connections, which are better known, but also his scientific patronage and the objects that made up his Kunstkammer.

Room 8: **S22 - Color Charts as Trading Zones between Science and Art 1500-1800**

Convener: **Giulia Simonini** (Technical University Berlin, Germany)

The seminal role played by color in the progress of science, technology, industry and commerce during the early modern period and enlightenment has never been thoroughly analyzed from a broad perspective. Today we tend to compartmentalize the historical investigation of color science, artisanal technology, and commercial endeavors as separate fields. However, historically, coloring substances represent a clear-cut intersection between these three worlds. The opening of communication channels between artisanal and academic worlds has been defined by Pamela O. Long a "trading zone" (Long 2011). The growing interest of natural philosophers in the processes of extracting pigments and dyestuffs from raw materials and the ability to control their use with systematic and scientific approaches were fundamental factors in the technological and commercial advancements that are usually associated with the early modern era and enlightenment. Gradually the secretive and tacit knowledge of artisans was offered to the sciences and popularized in dictionaries, encyclopedias, and academic journals. How was this possible in the first place? What were the driving forces that allowed the emergence of trading zones in mastering color extraction, manufacturing and application between science and artisanry? Besides the publication of color recipes and painting techniques as educational tools, this specific trading zone allowed the production of (colored) visual tools, like color charts, painting palettes, sample cards and pattern books, relating to color technology, color teaching, and color selling. These visual tools have been generally regarded as painters' instruments and teaching aids, and only in few recent studies linked to the sciences (Lowengard 2006; Kuehni and Schwarz 2008;

Bushart and Steinle 2015; Karliczek and Schwarz 2016). We propose a symposium which will focus on intersectional aspects of trading color-related information and knowledge, from chemistry through commerce to art, inviting historian of sciences as well as historians of other disciplines to share their competences.

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Chair: **Sarah Lowengard** (The Cooper Union, USA)

1 - **Truusje Goedings** (Indipendent Scholar, Netherlands)

A 17th Century Dutch Attempt at Making a Full Colour System with over 1,700 Different Hues

This paper aims at shedding new light on a late 17th-century Dutch manuscript completely dedicated in word and image to colours and their endless variety of hues. This small octavo size manuscript comprises 884 pages, including some filled with colour charts, and it seems to be ready for publishing. Its layout is remarkably systematic, precise, and consequent. It contains 1,723 large colour samples accompanied by short explanations of their composition, made accessible by a register at the end of the book, displaying further 352 smaller samples and repeating some of the hue in the book. Written in Delft in 1692 by one Mr Boogert, probably a well-educated enthusiast of illumination and optical science, this manuscript represents one of the first large attempts to standardize colour mixtures into a system. Until recently this colour book led a hidden existence in the Bibliotheque Méjanes in Aix-enProvence, France. At the time of his compilation it was likely conceived as a how-to book for Dutch 17th-century colourists (afsetters). Hereby, Boogert's system will be described and analysed, his motives assessed according to his own words and the artistic and intellectual climate of his time. Moreover, his work will be compared to modern colour systems like Pantone or Rall to see if comparison will stand.

2 - **Erma Hermens** (University of Amsterdam, Netherlands)

'Through the eye and through text'. A unique 17th-century Dutch Colour Chart for Painters: Identification and Interpretation

'Come and read this book which will engage you, both through the eye and through text, and you will be taught what to do to give everything after life its colour and character properly and accurately…' This is how, in its introduction, 'The Bright Lit Mirror of Painting…' (De KlaerLightende Spieghel der Verfkonst, Special Collections of the Bibliothèque Méjanes in Aix-en-Provence), offers a rationale for its remarkable format of page after page of colour samples with accompanying annotations. Written in Delft in 1692 by A. Boogert, this manuscript is a colour chart in book form. Although aimed at so-called afsetters, painters who coloured prints and drawings with watercolour, it is equally significant for oil painters. Boogert planned this unusual colour chart meticulously, as each colour page was first embossed with square shapes which frame each colour proof. On the facing page is a written description of the pigment, or of the ratios of the pigment mixtures. Along with the pure pigments, each colour is also presented in lighter and darker hues due to admixtures of white or black, and combinations with other pigments. This manuscript forms a truly unique resource on the manufacturing and trade of pigments, their specific uses, and chemical composition. However, it also poses many questions on the format used both in its layout and unusual physical features such as the embossed pages and the proposed colour mixtures, as well as on its function, its origin in 17th -century Delft, and its context of artistic, scientific and optical developments, all of which will be addressed in this paper. A full transcription, translation and

annotation of the treatise will be produced as part of a collaboration between the Rijksmuseum, the Bibliothèque Méjanes, and LAMS, which also includes scientific analyses to identify the pigments.

3 - **Giulia Simonini** (Technical University Berlin, Germany)
Lambert's Color Pyramid: Practical Applications for Artists' Techniques and Materials

The Mulhouse-born mathematician and astronomer Johann Heinrich Lambert (1728–1777) published in 1772 a book titled Beschreibung einer mit dem Calauschen Wachse ausgemalten Farbenpyramide (Description of a Color Pyramid Painted with Calaus' Wax). This book includes a pyramidal color chart, which scholars have so far regarded as a theoretical color order system. In fact, Lambert devised this pyramidal color chart for rather practical applications. Among these applications we find, for instance, the so-called painting-bynumbers technique and the production of color boxes with prefabricated color cakes. The painting-by-numbers technique is usually associated to the botanical draftsman Ferdinand Bauer (1760–1826), and the invention of prefabricated color cakes has been ascribed to the brothers Reeves and dated 1781. Even though it is widely acknowledged that Lambert's work rested on the color triangle of the mathematician Tobias Mayer (1723–1762), Lambert drew on the tacit knowledge of artisans too, who made use of similar visual devices to identify different color nuances and admixtures. Indeed, the pyramid project was carried out in collaboration with a "color expert," the court painter Benjamin Calau (1724–1785). A striking difference between Lambert's work and that of practitioners, though, are the tenets on which the color chart is based: trichromacy of paint mixing. Unlike painters and dyers, Lambert reduced the number of primary colors to three (plus black). Since the practical aspects of Lambert's pyramid have barely received any scholarly attention, this paper aims at presenting them within their historical framework. Hereby, the prefabrication of color cakes and the description of the painting-bynumbers technique will be the two cases in point analyzed in the attempt at contextualizing Lambert's work on colors. Moreover, this paper will focus on the impact of Lambert's work in disseminating tacit artisanal practices and in the commercialization of new artists' materials.

4 - **André Karliczek** (Friedrich-Schiller-University Jena, Germany)
Materialization of Vision – Color Standards in the Early Sciences

The development of universal and binding norms and standards was fundamental to the emergence of modern science. The quantification of nature by means of various measuring tools in the 18th century was followed by the standardization of their non-measurable, aesthetic qualities, such as color. Following Linnaeus' revolutionary teachings in natural history, standardizing visual traits became an essential desideratum, because they often allowed to distinguish insects and minerals too. But how were scientists to single out the colors of nature in a time when no synthetically reproducible colorant was available, and no binding color nomenclature was established yet? How could an eighteenth-century naturalist describe the colors of a butterfly safely? In addition to the description and identification of colors in nature, color standards also enabled the analysis of color changes in natural processes such as the origin of sky blue or the different nuances of urine. This paper aims at tracing the emergence of color standards in the early sciences in all realms of nature. On the one hand, it will be shown how natural history investigation has been able to draw on procedures already established in artisanal and artistic practice and, on the other hand, to adapt them for their specific requirements. The paper will answer questions like which standards and prerequisites must be met for a color standard to be acknowledged, handed down, and internationally spread? With the case in point of the Freiberg geognosist Abraham Gottlob Werner (1749–1817) it will be shown how a set of primary colors to describe the colors of nature was developed and then handed down by his students and followers up to the second half of the 19th century, including Charles Darwin, crossing disciplinary and geographical boundaries.

5 - **Friedrich Steinle** (Technical University Berlin, Germany), commentator

Room 9: **S93 - Medialities of natural knowledge in 18th century Europe: herbaria, notes, illustrations**

Conveners: **Alexandra Cook** (University of Hong Kong), **Sarah Benharrech** (University of Maryland, USA)

Drawing on four case studies, this symposium considers various approaches to gathering, organizing and visualizing natural knowledge in eighteenth-century Europe, together with implications of these practices for scientific legacies and reputations. Alexandra Cook's paper, "Giving Credit Where Credit is Due," posits an archeology of the visible trace as essential in establishing and/or resurrecting a scientific reputation. The visible trace in question is the red wax used by Dutch East India Company ship's surgeon, Laurent Garcin (ca. 1681 - 1751) to attach specimens to herbarium sheets now distributed anonymously in the Geneva Conservatoire et jardin botaniques herbarium. Identifying such traces is crucial to assessing scientific contributions by those who, while important during their lifetimes, have sunk into obscurity for lack of physical records. Sarah Benharrech's paper, "Abbreviated botany," looks at the botanical pedagogy of Antoine-Laurent de Jussieu on the basis of notes taken by his students. Dorothée Rusque's paper, "Making Nature Visible: The Graphic Representation of the Animal World in Jean Hermann's *Tabula affinitatum animalium* (1783)," presents the Strasbourg physician's table of animal affinities as two levels of visualization: classifying zoological species according to Linnean norms while the imbrication of the horizontal and vertical lines of the network determined their degree of affinity and the gradations between the classes. His work gave rise to an epistemological revolution by representing nature in three dimensions. Cabelle Ahn's paper examines the exhibition, production, and visual reformation of natural history drawings at the twilight of the French Revolution, taking as examples Gerard van Spaendonck (1746 - 1822), Pierre-Joseph Redouté (1759 - 1840). She takes the dual meaning of the word *exposure* as an organizing conceit to ask how natural history drawings were *exposed*, presented, and exhibited to the public; and how was the pedagogy of plant iconography subject to *exposure* to institutional upheavals?

Chair: Alexandra Cook (University of Hong Kong)

1 - **Alexandra Cook** (University of Hong Kong),
Giving Credit Where Credit is Due: Or why searching for a needle in a haystack is worth it

In early-modern Europe, it was often the case that the more credible the witness of an experiment, an observation or an event, the more credible the evidence reported (Shapin and Schaffer, Hayward). However, enjoying credibility during one's lifetime did not necessarily translate into a posthumous scientific legacy; if a savant's collections—which could well constitute the principal source of his/her credibility—were dispersed, his/her legacy might be in peril. A notable case is the Duchess of Portland, whose vast natural history collections were auctioned after her death, thereby obscuring her importance to science (Tobin). The preservation of Linnaeus's and Sloane's collections as constituted by their creators are notable exceptions to the usual practices of sale and dispersion. This paper looks at the case of VOC ship's surgeon Laurent Garcin (1681? – 1751) F.R.S., who attained credibility in his lifetime, only to fade from the record posthumously. I argue that this is largely attributable to a common and scientifically justified practice: the systematic distribution of Garcin's herbarium specimens in the general collection of the Geneva Conservatoire et Jardin botaniques. In the absence of the standardized labels used today, Garcin's specimens are rendered recognizable only by the red wax with which he secured them to the paper. Retrieving specimens once dispersed is nothing short of searching for a needle in a haystack; yet the endeavor is an important one for the history of science.

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2 **- Sarah Benharrech** (University of Maryland, USA)

Abbreviated botany: note-taking in A.-L. de Jussieu's courses (1775-1777)

Women's contributions to botanical knowledge are well documented thanks to the works of scholars like A. B. Shteir, S. George, M. Carlyle, to name a few. However, in most instances, little is known about the process by which these women gained proficiency in botany, especially when their knowledge acquisition occurred in the absence of male mentors, such as husbands or fathers. Mme Dugage de Pommereul (1733-1782) was one of the few known women practitioners of botany in late eighteenth-century France. She attended the courses that Antoine-Laurent de Jussieu taught at the Botanical School for three consecutive years in 1775-1777. The loosely bound sheets of paper she used to jot down notes can still be found in the collections of the Museum in Paris. My presentation will focus on the notes she took while attending Jussieu's lessons. Mme Dugage's notebook documents an exceptional case on which scholars have had until now very little information: course notes written by the student, and not by the teacher. Her notes help shed light on the history of the transmission and processing of information. To that end I intend to examine the materiality (F. Waquet) of the manuscript (ink, watermarks, notes, abbreviations, corrections, additions) and the paper technologies (shorthand, diagrams, charts) (S. Müller-Wille) allowing her to record and summarize the various botanical information of the course content. By comparing her notebook with Jussieu's teaching notes, it should be possible to assess her learning outcomes in botany.

3 - **Dorothée Rusque** (University of Neuchâtel, Switzerland)

Make Nature Visible. The Graphic Representation of the Animal World in Jean Hermann's Tabula affinitatum animalium (1783)

The scientific practices of the French naturalist Jean Hermann (1738-1800) demonstrate that Natural History knowledge was focused on the production of visualization devices. The Professor of Medicine, Chemistry and Botany at the University of Strasbourg created a rich Natural History cabinet, which he used as research and teaching equipment. If the dialogue between the different objects of the cabinet - natural specimens, books, images - was essential during the observation process, Hermann's publications reaffirmed the morphological character of naturalist writing in the 18th century. His Tabula affinitatum animalium (1783) is conceived as a tool for visualizing Nature. It is based on a one-meter table which depicted the animal world in a reticular model that aimed to capture, at a glance, the multiplicity of morphological affinities uniting the different species2. The book itself consisted of a commentary of the affinities, which are discussed. The table disavowed the idea of a linear series of Nature defended by Charles Bonnet (1720- 1793) to highlight the complexity of the relationships between natural beings. If Peter Simon Pallas (1741-1811) described the tree as the best representation of Nature in 1766, Hermann was the first to give a graphic representation of the idea of the network formulated by Vitaliano Donati (1717- 1762) in 1750. Hermann's table combined two levels of reading. It classified the zoological species according to the Linnean system while the imbrication of the horizontal and vertical lines of the network determined their degree of affinity and the gradations between the classes. Hermann's scientific contribution lay less in the detection of affinities than in their visualization. His book gave rise to an epistemological revolution3 because his initial project was to represent Nature by a threedimensional model. At the crossroads between visible and readable, the Tabula questions how a graphic representation can materialize a "vue de l'esprit".

4 - **J. Cabelle Ahn** (Harvard University, USA),

Conducting Nature: Exposing Plant Iconography in Late Eighteenth-century Paris

This paper studies the exhibition, production, and visual reformation of natural history drawings at the twilight of the French Revolution. The paper takes the two artists as case studies: Gerard van Spaendonck (Tilburg, 1746- Paris, 1822), the last peintre en miniature at the Jardin du roi, and later the first and only professor of plant iconography of the newly formed Muséum national d'histoire naturelle and his assistant and part-successor, Pierre-Joseph Redouté (Saint-Hubert, 1759- Paris, 1840). While Redouté has subsequently been crowned as "Le Raphael des Fleurs," for the ineluctable vitality of his drawings and handcolored prints, Van Spaendonck has been largely forgotten in scholarship. Along with Van Spaendonck, the foundational history of natural history drawings during the reorganization of Jardin and Cabinet du roi into the modern-day Museum national d'Histoire naturelle has too escaped scholarly attention. This paper thus takes the dual meaning of the word exposure as an organizing conceit to pose the following questions: how were natural history drawings exposed, presented, and exhibited to the public; and how were the pedagogy of plant iconography subject to exposure to institutional upheavals? In this, I examine various late eighteenthcentury attempts to make the vélins du roi (natural history watercolors on vellum painted by Van Spaendonck and later Redouté) accessible to a wider public for the arts, how the systematization of natural history impacted scientific and artistic attitude to these painted plant iconographies, and finally, how the consolidation of prints, herbaria, and drawings exposed pedagogical limitations of botany and the epistematic character of natural history drawings in late eighteenth-century France.

Room 10: **S73 - How can the description of visual and material practices contribute to a better understanding of scientific cultures? - 2. Scientific cultures**

Sponsored by DHST-DLMPST scientific section IASCUD (International Association for Science and Cultural Diversity)

Convener: **Karine Chemla** (CNRS / University of Paris, France)

The symposium aims at understanding how historians and philosophers might draw on visual and material resources used in given contexts, and on the ways actors used them (that is, the practices with them), to better grasp scientific cultures. Part 2 focuses on scientific cultures. The first two presentations examine the relationship between, on the one hand, material devices and practices and, on the other scientific cultures. Drawing on philosopher of science Rein Vihalemm, Müürsepp analyzes how material practices in the context of experimental research, including the equipment they bring into play, shape scientific cultures. Focusing precisely on a specific apparatus used in the National Accelerator Laboratory, that is, supersonic gas jet targets, Vitaly Pronskikh unpacks how epistemic practices and then, an epistemic culture take shape in the Laboratory. The last two presentations examine how pictural representations and practices with them characterize scientific cultures, and how this has a bearing on the way in which knowledge circulates. Xi Gao deals with a case when a body of knowledge was introduced in China, without the material practices on which it drew in Europe, that is, autopsy. She thus describes how material and visual resources and practices are shaped to accommodate and teach the new knowledge, thereby leading to the shaping of a scientific culture. Han Qi examines how practices of representing scientific instruments brought from Europe in China sheds light on the culture receiving them.

Chair: **Karine Chemla** (CNRS / University of Paris, France)

1 - **Peeter Müürsepp** (Tallinn University of Technology, Estonia)
Practical Realism and Material Practices

In the early 21st century the Estonian philosopher of science and of chemistry Rein Vihalemm initiated a new approach to understanding science called practical realism. The main tenets of practical realism addressing practice are: 1. The fact that the world is not accessible independently of scientific theories – or, to be more precise, paradigms (practices) – does not mean that Putnam's internal realism or "radical" social constructivism is acceptable. 2. Theoretical activity is only one aspect of science; scientific research is a practical activity and its main form is the scientific experiment that takes place in the real world, being a purposeful and critical theory-guided constructive, as well as manipulative, material interference with nature. 3. Science as practice is also a social-historical activity, which means, amongst other things, that scientific practice includes a normative aspect, too. That means, in turn, that the world, as it is accessible to science, is not free from norms either. There are at least two major perspectives to be discussed here. From the philosophical perspective, Vihalemm takes up the practice-based approach to science understanding the Kuhnian paradigms as practices. The core of those practices is obviously the methods of experimental research, which represent guidelines for manipulative, material interference with nature. From the technological perspective, the extent and essence of this interference depends on the equipment that is available for it. Therefore, the level of technological development that, for the scientist, starts from its description plays a crucial role in scientific practice and influences scientific cultures. There is an obvious feedback from scientific practices to general material practices in society as well. Science may owe more to the steam engine than the steam engine owes to science but it is not one-way traffic.

2 - **Vitaly Pronskikh** (Fermi National Accelerator Laboratory, USA),
Gas jet targets at NAL: from material practice to epistemic culture

A series of experiments with supersonic gas jet targets to advance the cutting edge of knowledge of proton interactions formed the basis of high-energy physics program at National Accelerator Laboratory (Batavia, USA) making use of its newly built Main Ring accelerator in 1970s. The experiments can be characterized by their resourcecentrism and their evolution as a series of epistemic practices with similar aims, techniques, and apparatus. In addition to its role as the central boundary object of the experiment chain that existed in 1970-1980, the gas jet target technology gave birth to two experimental trends at NAL: deploying gas jet technology in the domain of new particles, and using the concept of gas jets in NAL-manufactured targets. We will examine the creation and evolution of the cryogenic gas target technology, its proliferation within the Laboratory, and transformation. We trace how, in the course of material practice with gas jet targets, an epistemic culture based on supersonic gas technology develops, and a related tradition arises in the Laboratory. We point out that long-term experiments reveal themselves as not only symmetrical networks of actors of different natures, but also trading zones between epistemological cultures to explain the resistance of such experiments to paradigmatic shifts in phenomenal theory.

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3 **- Xi Gao (**Fudan University, China)

A Way of Understanding body knowledge: Illustrations and wax models for anatomical education during the Qing dynasty

How could anatomical instruction be carried out in an environment without autopsies? It was the dilemma faced by European anatomists around the 15th century, and also in the 19th century China. Basing his observations on dissections, Andreas Vesalius wrote and illustrated the first comprehensive textbook of anatomy, De Humani Corporis Fabrica Libri Septem (1543), which was introduced and translated into Chinese in the 17th century. Later, French missionaries also translated a French work on anatomy into Manchurian and circulated it within the Qing court. The images of the internal bodily structures and organs in these books presented to Chinese scholars and physicians a different system of body cognition in the world -- anatomy. As knowledge of anatomy spread to East Asia, Japanese scholars and doctors formed the view that the traditional body knowledge was wrong. They dissected the human body and peeped into the organs and internal construction to correct the traditional "erroneous" cognition. While Japanese scholars embraced anatomy as scientific knowledge, Chinese accepted it passively as westerners initiated the spread of anatomy in China. From the early 19th century, protestant missionaries began teaching Chinese students' anatomy. However, it was not until the 20th century that anatomy became one of the critical disciplines and thoughts influencing the transformation of the Chinese social concepts. In 1913, the Chinese government issued an autopsy regulation, which allowed autopsies for anatomical instruction. So how did anatomy education unfold without autopsies over the previous 80 years? Through a survey of the Anatomical Altas and wax model of the human body, this paper explores the process of acquiring medical knowledge and shaping scientific culture in the dissemination and acceptance of western body knowledge. It further analyzes how the transformation of Chinese practitioners' body cognition and the establishment of anatomy discipline during the Qing dynasty were completed.

4 - **Han Qi** (Chinese Academy of Sciences, China),

Picturing Science: Scientific Instruments as a Part of Ritual Objects---Scientific Cultures at the Kangxi and Qianlong Courts

In the past three decades, scholars in the field of history of science have written quite many papers on the Kangxi emperor and his study of European mathematics and astronomy. However, no detailed studies have been done about his interest in scientific instruments. Actually, he not only collected many European instruments, but also displayed them at the court and showed to his subjects. Based on European and Chinese sources, I will discuss how scientific instruments were brought to China, and how the Kangxi emperor practiced them in his trips to provinces. As the grandson of the Kangxi emperor, the Qianlong emperor also ordered the court painters to draw paintings of various birds and flowers, including those of exotic origin. More importantly, he ordered the compilation of an imperial illustrated book related to ritual objects, in which European scientific instruments were included. These will show how scientific cultures practiced at the Qing court and the reasons why European astronomical instruments and canons were added as a part of ritual objects within political context.

Room 11: **T8 - Medical Displacements**

Chair: **Elaine Leong** (University College London, UK)

1 **- Valentina Pugliano** (Massachusetts Institute of Technology, USA)

Onorio Belli (1550-1603), Prospero Alpino (1553-1617) and Venice's Levantine Doctors: A Forgotten Network of Knowledge in the Eastern Mediterranean World

While we can count on a growing body of scholarship to shed light on the cultural contacts between southern Europe and the Near East in the realms of art, architecture, and book production in the long early modern period, we know far less about which practices of medicine and science met across the Mediterranean, and how. A privileged view into this world, I argue, can be gleaned by examining a public health infrastructure developed by the Venetian Republic between 1350 and 1700. Intended to ensure the prosperity of Venice's commercial and political interests overseas, this infrastructure became an unexpected platform for the circulation of antiquarian and natural knowledge, plant specimens, and medical tools and folklore across the Mediterranean. For three centuries, Venice appointed physicians, surgeons and apothecaries (medici condotti) to guard the health of its diplomats and merchants in its eastern Mediterranean dominion and in its consulates and embassies in Mamluk and Ottoman lands, notably in Istanbul, Syria and Egypt. These medical servants are notable for extending their care beyond the Venetian colony to the local Muslim, Christian and Jewish communities, becoming routine cultural and political go-betweens for the Republic. This paper argues that their medical appointments are also notable in that they were quickly seen as opportunities to further one's intellectual interests, attracting the attention of university graduates enamoured with the writings of Dioscorides and Pliny and accustomed by humanism to look to the East to learn about the natural world and past civilizations. After discussing the main structural characteristics that made this preventative medical infrastructure into an engine of knowledge exchange, I will focus on two key sixteenth-century figures – Prospero Alpino (Cairo, 1581-1584) and Onorio Belli (Candia, 1583-1599), to provide an example of the condotti's activities and consider their role in the flourishing of Renaissance natural history

2 - **Elisabeth Hsu** (University of Oxford, UK)

Visualisations of tactility in Chinese pulse diagnostics

In this paper, I focus on the visualization of the sixteen pulses indicative of the danger of death in Andreas Cleyer's (1634-1698) edited volume Specimen Medicinae Sinicae of 1682. I have already discussed some of them in the past but not systematically. I will also reflect on the different visual rendering of only a few select pulses among the 24 depicted in Cleyer. The aim of the paper is to compare and contrast visual and tactile assessments of the same event with each other.

3 - **Yijie Huang** (St Catharine's College Cambridge, UK)

How to clarify touch? Literal idioms, numbers and their relationship in John Floyer's (1649-1734) pulse diagnostics

From the earliest stage of pulse taking, the conception of quantification had entwined with the literal, qualitative method to grasp subdermal complexity and channel the rhetoric of touch. Praxagoras, Herophilus and Galen used the term "quantity" to measure the size of the pulse (Lewis 2017; Von Staden 1989; Singer 1997). Medieval physicians, conceiving the harmony of the body through music, emphasised on quantitative consciousness in inspecting the pulse's rhythm (Kuriyama 1999; Siraisi 1975; Wallis 2010). William Harvey, inspired by sixteenth-century Italian scholars, counted heartbeats to calculate the speed of the blood circulation (Harvey 1976). Yet only to the late seventeenth century in England, quantifying the pulse started to present itself as an explicit diagnostic means, and John Floyer's treatise The Physician's Pulse-Watch (1707 and 1710) is widely regarded as a typical example of this change. Many historians believe that Floyer's work substantialises the pursuit for forging touch more transparent in pulse taking, and numbers were introduced to replace conventional literal idioms to meet this demand (Kuriyama 1999; Stolberg 2016). A close look at Pulse-Watch, however, suggests that numbers and literal idioms were connected in a way much more close and complicated than assumed. This paper examines Floyer's application of numbers and question the purpose of his quantifying practice while underlining the key fact that neither he nor his predecessors had ever abandoned the use of literal terms. While numbers constituted a new language that a physician could adopt to express his

touch, they did not mean to invade the central domain occupied by sensory experiences; rather, they categorised the latter's richness. In Floyer's pulse records, 80 did not make sense by itself; instead, what literal terms it linked, and what corporeal variations – of the humours, diseases and symptoms – these terms depicted, defined more directly and concretely a telling touch.

4 - **Chen Wei** (Chinese Academy of Sciences, China)

The Road of Adulterated Herbs: the intercultural comparison of true knowledge about false things

The historians of science and technology almost always focus the knowledge about exactly true things. However, the adulterated objects do not mean the knowledge relating them are false. In fact, the collection and the detailed recordation of the similarities and differences between the pure and adulterated objects, and how to distinguish the counterfeit method make up the cognition about the true, of course also the false things. In the space of the premodern Afro-Eurasian communication network, the variety of precious herbs constitute one important part of the materials flowing across a vast territory. In many premodern cultures, the knowledge about the character of precious commodities and their cheap, semblable, often local counterfeit were recorded. Through the comparative examine among the four groups of text, i.e. the Greco-Roman works in classical period, the medical and commercial investigation works in Islamic world, the medical work and daily encyclopedia in premodern China and the record by the Europeans arriving the Orient in late medieval and early modern, we can find the traces of the intercultural diffusion of knowledge about the adulterated exotic herbs based the similarities of the approaches of adulteration, the choices of counterfeits and the distinguishing methods. The knowledge also shifted in the records with different natures.

5 - **Yiwei Yan** (Chinese Academy of Sciences, China)

Tools and Practice of "Cutting": Surgical instruments brought to China by 19th-century medical missionaries

In the latter half of the 19th century, common Chinese patients began to have their first encounters with western surgical instruments, a unique experience they gained in the "cutting rooms" (i.e. operating rooms) of various mission hospitals. Those surgical instruments adopted by medical missionaries, such as needles, tweezers and knives for cataract couching or extraction, lithotrite and trilabe for the removal of bladder stones, provided therapeutic solutions to many diseases which had been considered intractable. The reason for the doctor to choose a certain type of surgical tool seems to have been affected by many factors, including its clinical effectiveness, manipulability, purchase cost and repairability, etc. The type of tools in turn fashioned the mode of surgical operations. It is an interesting question as to how important a role the surgical instruments played in the transmission process of western medical knowledge to China.

Thursday 3 September, 16.00 - 19.00

ESHS General Assembly and Closing of the Conference
