PALERMO

September 18 – 22, 2023

BOOK OF ABSTRACTS

42nd Scientific Instrument Symposium

Through Ages, Cultures, Concepts:
Instruments in Collections, Books, Archives

XLII SIC Symposium

PALERMO, 18 – 22 September 2023

Scientific Organizing Committee

SIC Board: Roland Wittje (Indian Institute for Science and Technology), Tacye Phillipson (National Museums of Scotland), Louise Devoy (Royal Observatory of Greenwich); *local host*: Ileana Chinnici (lNAF Osservatorio Astronomico di Palermo); *co-organizers*: Antonella Gasperini (INAF Servizio Musei Biblioteche e Archivi), Aurelio Agliolo Gallitto e Giuseppe Lazzara (University of Palermo)

Local Organizing Committee

Maria Rosalia Carotenuto (*chair*), Manuela Coniglio, Maria Rita Caruso, Giulia D'Agostino, Laura Daricello, Flavio Morale, Maria Luisa Tuscano, Salvatore Speziale.

Webpage: www.sic2023.net (by Promimpresa srl)

Scientific Instrument Commission

XLII Annual Symposium

THROUGH AGES, CULTURES, CONCEPTS: INSTRUMENTS IN COLLECTIONS, BOOKS, ARCHIVES

Palermo, 18-22 September 2023

TIME	MONDAY 18 SEPT		TUESDAY 19 SEPT		WEDNESDAY 20 SEPT			THURSDAY 21 SEPT			FRIDAY 22 SEPT	
VENUE	Palazzo Steri, Rectorate		Faculty of Theology		Faculty of Theology			Faculty of Theology			Physics Department	
9:00			*Put up posters*									
9:30			19-01: Decolonising the Past, Present, and Future of Scientific Instrument Studies (2) **Chair: Helmuth Trischler**	19-02: Educational Demonstrations, Projects, Investigations and Experiences with Historical Scientific Instruments (2) **Chair: Elizabeth Cavicchi**	20-01: Scientific instrumentation in pre- and early-modern Islamicate societies. Astrolabes and what else? (1) **Chair: Petra Schmidl**	20-02: Collections **Chair: Zhao Ke**	20-03 Instrument Making and Makers **Chair: Gloria Clifton**	21-01: Open Challenges in the Conservation of Scientific Instruments (1) **Chair: Maria Rosalia Carotenuto**	21-02: Perspectives of Engaging with Instruments (1) **Chair: Charlotte New**	21-03: 19th Century Instruments **Chair: Jan Tapdrup**	22-01: Within the Market: On the Identity of Dealers in Scientific Instruments and the Nature of their Commodities **Chair: Janet Laidla**	22-02: Early Modern Instruments **Chair: Michael Korey**
10:00												
10:30												
11:00												
11:30			Coffee break		Coffee break			Coffee break			Coffee break	
12:00			Poster session **Chairs: Roland Wittje and Julien Gressot**		20-04: Scientific instrumentation in pre- and early-modern Islamicate societies. Astrolabes and what else? (2) **Chair: Taro Mimura**	20-05: 19th and 20th Century Instruments **Chair: Martin Weiss**		21-04: Open Challenges in the Conservation of Scientific Instruments (2) **Chair: Emma Angelini**	21-05: Perspectives of Engaging with Instruments (2) **Chair: Stéphane Fischer**	21-06: Late Medieval to Early Modern Instruments **Chair: Taha Arslan**	22-03: Observatories **Chair: Louise Devoy**	22-04: Biographies **Chair: Kristin Halverson**
12:30												
13:00												
13:30												
14:00			Lunch break		Lunch break			Lunch break			Lunch break	
14:30	Registration											
15:00	Opening Ceremony											
15:30	18-01: Decolonising the Past, Present, and Future of Scientific Instrument Studies (1) **Chair: JC Niala**	18-02: Educational Demonstrations, Projects, Investigations and Experiences with Historical Scientific Instruments (1) **Chair: Panagiotis Lazos**	19-03: 20th Century Instruments **Chair: Juan-Andres Leon**	19-04: Time Measuring Through Ages, Cultures and Contexts **Chair: Jane Desborough**	20-06: Visual Representations: Models, Drawings, Photography and Paintings **Chair: Floor Koeleman**	20-07: Mid-18th to mid-19th Century Instruments **Chair: Jip van Besouw**		21-07: Scientific Instruments in Texts and Archival Sources **Chair: Sumner Braund**	21-08: Reconstructions and Replications **Chair: Laila Zwisler**		Annual General Meeting of the SIC and Farewell (plenary)	
16:00												
16:30												
17:30	*Break*		Visits to the Collections		Visits to the Collections			Visits to the Collections			Visits to the Collections	
18:00	Welcome Reception											
18:30												
19:00			Early Career Scholars' Dinner								*Break*	
19:30												
20:00											Conference Dinner	

42nd Scientific Instrument Symposium

Through Ages, Cultures, Concepts: Instruments in Collections, Books, Archives

18 - 22 September 2023, Palermo, Italy

BOOK OF ABSTRACTS

Contents

PROGRAMME

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Organized by Silke Ackermann, JC Niala, Jahnavi Phalkey and Helmuth Trischler *p. 24*

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Organized by Silke Ackermann, JC Niala, Jahnavi Phalkey and Helmuth Trischler
Chair*: Helmuth Trischler (Deutsches Museum Munich, Germany)*

Session B – Aula Nunzio Russo

EDUCATIONAL DEMONSTRATIONS, PROJECTS, INVESTIGATIONS AND EXPERIENCES WITH HISTORICAL SCIENTIFIC INSTRUMENTS (2)

Organized by Elizabeth Cavicchi and Panagiotis Lazos
Chair*: Elizabeth Cavicchi (Edgerton Center, MIT, USA)*

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Chairs*: Roland Wittje and Julien Gressot*

In alphabetical order of (first) authors:

15.30 – 17.30 Parallel sessions (A, B)

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Organized by Taro Mimura and Petra G. Schmidl
Chair*: Taro Mimura (University of Tokyo, Japan)*

Session B (12.00 – 14.00) – Aula Magna

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MID-18TH TO MID- 19TH CENTURY INSTRUMENTS

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Session A (9.30 – 11.30) – Aula Maurolico B

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Organized by Maria Rosalia Carotenuto, Anna Giatti, Giuseppe Lazzara and Emma Angelini *p. 116*

Chair: *Emma Angelini (Politecnico di Torino, Italy)*

Session B (9.30 – 11.30) – Aula Nunzio Russo

PERSPECTIVES OF ENGAGING WITH INSTRUMENTS (1)

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Session C (9.30 – 11.30) – Aula Magna

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Organized by Maria Rosalia Carotenuto, Anna Giatti, Giuseppe Lazzara and Emma Angelini
Chair*: Maria Rosalia Carotenuto (University of Palermo, Italy)*

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Session B (15.30 – 17.30) – Aula Magna

RECONSTRUCTIONS AND REPLICATIONS

Chair: *Laila Zwisler (Technical University of Denmark)*

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Organized by Rossella Baldi, Martina Schiavon and Céline Fellag Ariouet *p. 163*
Chair: *Janet Laidla (University of Tartu, Estonia)*

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Chair: *Michael Korey (Staatliche Kunstsammlungen Dresden, Germany)*

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Chair*: Louise Devoy (Royal Museums Greenwich, UK)*

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VISITS TO COLLECTIONS (TIMETABLE)

Museo della Specola (Astronomical Museum)
(*Address*: INAF Osservatorio Astronomico, Piazza del Parlamento, 1)

Max 20 visitors per group

- Tue 19, 17.45-18.45
- Tue 19, 18.45-19.45
- Wed 20, 17.45-18.45
- Wed 20, 18.45-19.45
- Thu 21, 17.45-18.45
- Thu 21, 18.45-19.45

Museo Storico dei Motori e dei Meccanismi
(*Address*: Viale delle Scienze, Edificio 8)

Max 30 visitors per group

- Tue 19, 17.45-18.45
- Tue 19, 18.45-19.45
- Wed 20, 17.45-18.45
- Wed 20, 18.45-19.45

Collezione storica degli Strumenti di Fisica
(*Address*: Via Archirafi, 36)

Max 20 visitors per group

- Wed 20, 18.00-18.45
- Fri 22, 17.30-18.15
- Fri 22, 18.15-19.00

SESSION, PAPERS & POSTERS

ABSTRACTS

SESSION

DECOLONISING THE PAST, PRESENT, AND FUTURE OF SCIENTIFIC INSTRUMENT STUDIES – CONTINUED

Organizer's full names: Silke Ackermann (History of Science Museum, Oxford University), JC Niala (History of Science Museum, Oxford University), Jahnavi Phalkey (Science Gallery, Bengaluru), Helmuth Trischler (Deutsches Museum, Munich)

Contact e-mail: silke.ackermann@hsm.ox.ac.uk

Session Abstract

Following the overwhelming success at the conference in Athens in 2022, this follow-up themed session aims to explore further all facets of decolonisation. Topics include:

- Provenance – the circumstances and sources of acquisition
- Language and images – the way in which artefacts, their producers and users are being described, depicted and referred to
- Materials – the colonial and extractive origins of raw materials and products (for example, mahogany or rubber)
- Contemporary collecting – new initiatives to expand the reach and representation of scientific instrument collections
- Exhibitions – projects which have tackled decolonisation through display and co-curatorship
- Politics – political and nationalist agendas in the decolonisation debate
- Restitution and repatriation – return of objects to producing communities
- Contested histories and epistemic injustice – exclusions and silences in knowledge production
- Transfer of knowledge – reassessing geographies of the movement of knowledge

On Decolonisation and the Museum

Jahnavi Phalkey

Science Gallery, Bengaluru

In a recent paper on decolonisation and the university, the literary scholar Priyamvada Gopal has argued that "'Decolonisation is reparative of the 'European' itself, seeking to understand and to extend knowledge about how cultures and communities outside it have shaped 'Europe'." How do we understand such a claim in the context of the museum which is at once a public space as it is a space for research and knowledge production? What is the role of the museum in a reparative process - one that is executed in full public view? In my presentation, I will explore Gopal's argument with specific examples and the consequences of such an argument for collections, reparations and restitution.

Jahnavi Phalkey is the Founding Director of Science Gallery Bengaluru. Her main research interests are in the twentieth century history of science and technology, especially the physical sciences. She is the author of Atomic State: Big Science in Twentieth Century India and has co-edited Science of Giants: China and India in the Twentieth Century. She is the producer-director of the documentary film Cyclotron. Jahnavi read civics and politics at the University of Bombay and the School of Oriental and African Studies, London. She holds a doctoral degree in history of science and technology from the Georgia Institute of Technology, Atlanta.

What is ‘Islamic Science’ exactly?

Silke Ackermann

History of Science Museum, Oxford

The label ‘Islamic science’ is widely used in museums around the world. But what exactly constitutes ‘Islamic science’? What precisely distinguishes an astrolabe with markings in Arabic from a contemporary one engraved in Latin? And why is the latter not classified as ‘Christian’, but rather as ‘European’ or ‘Western’? The paper will argue that the label ‘Islamic Science’ was first used by European scholars in a direct or indirect colonial context, and applied to refer to something that is not ‘us’, but ‘them’ – and as such is no longer appropriate in our contemporary discourse.

Equally, ‘Islamic science’ often carries the conscious or sub-conscious notion of ‘advanced knowledge’, in the sense of ‘preserving classical knowledge and handing it over to Europe’, for which respect is owed. Apart from the fact that this sentiment fails to recognise the independent scholarly work that was carried out on the basis of classical texts outside Europe by scholars of all three Abrahamic religions (Judaism, Christianity and Islam) and often in collaboration, it also fails to acknowledge that much of this activity took place in Africa. So why do we not find the label ‘African science‘ for instruments commissioned and produced in the Maghreb?

This paper will explore how to do these multi-layered and complex narratives justice in displays and academic teaching, and how to involve our audiences and communities in this debate with the view of taking an innovative approach to established categories that has the potential to open up completely new horizons, leaving (post-)colonial straight-jackets behind.

Silke Ackermann is the Director of the History of Science Museum at Oxford University (UK). Together with her team she works on Vision 2024, the ambitious transformation project to celebrate the Museum’s centenary.

Safekeeping as an Alternative to Acquisition

David Pantalony

Ingenium, Canada's Museums of Science and Innovation

As part of a long-term project related to Indigenous star knowledge, my institution has embarked on some safekeeping agreements with Indigenous artists. In this presentation, I will describe the origins and processes of these agreements from the museum's perspective. In addition, the artists themselves will talk about this process from the perspective of their work and community. At the museum, these agreements are having a significant impact on our traditional approaches to acquisition, display, storage, conservation, provenance research and intellectual property. At the heart of these agreements is a shift in how we think about ownership, a foundational concept in Western museum practice, and the opportunities that arise when this comes into question.

David Pantalony is Curator of Science and Medicine at Ingenium, Canada's Museums of Science and Innovation, with adjunct positions at the University of Ottawa.

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(De-)colonising the Deutsches Museum: Coping with the material culture of colonial scientific objects

Prof. Dr. Helmuth Trischler

Deutsches Museum

Germany was a latecomer in the imperialistic quest for colonies and so was the Deutsches Museum in its strife to collect and exhibit the techno-scientific culture of Germany's newly established colonies. Only founded in 1903, the museum tried hard to include the colonies in the efforts to represent the past and present of science in the museum's collections. So-called wish lists of objects were sent to the colonial authorities. Only recently serious efforts of provenance research that is not only related to the period of National Socialism but also to the colonial past have started to get a deeper understanding of the material culture of these in many ways precarious collections.

This paper explores these collections in a multi-perspectival fashion. Firstly, it explores the political and cultural contexts of acquisitions at the eve of World War I. Secondly, it looks at the modes of sense-making of these collections in the museum galleries, the multiple ways, in which exemplary objects were understood, described, and depicted. Thirdly, it tries to uncover the often hidden colonial legacy of artefacts by bringing together approaches from material culture studies and methods of conservation sciences. Finally, it points to recent efforts to cope with the multiple challenges that these collections pose today. In doing so, the paper stresses that not only the sectors of museums of natural history or arts and culture but also museums of science and technology holding all sort of techno-scientific objects including scientific instruments are needed to decolonise: on the epistemic level by responsible research; on the curatorial level by offering new narratives; and on the political level by starting discussions on restitution and repatriation.

Dr. Helmuth Trischler is Head of Research at the Deutsches Museum, Munich, professor of Modern History and History of Technology at Ludwig Maximilian University of Munich and Co-Director of the Rachel Carson Center for Environment and Society. He has widely published on the history of science and technology.

The VoH Database: An effort to reassess the transfer of astral knowledge across Eurasia before 1700

Rana Brentjes

Max Planck Institute for the History of Science

The goal of the VoH Database is to assemble material objects with astral imagery across Eurasia and North Africa between 4000 BCE to 1700 CE. Looked at from a perspective of decolonialization, one of its central efforts is to recover the contributions of non-imperial cultures to the production of astral knowledge. It is a decolonizing effort in the sense that "white spots" in history of science narratives are hoped to be filled through this focus on objects and images. Depending on state and private online collections primarily of the western world – museums and private collections of the Global South are rarely present online – our more than 8000 images document asymmetries in private and public collecting practices in Europe, the US, and several Asian states. A particular problem arises regarding "scientific instruments". Here, despite all efforts, we could only identify this group of knowledge carriers from the main high cultures treated in the histories of science: the Ancient Near East, Greece, and the Roman Empire; the Medieval-Islamicate world and Western Christian Europe; Early Modern Europe and the Early Modern Islamicate world up to China, and non-Islamicate South Asia. Not even the major museum such as the Louvre, the British Museum and the History of Science Museum, Oxford offer scientific instruments from Islamic cultures in Sub-Saharan Africa and southeast Asia, while the national Islamic Art Museum in Malaysia collects and shows Andalusian instruments but has no locally produced instruments available online. These observations indicate that colonialism or a colonialist perspective is only one obstacle for creating epistemic justice in history of science. Contemporary ideas about the value of past scientific cultures and current identities as a religious group contribute their own share to such asymmetric collecting practices. A second important insight drawn from our inclusive collecting practice covering science, religion, mythology, economy, and power highlights that astral knowledge in pictorial form is not only found on scientific instruments but on instruments used in other socio-cultural contexts such as religious practices or magic.

In my talk I will showcase objects that promote the advantages of such an inclusive collecting practice and document the added insights gained about the transfer of astral knowledge across Eurasia and North Africa.

Rana Brentjes is the Digital Content Curator of the Visualization of the Heavens WG at the MPIWG, Berlin. She has co-edited two books: Routledge Handbook on the Sciences in Islamicate Societies (2023) and Imagining the Heavens (2023) and co-authored a paper on the migration of the zodiac in Asia.

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Mahogany in the collection of the History of Science Museum

Helen Pooley

History of Science Museum, Oxford

Cultural institutions, including history of science museums, are increasingly reviewing the objects in their collections in the context of colonialism and slavery. This reflects the growing awareness of the longstanding legacies of slavery culturally, socially and economically. Mahogany has been the subject of many recent studies, as a material that was harvested almost entirely using slave labour in the eighteenth and early nineteenth century. This paper discusses how mahogany features in the collection of the History of Science Museum, and what it's use can tell us about science and society in the past.

When Europeans first colonised the Caribbean, Mahogany trees were deemed of little value and were often cleared to make way for sugar plantations. In the centuries which followed, however, colonisers began to value this hardwood for its stability and strength and it was extensively used in shipbuilding. Following the introduction of the Naval Stores Act by the British in 1721, which saw duties scrapped, mahogany became the wood of choice for many makers of scientific instruments.

There are more objects made from mahogany than any other named hardwood in the Museum's collection. These range from navigational instruments (including chronometers, octants and telescopes) to cases and pieces of furniture.

These individual objects can cast a light on the colonial world in which they were created, in terms of the trade in raw materials which made mahogany so readily available to instrument makers and craftsmen; the places where the objects were made, bought and sold; and the people who purchased and used them.

Helen Pooley is a Learning Producer at the History of Science Museum in Oxford. She is interested in finding ways to connect the objects in the collection with different audiences, particularly young people. She is currently developing learning materials for school visits and study days on the topic of colonialism and slavery.

The “Coimbra” Portuguese mariner’s astrolabe: the instrument and notes on decolonisation

Pedro Júlio Enrech Casaleiro

University of Coimbra, CITEUC

The Geophysics and Astronomical Observatory of Coimbra University holds an impressive scientific instrument collection, including a remarkable Portuguese mariner's astrolabe crafted from brass, considered to be one of its masterpieces. A recent loan request from a museum in the Emirates prompted a comprehensive review of the astronomical collection's catalogue documentation. Materials were tested and inventory sheets were updated to ensure accuracy. To gain insight into the astrolabe's origins, specialists from different fields were consulted, yet its exact history remains a mystery. This enigma has prompted varied theories and perspectives on the motivation behind its construction.

Given its significance as a critical tool in the Portuguese and Spanish voyages of discovery during the 15th and 16th centuries, the astrolabe's potential colonial implications cannot be ignored. Therefore, this presentation will explore its colonial legacy through the lens of decolonization methodology. We will examine the astrolabe's technological advancements and its role in enabling the exploration of the other side of the world. This includes the instrument's impact on the new cartography of the planisphere, the establishment of trade routes, and the early stages of planetary globalization.

Pedro Casaleiro holds a Ph.D. in Museum Studies, University of Leicester UK, works in museums since 1991, at Coimbra University Science Museum 2003-2019, in management, collections and communication. Is invited professor of Museums Studies at the Faculty of Arts and Humanities and researcher at the Geophysical and Astronomic Observatory

Objects as Arbiters of Justice: Weights and Measures from the Madras Presidency, 1798 – 1856

Senthil Babu D[1] and Roland Wittje[2]

[1]*French Institute of Pondicherry, India;* [2]*Indian Institute of Technology Madras*

In this paper, we will discuss the standardization of weights and measures in South India under the British East India Company as central to the transition of private property rights during the late 18th and early 19th century. In the late 18th century, the British East India Company started to administer revenue rights over the Madras Presidency. A Committee was established at Fort St George in 1798 to look into the local diversity in measurement units of length, capacity, weights and currencies. This committee worked for more than forty years, with protracted debates and long periods of silence. As part of its work, it collected physical samples of weights and measures, some of which can now be found at the Science Museum, London. Along with these, we find brass standards of the Indian weights, crafted by the London instrument maker Robert Bate, who was commissioned to make standards for the United Kingdom, following the 1824 Act of Parliament to standardize weights and measures.

In our project, which is work in progress, we want to bring the colonial archive and the objects together to explore a social history of standardization, where in instruments of measuring become arbiters of justice. Such arbitration, we argue, was mediated by abstraction, facilitated by both computation and the control over the instruments and standards for measurement.

Senthil Babu D. is a historian of mathematics and Researcher at the Department of Social Sciences of the French Institute of Pondicherry. He has published Mathematics and Society: Numbers and Measures in Early Modern South India (Oxford University Press, 2022) and works on the Archive for Mathematical Practices in South India.

Roland Wittje is Associate Professor in History of Science and Technology at the Indian Institute of Technology (IIT) Madras, and President of the Scientific Instrument Commission.

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Scientific instruments for measuring the human body and their ideological use in the 19th century

Fotini Asimakopoulou

Department of Education, University of Athens

In the 19th century, various racial theories were formulated and the intellectuals who put them forward tried to put them into a 'scientific' context. In addition to theories of descent, heredity of climate, and even theories that ideologically used the "struggle for survival" of Darwinism, theories were developed that were based on the measurement of the human body, especially the skull. We are aware of the influence and widespread dissemination in society of concepts of the brain, so-called phrenology.

In the attempt to "scientify" the racial theories, a branch developed which was devoted to craniometry. In some universities, craniometry even became part of the teaching, not only in medicine, but also in other faculties, for example in history and ethnology.

In this paper we will present some of the instruments which were used by craniometrists for ideological purposes and try to show how they were for a long time integrated into university faculties and were considered to be instruments of a "normal" science in the Kuhnian sense of the term.

Fotini Asimakopoulou is Professor of History, Department of Education, University of Athens. Publications on the European history of the 19th century, the history of engineers, the history of the ideas and on the rise of racial theories during the 19th century. Has worked on the European intellectuals who promoted the positivist and “progressist” ideas and participated at the various European revolutionary movements.

Italian Cosmic-ray researches in Eritrea in the 1930s

Sofia Talas and Fanny Marcon

University of Padua

Bruno Rossi was one of the 20th-century pioneers of cosmic-ray physics. In 1932, he moved from Florence to Padua, where he held the chair of experimental physics at the university. He was expelled in 1938 due the racial laws and eventually settled at MIT, for the main part of his career.

In the early 1930s, Rossi, like many other physicists, got particularly interested in the nature of cosmic rays but, for these studies, it was necessary to work close to the Equator. Bruno Rossi thus applied to get funds from the CNR, the Italian National Council of Research and, in 1933, he organised a scientific expedition in Asmara, Eritrea, that was at the time an Italian colony.

In this paper, after presenting Rossi's work in Eritrea, we will try to contextualise his research in the Italian colonial framework, hardly known by the public, and see how this could be presented in a museum space.

Sofia Talas is the curator of the Giovanni Poleni Museum at the University of Padua. Her main research interests are in the history of scientific instruments and the history of physics from the 18th to the 20th century.

Fanny Marcon is the curator of the Enrico Bernardi Museum of machines and of the scientific instrument scattered collections of the University of Padua. Her research focuses on the diffusion of scientific practices in the 19th century and on scientific instrument makers.

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SESSION

EDUCATIONAL DEMONSTRATIONS, PROJECTS, INVESTIGATIONS AND EXPERIENCES WITH HISTORICAL SCIENTIFIC INSTRUMENTS

Organizer's full names: Elizabeth Cavicchi and Panagiotis Lazos

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Session Abstract

This session spans diverse educational demonstrations, projects, investigations and experiences that bring schoolchildren, students, teachers and the general public together with historical scientific instruments. Settings range from museums, to collections, to classrooms. Educational activities involve learners as investigators, researchers, and participants.

Featuring a potential hands-on demo while presenting, Jan Waling Huisman expresses the historical story-telling, with hands-on and hands–off viewing of instruments, of special tours for primary and secondary school students at University of Groningen, Netherlands. The magic lantern fascinates schoolchildren today in educational demonstrations, including historical context, performed by Patrice Guérin, with Projections Lumineuses, member ASEISTE, France. High school students of Flora Paparou, in Vrilissia, Greece, research, and then reenact, electrostatic demonstrations of 18th century itinerant lecturer Domien, priest of the Greek church.

Michela Maschietto involves teacher-training students with mathematical machines in classrooms and museum of University of Modena e Reggio Emilia, Italy. Inspired by historical mathematical machines, Pietro Milici, University of Palermo, Italy, presents his invention that enables today's students to trace transcendental curves with historical methods. Current students investigate instruments that past MIT (USA) students created, in Elizabeth Cavicchi's classes.

Undergraduate primary student teachers investigate an orrery at Maraslean Teaching Center in Athens, Greece, in educational projects of Panagiotis Lazos, Constantina Stefanidou, and Constantine Skordoulis. Supported by Silvia Majorana, Maura Fugazzotto, and Germana Barone, high school students are researchers in observing and cataloguing collections at University of Catania, Italy. George Vlahakis invites students in Athens Greece to use their bodies as instruments, analogous to historical investigations.

The museum: Hands-off or hands-on?

Jan Waling Huisman

Museum of the University Groningen (UMG), Netherlands

For ages museums served as a place where the audience could look at the wonders of the world in astonishment, being amazed by the fine arts and the knowledge and wisdom of scientists. It was a place of quietness and contemplation, mostly for the more well to do.

However, in recent years these roles are changing. Audiences are more diverse and more demanding. They want to be entertained, but there is also the growing need to educate in the museum. One of the key things in this transition is the demand from schools for educational projects, which theyself are not capable to incorporate in their curriculum. Hence, the need for a public engagement program, which, in the case of the University museum, is also a task, laid upon us by the board of the University.

To achieve this, the new permanent exhibition has more focus on storytelling and less on explaining instruments. There are several tours for primary and secondary school pupils, with the inclusion of a table with several instruments on display for hands on use.

Besides that, there is growing demand from teachers within the university to use (original) instruments and objects during their classes, which we facilitate as much as possible.

In my talk, I will give an overview of the experiments we perform, and the problems encountered. Hopefully hands-on!

Jan Waling Huisman is responsible for the wellbeing of the largest part of the collections of the University Museum in Groningen, the Netherlands. For more than 30 years he is curating, describing and discovering the collections. All to make them available in a most engaging way in the museum, during classes and everywhere else.

Much ado about science!

Flora Paparou

PhD, Science Teacher in Secondary Education, GREECE

"Much ado about science!" was the title of a science theater performance prepared by a group of students of the 1st Upper High School of Vrilissia, Greece, and presented to an international student audience within the framework of an Erasmus+ school-collaboration project.

The 18th century public demonstrations and specifically the story of an itinerant lecturer, named Domien, who is mentioned by Benjamin Franklin, gave us the inspiration for the theatrical play scenario. He was a native of Transylvania and Priest of the Greek church, who travelled worldwide, earning his living by demonstrating electricity experiments. Historical experiments on static electricity, such as the electric whirl, the electric kiss and the electric chain, became the heart of our science-show.

For the preparation of this science communication activity the students were introduced to the history of scientific instruments and science communication. They learned to handle the apparatuses which were to be used and understood the association of these modern laboratory-machines with historical scientific instruments of the same type (or function) hosted in museums and collections. They became curious about static electricity phenomena, did research on the experiments, created simple scientific instruments and improved others. They worked hard on the scenario, in order to make it attractive to their peers. They also studied how to demonstrate instruments and experiments. Finally, they created beautiful photos and videos for a virtual presentation of their science-show. Stepping into their role they tried to captivate their audience by combining science and art, and I think they succeeded!

Flora Paparou is a chemical engineer. She currently works as a science teacher, in secondary education. She holds a PhD on the use of historical scientific instruments in science teaching. Her recent research focuses on use of historical experiments in the science classroom and the creation of science communication events with the help of her students.

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Educational activities with the mathematical machines at school and at the University Museum

Michela Maschietto

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This contribution concerns the activities carried out in mathematics education and popularization of mathematics with mathematical machines by the Laboratory of mathematical machines (www.mmlab.unimore.it). Mathematical machines are mechanical tools for geometry drawn from historical treatises and related to the history of mathematics (a mathematical machine is "a tool that forces a point to follow a trajectory or to be transformed according to a given law"); they are a collection of the Museum System and Botanical Garden of the University of Modena e Reggio Emilia.

The activities mainly focus on the use of machines as mediators of mathematical meanings within the mathematics laboratory methodology. They concern teacher education and the implementation of mathematics laboratory sessions with pupils at different school levels. The latter take place not only at school, but also in the museum spaces. At school, educational activities are the results of collaborative work between teachers and researchers and are structured in several sessions for the same class; while at museum, a single laboratory session is carried out, according to the following structure: after a brief introduction on the topic (conic sections or geometrical transformations) chosen by the teacher, the students first work in small groups on different mathematical machines with the support of worksheets (the completed worksheets can be collected by the teacher for later work in classroom), then they present to the whole class what they have discovered on their machine. At the end, the students visit the exhibition "Machines, mechanics and mathematics" (https://www.macchinematematiche.org/macchine-meccanica-e-matematica.html, in Italian).

Michela Maschietto, PhD, Associate professor in mathematics education. Her research works concern the mediation of artefacts (material and digital ones) in the construction of mathematical meanings and teacher education. She organizes all the activities with the mathematical machines, at school and in the museum.

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Unifying integraphs and transcendental curve tracers: a new pedagogical device collecting a historical legacy

Pietro Milici

University of Palermo

During the 17th century, scholars like Descartes and Leibniz introduced theoretical machines (i.e., sketches to be considered mentally but not practically realized) to legitimate the geometrical status of algebraic and transcendental curves obtained as solutions of analytical equations.

In the early 18th century, Perks, Poleni, and Suardi designed and realized devices tracing transcendental curves by introducing a wheel guiding the direction of the curve. The same idea was independently adopted at the end of the 19th century to plot the integral of a graphically defined function by the integraphs.

This paper aims to introduce a new machine (that the author invented, patented, and realized) to show in an evident way how the tracing of an exponential (probably the most important transcendental curve) is close to the integration of a function. In other words, the 19th-century integraphs are close to 18th-century curve tracers. The main idea behind the device is the possibility of rotating the direction of the wheel with respect to a rod, an idea already presents in Poleni's work on the machine for the exponential. Furthermore, the integraph is characterized by a T-shaped rod.

The aim of the new device is mainly pedagogical, with particular attention to the simplicity of the design and the possibility of using just some of its components to focus on single mathematical concepts. A prototype of the machine is visible at www.machines4math.com

Pietro Milici is a researcher at the University of Palermo. His main research interests deal with mathematical machines from multiple perspectives: history and philosophy of science, the foundation of mathematics and computer science, and STEM education. He founded Machines4Math, a company developing innovative learning tools for laboratory activities.

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Students of Today meet Students of the Past through their instruments, notebooks and themselves

Elizabeth Cavicchi

Edgerton Center, Massachusetts Institute of Technology (MIT)

While science research, its instruments and participants continually change, science education exhibits greater consistency over time. That combination of change and stability offers contrast and connection for educational activities that introduce current students to past students. I invite my university students to engage with predecessor students, through visits to MIT Museum, MIT Distinctive Collections (the school's archive), interviewing an alumnus via zoom, and with classroom-accessible materials including digitized student work. Instruments designed, built and operated by historical students doing thesis research intrigue my students. Posing a unique instrument – Strain Gauge Denture Tenderometer- to my class as a mystery, MIT curator Debbie Douglas encouraged students to conjecture its function, unscrew its housing, manipulate its dentures. She complemented these activities with photos of maker Aaron Brady, and his 1956 thesis. My students reflected that their curiosity about the device brought Brady and his research to life. Seeing historical students' lab notebooks in the archives, students observed overlap with recent courses. From historical course schedules, my students were dismayed that classes were held on Saturday! After reading Don Labbe's 1974 thesis designing the gamma ray scanner used for testing fuel plates for MIT's nuclear reactor, my students interviewed him. Thesis diagrams, and models I made from LEGO, facilitated these current and past nuclear engineering students in understanding the apparatus and sharing experiences. As current students meet past students through their instruments and works, they meet new parts of themselves.

Elizabeth Cavicchi interweaves science, history, instruments, art and social justice in her teaching at MIT's Edgerton Center. Together with Peter Heering, she coedited SIC's volume 9, *Historical Scientific Instruments in Contemporary Education*, 2022, where SIC community members relate diverse educational projects. Among students and internationally, Dr Cavicchi encourages exploratory education.

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Primary student teachers' engagement with a historical orrery in the context of informal science education

Lazos Panagiotis[1], Stefanidou Constantina[2] and Skordoulis Constantine[2]

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Engaging students and teachers with historical scientific instruments is highlighted over time in science education research. This paper is part of a broader study which investigates whether, and in what extent, students preparing to teach primary school can be involved in designing and implementing educational material based on historical scientific instruments belonging to the collection of Maraslean Teaching Center in Athens, Greece.

This paper presents the part of the study regarding a particular group of seven undergraduate primary student teachers, who attended the optional subject "Informal and Non-Formal Science Education". The course consisted of two parts, the theoretical one, in which students were introduced to informal education (science books, theater, museums, centers, etc.) and the second part, in which students had to design an educational program for informal science education. During that part, the students were first familiarized with the collection of the historical scientific instruments of Maraslean Teaching Center, and then they were involved in the project of "Learning the past looking at the future". This project highlights some aspects of the procedure of dating historical scientific instruments. The group interest gravitates around an orrery in the collection, manufactured by Ernst Schotte (Germany). The students observed which planets and satellites the orrery has and then they researched when these planets and satellites were discovered. By investigating this history, students inferred the earliest date at which this orrery could have been constructed. Both the method the group followed and the interaction between the students and the orrery will be presented.

The student teachers will present their completed project in their schools and at the Maraslean Teaching Center. This educational experience piques pupils, teachers' and parents' interest in the several perspectives of introducing historical scientific instruments in science education, including STEM activities and more.

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Panagiotis (Takis) Lazos is a physics teacher in secondary education and the head of the 4th Laboratory Center of Natural Sciences of Athens. He is also a PhD student in the National and Kapodistrian University of Athens. His main research interest is history of scientific instruments of the 19th century in Greek education.

Constantina Stefanidou is a physicist who has a PhD in Science Education from University of Athens. Her research is on didactics of science, focusing on historical and philosophical perspectives as well as conceptual difficulties and their relation to model-based teaching and learning and informal science education. She participates in international conferences (ESERA, IHSPT) and science communication actions.

Constantine Skordoulis is Professor of Epistemology and Didactical Methodology of Physics in the Department of Primary Education, National and Kapodistrian University of Athens. His research interests include History of Science and Science Education from a critical perspective. He is the Director of the Laboratory of Science Education and Educational Technology and Head of the Postgraduate Studies Program «STEM Education and Educational Robotics».

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From Cataloguing to Enhancement: how to involve high school students in cultural heritage management. The example with the ancient scientific instruments collections of the University of Catania

Silvia Majorana[1], Maura Fugazzotto[1,] Germana Barone[1], Elena Geraci[1], Nunzia Martorana[2], Cettina Santagati[1], Marilisa Spironello[1], Filippo Stanco[1]

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More than 400 ancient scientific instruments are stored in the museum collections of the University of Catania. Despite their historical-scientific relevance, successful projects need to face many management issues: what exactly are they? What were they for? How to make them comprehensible and attractive for the new generations? The University Museum System (SiMuA) tries to find virtuous solutions by involving students in the current research activities performed on museum collections. Particularly fruitful were two PCTO projects (national school-work programs promoted by the Ministry of Education (MiUR) and designed by the Universities) aimed at showing challenges and solutions to two of the main phases of cultural heritage management: Cataloguing and Enhancement.

At the basis of both projects are the same activities: direct observation, manipulation of ancient instruments, use of digital tools, final creation of a tangible product. While the Cataloguing project led to the compilation and creation of technical data sheets, the Enhancement one, based on 3D modeling through photogrammetry, led to the hypothesis of future paths through Augmented Reality and 3D printing of the museum objects, to be used in future new inclusive settings, such as new projects specifically designed for blind audiences. Beside the first basic educational objectives promoted by the PCTOs - acquisition of soft skills and orientation - a third important one has been reached: the creation of an identity awareness and a link with one's past, through cultural heritage. Furthermore, new engagement methods for particular museum objects were adopted from the SiMuA for innovative museum tours.

Silvia Majorana is a PhD student in Sciences for Cultural Heritage and Production, with a research project about cataloguing and enhancement of the scientific instruments of the University of Catania. Previously, she dealt with museology and university museums (since 2021: Subject Expert in Museology), audience development, management of cultural heritage.

Maura Fugazzotto is PhD in Sciences for Cultural Heritage and Production. Currently, she is a post-Doc for non-destructive investigations of minero-petrographic museum objects. She is involved in researches and activities for the conservation and valorization of museum objects, in the field of University Museum System of the University of Catania.

Germana Barone is Full Professor of Mineral georesources and minero-petrographic applications for the environment and cultural heritage at the University of Catania, and head of the University's Museo dei Saperi e delle Mirabilia Siciliane. She manages researches and activities related to applied petrography and museum valorization and fruition.

Elena Geraci is a lecturer in Nuclear Physics and she investigates several aspects of stable and unstable nuclei. As a delegate for public engagement of DFA-UNICT, she organized projects devoted to high school students' exposure to Physics topics. She is the scientific coordinator of the *Collezione Strumenti Antichi di Fisica*.

Nunzia Martorana is a researcher in Physics at INFN-Catania. She studies innovative materials to monitor particle beams. She also investigated several aspects of nuclear physics with stable and unstable nuclei. During her postdoc UNICT position she contributed to the realization of educational projects devoted to introducing students to Physics concepts.

Cettina Santagati, PhD. She is associate professor at the Department of Civil Engineering and Architecture, University of Catania. She is part of the Laboratory of Architectural Photogrammetry and Survey "Luigi Andreozzi" and head of the Laboratory of Digital Surveying, Representation and Reconstruction at Museum of Representation, University of Catania. Her research interests are focused on: 3D acquisition and modelling, HBIM, Virtual Museums.

Marilisa Spironello is an Art Historian, Tourist Guide and Phd student in Science for Cultural Heritage and Production at the University of Catania. She studies the history of applied arts and goldsmithing with reference to the Sicilian context and she deals with the design of integrated routes for museum education.

Filippo Stanco is Associate Professor of Computer Science at the University of Catania. Actually, is head of BSc of Computer Science and he is Deputy Rector for Technological Innovation on Information and Communication. His interests include Image Processing, Serious Game and the application of technologies at Cultural Heritage.

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The Human Body as Scientific Instrument. An “educational approach"

George N. Vlahakis and Konstantinos Konstantopoulos

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Scientific Instruments are part of science education in primary and secondary schools at least since the mid-19th century, at least theoretically.

Nevertheless, their use and their value for measuring several physical properties though taken for granted by the educators are not always clear to the young students. In fact, they are sometimes not only ignorant about the precise role an instrument plays for the verification of a law or the discovery and explanation of a natural phenomenon but even suspicious.

In the present paper we aim to discuss the use of the human body, in a historical perspective, as an approach to make the young students to understand that even themselves in a way can be potentially a scientific instrument.

To make this approach clearer we intend to present as case study the measurement of the length, the heat and the time using organs or parts of a human body and then to compare them as instruments with "real" instruments that we use in a typical way to measure such physical quantities.

George N. Vlahakis is an associate professor of History of Science and Philosophy at the Hellenic Open University. He is director of the M.Sc. Program “Science Communication” and the M.A. Program “Philosophy and the Arts”. The history of scientific instruments is among his main research interests.

Konstantinos Konstantopoulos is a Ph.D. candidate in History of Science and member of the Laboratory of Science, Technology and Medicine Communication of the Hellenic Open University. He has a fresh and intense interest in the history of scientific instruments.

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The path of the PARABOLA

Linnéa Bergsträsser

Europa-Universität-Flensburg

In this talk I will discuss the historical demonstration of superposition of forces. In doing so, I will discuss mainly a typical mechanical demonstration experiment from the 18th century.

At this time Newton’s mechanics was not exclusive to textbooks. At universities, mechanical demonstrations played a significant part in popularizing and teaching Newton's mechanics. To describe the movement of bodies there were numerous exciting demonstrations which illustrated Newton's theory of motion and the superposition of forces. I will talk about the parabolic track which was ascribed to s’Gravesande in the Netherlands. From there this demonstration device spread throughout the universities of Europe.

Even today a large number of parabolic tracks can be found in museums, universities, schools and other scientific collections. The fact that so many instruments are still preserved and the fact that the demonstration can be found in all the important textbooks of the 18th century suggests that this demonstration was actually performed at universities.

Did all these instruments look the same or were there different versions at different universities? Was there a standard version of this demonstration experiment? How did these instruments change over the years? And how was it described in the textbooks of the 18th century?

I will discuss these questions in more detail as part of my PhD as well as part of this talk.

Linnéa Bergsträsser has been a PhD student at the Europa-Universität in Flensburg since 2021. Until 2016 she studied History of Science at the Friedrich-Schiller-Universität in Jena and graduated with M. Sc. The focus of these studies was primarily on the history of scientific and teaching objects.

POSTER SESSION

POSTER 1

The historical collections of scientific and didactic instruments of the Palermo Museum of Mineralogy

Sergio Calabrese, Filippo Brugnone, Lorenza Li Vigni and Paolo Ferla

Dipartimento di Scienze della Terra e del Mare (DiSTeM) - Università degli Studi di Palermo

The scientific collections of the historic Museum of Mineralogy of Palermo consist of a large number of scientific instruments and didactic accessories, among which are ancient instruments dating back to the second half of the nineteenth century. The precious collections are located in via Archirafi 36 and are preserved by the Dipartimento di Scienze della Terra e del Mare (DiSTeM) of the University of Palermo. The collection of scientific instruments covers the evolutionary pathways of two fundamental disciplines of earth science: mineralogy and petrography. In the last few years, more than one hundred instruments were studied, photographed and catalogued. The collection could be divided into four different sections: physical measurements, optical observations, x-ray investigations, and didactic tools. They include goniometers, precision balances, pycnometers, petrographic and mineralogical microscopes, X-ray instruments, and a large number of accessories. Along with these, a beautiful collection of specimens for didactic purposes, among which are ancient wooden-crystal models, atomic structures and a wood Wulff-net for stereographic projections.

Sergio Calabrese is Geochemistry and Volcanology researcher at the department DiSTeM, University of Palermo. For several years, he has been curator of the Museum of Mineralogy of Palermo, and is still engaged in museum education, cataloguing and dissemination of scientific culture.

Paolo Ferla is a full professor of Petrography in Palermo, now retired but still actively collaborates in the valorization of the collections of the Mineral Museum of Palermo. Moved by passion and curiosity, he has devoted more than two decades to the museum's collections, and is considered the historical memory of the department.

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POSTER 2

The Visualization of Scientific Instruments on the Web

Carlos Adriano Cardoso and Décio Martins

Coimbra University

This study analyzes how museums that own collections of scientific instruments make their collections available through their Webmuseums. Focused on 16 museums extracted from a universe of about 164 physics museums existing in the UMAC-ICOM Database, this study aimed to understand the relationships between the information structures and the graphic or textual strategies for information retrieval with the logic of printed catalogs. The study concludes that the method presented mostly does not transpose the sequential and hierarchical logic to represent knowledge to the detriment of other ways of representing the complexity contained therein.

Carlos Cardoso is pursuing a Ph.D. in History of Science at Coimbra University, researching the digital curation of scientific instruments. He has been supervised by **Décio Martins,** professor and Scientific Advisor of the Physics Cabinet of the Coimbra University, named a "Historic Site of Physics" by the European Physical Society.

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POSTER 3

The Ramsden Circle: some iconographic representations

Ileana Chinnici and Manuela Coniglio

INAF - Osservatorio astronomico di Palermo

The poster will describe this famous iconic instrument and its scientific and artistic representations. The Ramsden Circle was quite popular in scientific literature as a prototype of large circular scale instruments and it is often illustrated in treatises and publications on astronomical instruments. It is also sometimes depicted in artworks preserved in unexpected locations.

Ileana Chinnici is astronomer and mainly works in the field of the history of 19th-century astronomy. She is in charge of the historical collections which are preserved at the Palermo Observatory.

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POSTER 4

From a Prince to an Observatory, from 'The Leopard' to a museum: the many lives of a telescope in Palermo

Manuela Coniglio

INAF - Osservatorio Astronomico di Palermo

How many lives can a scientific instrument live? One of the possible answers draws its inspiration from the 60th anniversary of the release of 'The Leopard', the movie by Luchino Visconti, based on the homonymous novel by Giuseppe Tomasi di Lampedusa. The main character is inspired to Giulio Fabrizio Tomasi, prince of Lampedusa, amateur astronomer and ancestor of the writer. In his small private observatory near Palermo, he had high quality scientific instruments with which he delighted in observing the sky. Among them, a small excellent nineteenth-century equatorial telescope by Lerebours & Secretan. It was used for the first time for amateur observations, then it was acquired by the Palermo Observatory for scientific work and expeditions and 60 years ago it was even on the international set of a famous movie. Today the Lerebours & Secretan telescope has a new identity: it is a cultural asset of the astronomical heritage which is preserved at the Specola Museum.

Manuela Coniglio, Archivist and graduate in Cultural Heritage and Historical Sciences, is a temporary researcher at the INAF-Osservatorio Astronomico di Palermo, where she deals with the enhancement of the MAB historical heritage. She carries out research on the history of astronomy and collaborates on projects for the promotion of the INAF historical heritage.

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POSTER 5

Observatories across miles: how astronomers at Palermo and Greenwich worked together through the 19th century to share knowledge, data, instruments

Louise Devoy[1] and Ileana Chinnici[2]

[1]*Royal Museums Greenwich, UK;* [2]*INAF, Palermo Observatory, Italy*

This poster will highlight a range of case studies that illustrate how astronomers at Palermo and Greenwich observatories worked together throughout the 19th century to share knowledge, data and instruments.

1. *Sharing technical expertise*

In 1801, Palermo astronomer Giuseppe Piazzi discovered the dwarf planet Ceres with the Ramsden Circle that had been installed just a few years previously. Piazzi described this famous instrument in his *Della Specola Astronomica de' Regi Studi di Palermo*, which was subsequently translated from Italian to English in 1805 by Margaret Maskelyne, daughter of the fifth Astronomer Royal, Nevil Maskelyne. Piazzi had spent about two years in London to supervise the construction of this instrument and made observations of the solar eclipse of 1788 with Maskelyne at Greenwich. This knowledge exchange continued with the seventh Astronomer Royal, George Biddell Airy.

2. *Testing instruments*

We know of at least two instruments which were tested at the Greenwich Observatory by Airy and acquired by the Palermo Observatory after his advice: a Whiffin Marine Chronometer and a Frodsham Chronographic Pendulum. The first was used during many scientific expeditions; the second served the main telescope of the Observatory, the large Merz equatorial which was installed in 1865.

3. *Exchanging library materials*

By examining the distribution lists of annual reports, eclipse expedition reports and astronomical data sets, we can directly trace the knowledge exchange between astronomers at Palermo and Greenwich.

Louise Devoy is Senior Curator of the Royal Observatory, Greenwich. She is currently researching and developing new display narratives in preparation for the site's 350th anniversary in 2025.

Ileana Chinnici, see Poster 3.

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POSTER 6

Instruments from the Vatican Spectrochemical Laboratory

Richard D'Souza

Vatican Observatory

After the present Specola Vaticana was established in the 1890s by Pope Leo XIII, it operated for a few years within the walls of the Vatican before moving in 1930s to the Papal residence in Castel Gandolfo – to avoid the increasing light pollution of Rome. At the same time, the young Observatory was a recipient of a gift of a large collection of meteorites from the collections of Marquis de Mauroy. A spectrochemical laboratory, led by Fr. Alois Gatterer was established on the ground floor of the Papal residence in Castel Gandolfo to conduct a spectral analysis of the meteorites, and was equipped with several excellent instruments. The laboratory was one of the first of its kind in the world: it produced several high-resolution spectral atlases of individual elements (including Iron) to eventually compare with the meteorites and established a journal proper to the newly born field. The work of the laboratory was well appreciated throughout the world, and its influence extended beyond the field of meteorites and astronomy. Due to new research directions at the observatory, the laboratory was eventually dismantled in the 1970s, but a few instruments of the equipment are still preserved and kept at the Specola and will be here presented.

Richard D'Souza, after graduation at the Max Planck Institute for Astronomy in 2016, joined the staff of the Vatican Observatory (also known as Specola Vaticana); he studies the formation and evolution of the galaxies and is in charge of the historical collections of the Specola.

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POSTER 7

A Dough Kneader for your Laboratory: Farinograph and Bread-Making Research in Turkey between 1930-1950

Barışcan Ersöz

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Bread has always been the main food source of a significant portion of the people in Turkey. In the early Republican era, it was also a public issue because of its price and quality and became a subject of scientific research. Two institutions, the Yeşilköy Seed Breeding Station in Istanbul and the Higher Institute of Agriculture in Ankara established bread-making laboratories in addition to their extensive research on wheat breeding. These laboratories investigated different types of wheat and other grains and explored the best varieties which were suitable for bread-making. The farinograph, an instrument that was invented by Hungarian agricultural scientist Jenő Hankóczy in 1905 and thereafter used to determine some of the physical properties—e.g. elasticity, stability, water absorption—of flour and dough, played an important role in the studies of these laboratories. Researchers such as Saffet Osman Arat and Otto Gerngross used farinographs extensively and based their conclusions about the best wheat varieties for bread-making on the data they collected with this instrument. This presentation aims to take a glance at this research with farinographs, which was conducted in the bread-making laboratories in Istanbul and Ankara between 1930-1950 to determine how they shaped the more extensive wheat breeding research of this period and how one scientific instrument was related with the more general debates on the problems of bread-making and social issues that concern the consumption of bread.

Barışcan Ersöz, PhD. is currently working at Istanbul University, Department of the History of Science. His research is mainly focused on the history of biology, genetics and agricultural sciences in modern Turkey. He recently finished his doctoral thesis on the plant breeding institutions in Turkey.

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POSTER 8

L'Equatorial Photographique de l'Observatoire d'Alger

(The Algiers Observatory Astrograph)

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Parmi les quatre instruments principaux installés sur le site de Bouzaréah, où se trouve l'Observatoire d'Alger, il y a l'Équatorial photographique. Celui-ci fut installé en 1890 lors de la participation de l'Observatoire d'Alger au projet international de la Carte du Ciel, qui devait produire la carte photographique de l'entière voûte céleste en assemblant les clichés obtenus dans divers observatoires des deux hémisphères. Avec l'Équatorial Photographique on a détecté quarante (40) Petites Planètes (connues actuellement sous l'appellation d'Astéroïdes) dont El Djazair , Bouzaréah et Lacroute (Pierre) qui est le concepteur de la mission Hipparcos (1967-1989). On est en train d'étudier des stratégies de conservation de cet instrument en comparaison avec d'autres exemplaires d'astrographs de la Carte du Ciel.

Among the four main instruments installed on the Bouzaréah site, where the Algiers Observatory is located, there is the Photographic Equatorial Telescope. This was installed in 1890 during the participation of the Observatory of Algiers in the international project of the Carte du Ciel, which was to produce the photographic map of the entire celestial vault by assembling the sky photographs obtained in various observatories of the two hemispheres. With the Photographic Equatorial forty (40) Asteroids have been detected, including those named El Djazair, Bouzaréah and Lacroute (Pierre) who is the designer of the Hipparcos mission (1967-1989). Conservation strategies for this instrument are being studied in comparison with other extant Carte du Ciel astrographs.

Zaki Cherif Grigahcène, Ingénieur en électronique à l'Université d'Alger, Master en instrumentation à l'Université de Paris-Sud (France), Responsable du service des observations et instruments d'astronomie, participé au Colloque "Histoire de l'astronomie dans le Maghreb", 2006, Tlemcen - Algérie.

Engineer in electronics at the University of Algiers, Master in instrumentation at the University of Paris-Sud (France), Head of the astronomical observations and instruments department, participated in the Colloquium "History of astronomy in the Maghreb", 2006, Tlemcen - Algeria.

Hamid Sadsaoud, see p. 177; **Ahmed Grigahcène**, see p. 77

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POSTER 9

How pure was Istanbul's air in the eighteenth century?

Spallanzani's eudiometric measurements in Istanbul

Özge Hazar

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The first meteorological observatory in Turkey was founded in Istanbul in 1868 by the initiatives of Aristide Coumbary (1836-1899), an amateur astronomer. Thanks to the measurements made at this institution (Observatoire Impérial Météorologique), daily weather forecasts were published for the first time in Istanbul newspapers. Europeans residing in Istanbul also carried out meteorological observations throughout the 19th century. On the other hand, European naturalists who came to the Ottoman Empire from the 17th century on, made meteorological observations with the scientific instruments they brought along and published the data they collected. One of these was Abbé Lazzaro Spallanzani (1729-1799).

Spallanzani came to the Ottoman Empire in 1785 when he was a lecturer in natural history at the University of Pavia. While conducting research in Ottoman lands, he collected paleontological, zoological, botanical, mineralogical and lithological specimens. He also made meteorological measurements by using the thermometer, barometer, compass and eudiometer he had brought with him. The travel notes of his observations in Istanbul were published in 1888 under the title *Lazzaro Spallanzani Viaggio in Oriente*.

During his 11-month stay in Istanbul, Spallanzani measured the atmospheric pressure, the air temperature, and analyzed the air samples he collected from crowded sites with his eudiometer. This poster presentation aims to introduce Spallanzani's eudiometric measurements made at different locations of Istanbul and describe the Ottomans' attitude towards his research.

Özge Hazar, Research Assistant, Ph.D. Student, Istanbul University, Department of History of Science. Özge Hazar graduated from Istanbul University, Department of Archaeology. She got her MA from Istanbul University, Department of History of Science. She is interested in the relationship between archaeology and the history of science, natural history collections, and travelogues on natural sciences.

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POSTER 10

Alessandro Torlonia's telescope, made by Angelo Lusvergh: Preservation measures before exhibition

Tiziana Macaluso

INAF-Osservatorio Astronomico di Roma

Angelo Lusverg's Newtonian reflecting telescope (Rome, 1835) was donated by Prince Alessandro Torlonia (1800-1886) to Feliciano Scarpellini (1762-1840) and it became part of the instrumental equipment of the Observatory of the Campidoglio. The telescope was equipped with a black marble primary mirror and it does not appear to have ever been used in any major observations.

The activity of the famous Lusverg factory, located in piazza del Collegio Romano, took place in Rome from the end of the seventeenth century to the whole of the nineteenth century.

The preservation of the telescope focused on restoring the structural continuity between the wooden and metal elements, and it has been done to allow movement and exhibition of the telescope for the exhibition "*La scienza di Roma. Passato presente e futuro di una città. Roma, Palazzo delle Esposizioni,* 12 ottobre 2021 – 27 febbraio 2022*"*.

Tiziana Macaluso, since 2020, is a conservator working at the cultural heritage unit at INAF–Astronomical Observatory of Rome (research grant). Contract professor at the *Università degli studi di Torino* and *Scuola di Alta Formazione Icpal* by teaching for the degree courses in conservation and restoration of historical heritage. She has been a restorer in the leading institutions of the Italian *Ministero della Cultura* and coordinator of a laboratory at the *Centro Conservazione e Restauro "La Venaria Reale"*.

POSTER 11

The “Impossible” Circle

Filippo Mirabello, Maria Rosalia Carotenuto, Aurelio Agliolo Gallitto

University of Palermo

“More than 30 years ago Paolo Brenni went to the Astronomical Observatory in Palermo to check the Ramsden Circle and manage its shipment to Florence for a restoration treatment at the Science and Technology Foundation …”

The first author of this poster had the honour of working with Paolo and wants to remember him here by presenting the restoration of the Ramsden Circle, a unique instrument in the world, now part of the collection of the Astronomical Observatory in Palermo.

Unpublished details relating to the construction technique will be reported, revealing the perfection of an instrument that was highly admired in the late 18th-century scientific world. In consideration of the technological knowledge of the time, its construction was really challenging (Ramsden called it "titanic") and reached the top of the best available technology in those years.

Giuseppe Piazzi (1746-1826), founder and first director of the Observatory in Palermo, discovered the first asteroid, Ceres Ferdinandea (1801), and carried out observations for the two editions of his famous Catalogues of stars (1803 and 1814) by using this instrument. Piazzi considered the Circle a masterpiece. Even today -two centuries later- the talent of a maker like Ramsden (admitted to conferences only as an auditor!) amazes anyone. By inserting a telescope in a circular scale to achieve higher accuracy in star position measurements he was able to deliver to Piazzi a brilliantly and originally designed instrument, created with the tools of the time. However, how did he do that? We will also try to clarify how Ramsden succeeded in the difficult construction of the Palermo Circle.

Filippo Mirabello is an industrial expert. From 1982 to 2016 he worked for the restoration of the scientific heritage owned by the University of Palermo. In the nineties, he collaborated with Brenni for the restoration of the Ramsden Circle and the Merz telescope kept at the Specola museum in Palermo.

Maria Rosalia Carotenuto, see p. 120

Aurelio Agliolo Gallitto is a professor of Physics at the University of Palermo and the scientific responsible of the university historical collection of the physics instruments. His research field mainly concerns the history and development of scientific instruments and their applications in teaching.

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POSTER 12

Turn of the century massification in Italian education through the lab looking glass: a biography of the physics teaching aids of the MuSEd ISMA fund

Rossella Mortellaro

MuSEd, Museo della Scuola e dell'Educazione "Mauro Laeng", Dipartimento di Scienze della Formazione, Roma Tre

The poster illustrates, through the research methodologies of so-called "storia della cultura materiale della scuola" (history of material culture of schooling), how even a small number of scientific instruments for the study of physics can be an important asset for a museum dedicated to the history of education. The MuSEd, the oldest Italian museum institution dedicated to the history of pedagogy, school and education, acquired a collection of teaching aids from the charitable entity Istituti Santa Maria in Aquiro (ISMA) in 2002. Prominently for this project, the collection included several scientific instruments for the study of physics dating back to the period between the second half of the nineteenth century and the first decades of the twentieth century.

The "biography of the scientific instrument" is defined by its evolutionary path, from manufacturing to its final destination; to this end, the historian of education draws on a number of new sources, such as commercial catalogs, advertisements, bulletins of scientific societies, reports of universal expositions together with textbooks, legislation and programs for schools up to the documentation relating to school activity. The history of the material culture of the school allows us to depict the historical, social and educational context as well as the pedagogical and regulatory evolution of educational processes and school practices. The scientific tools of the ISMA fund, in particular, illustrate a moment of significant transition in the world of Italian schools, characterized by the development of mass schooling and the consequent birth of the school industry.

Rossella Mortellaro is a biologist and an educator. Since January 2023 she has been a PhD candidate at the MuSEd with research on science education between the 19th and 20th centuries reconstructed through the scientific collections preserved there.

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POSTER 13

Study and restoration of four chemistry didactic posters from late XIX century

Angelika Ansaldo Patti[1], Bartolomeo Megna[2] and Antonella Maggio[2]

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In the late nineteenth century, the use of periodic table as the standard display of chemical elements wasn't established and some other ways of organizing chemical information on elements were used as didactic support. In this paper the study and restoration of four posters on chemical information is presented. The four posters are: two posters are the halves of a single list of known elements with their atomic masses; one is a list of known elements with their physical chemical properties; the last one is a graphical representation of light spectrum emitted by different elements.

The posters have been found in an unsealed showcase, unprotected from weathering, light and dust. They therefore showed the signs of typical degradation of twentieth-century papers, such as yellowing from oxidation and acidity, as well as mechanical damages due to mounting on canvas and wooden sticks and due to wrong displaying. The artworks have been disassembled from the original structure, and treated in order to consolidate the support, slowing down the degradation processes, and in order to allow a long-term conservation and easy and safe use. For this reason, an assembly structure has been designed, as similar as possible to the original, which would allow them to be exposed, minimizing the risk of further future damages. All the interventions have been carried out as part of the internships within the Master's Degree Course in Conservation and Restoration of Cultural Heritage.

Angelika Ansaldo Patti is an accredited books conservator, graduated at the European Course for Conservators-Restorers of Book Materials in Spoleto (Italy) in 2003 and at the University of Tor Vergata, Roma (Italy) in 2007. Since 2019 regularly lectures book and manuscripts conservation at the University of Palermo.

Bartolomeo Megna is an assistant professor in Materials' Science and Technology, specialized in characterization of constitutive materials of cultural heritage.

Antonella Maggio is an associate professor of organic chemistry, interested in the history, teaching and dissemination of chemistry.

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POSTER 14

Hazards in the Science Collections

Tacye Phillipson

National Museums Scotland

Most scientific instruments in collections pose little or no hazard to their custodians, or to other material around them. However, sometimes items are encountered which do need some extra consideration. The hazardous material may not be original to the item, either residue left behind from the history of the object, or the result of degradation. In this poster I will seek to raise awareness of the range of potential hazards by presenting some examples of items which have been assessed in the science collections of National Museums Scotland. One case study is of a particularly early and important sample, collected by the Museum in 1856. This specimen was acquired as 'Sample of liquefied carbonic acid gas, made by Kenneth T. Kemp of Edinburgh, 1830' contained within the apparatus which had produced the chemical. Assessment of the potential hazard which it might present on display led to enhanced knowledge of the object. We concluded that the apparatus was very unlikely to have survived intact if it had actually contained liquid carbon dioxide.

Tacye Phillipson is Senior Curator of Science and is responsible for the Museum's science collections, with particular expertise in the physical sciences and 20th and 21st century material. She is also interested in safely maintaining collections containing hazardous materials and is one of the museum's Radiation Protection Supervisors.

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POSTER 15

Les instruments scientifiques du premier laboratoire universitaire français de psychologie expérimentale

(The scientific instruments of the first French university laboratory of experimental psychology)

Christophe Quaireau and Julie Priser

Université Rennes 2, Place du Recteur Henri Le Moal, 35043 Rennes Cedex

In 1896 Benjamin Bourdon created the experimental psychology and linguistics laboratory at the University of Rennes. It is the second psychology laboratory in France but above all the very first in a French university. Rennes 2 University therefore has a collection of rare scientific instruments from this unique laboratory with regard to the history of the discipline.

From the beginning of the laboratory, Benjamin Bourdon acquired various devices to study perception, movement, attention, memory, etc. Despite several relocations, about a hundred devices from this first laboratory have been preserved.

Over time, a more contemporary scientific heritage, made up of psychometric tests and devices used in the fields of educational and vocational guidance, has been accumulated. During the centenary of the laboratory, in 1996, we began the process of preservation and valorization of these various instruments, and since 2011, an exhibition space has made it possible to show, in particular, the Helmholtz resonators, a recording cylinder, a Ranvier trolley, a stereoscope, a spectroscope, a rotating tachistoscope, a Hipp chronoscope.

The objective of this work is to briefly tell the story of this singular laboratory and to present some emblematic and historic instruments of the studies carried out in scientific psychology.

Christophe Quaireau is PhD in experimental psychology at Rennes 2 University and a project manager for the heritage of scientific instruments in psychology.

Julie Priser is a collection's assistant and specialized in scientific instruments from 19th century to nowadays. Since 2021, she has been working on the mission to instrument's safeguard the laboratory of experimental psychology and supervised by Christophe Quaireau.

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POSTER 16

Restoration of Giuseppe Pagano's portrait

Sabrina Sottile, Antonella Tarantino, Bartolomeo Megna, Sabrina Carrozza, Laura Guastella and Elisa Milanese

University of Palermo

The oil-on-canvas painting depicts the "portrait of Giuseppe Pagano", kept at the Institute of Human Physiology of the University of Palermo. The conservation will be carried out as part of the laboratory activities of the Degree Course in Conservation of Cultural Heritage, University of Palermo.

The painting depicts physiologist Giuseppe Pagano, a personality of great importance in the panorama of Sicilian medicine. During his formative years, carried out at the Institute of Physiology in Palermo, he began to publish numerous experimental researches of great relevance. In 1900 he became professor of physiology and later of special medical pathology, within the same Institute where he carried out his studies. In 1938, his studies were fairly recognised and almost granted him the Nobel Prize. Unfortunately the prize was given to a Belgian physiologist.

The painter, Giacomo Grosso, was an acclaimed artist of Piedmontese background, who had great success with aristocratic and upper middle-class clientele as a portrait painter. The work was donated by Pagano's family to the Institute of Physiology.

The painting, which has never undergone restoration, is in a mediocre state of preservation, with *lacune* at the thickness of the frame, attributable to a biological attack, which also resulted in the loosening of the canvas tension. It also has additional *lacune* on the pictorial film, caused by the movements of the support.

The goal of the restoration work is to improve the work aesthetically as well as conservatively, and, above all, it represents an opportunity to further the study of a subject of great scientific importance.

Sabrina Sottile is professor on contract, restorer freelance of panting on canvas.

Antonella Tarantino is officer of the Sistema Museale di Ateneo.

Carrozza Sabrina, Guastella Laura, Milanese Elisa are students of University of Palermo, Conservation of Cultural Heritage.

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POSTER 17

The 3D digital modeling of instruments of the Museo della Specola

Salvatore Speziale

INAF - Osservatorio Astronomico di Palermo "Giuseppe Vaiana"

The high-definition reproduction of a three-dimensional model can now be considered a practice in the field of cultural heritage documentation. Such models can give the possibility of examining hidden details of an artwork and obtaining data and information of both general and specific nature, useful for study, restoration and conservation. In this poster, some examples of 3D digital models of instruments on display at the Museo della Specola will be presented and explained: the SIC participants will have the possibility to explore them in detail on a monitor.

Salvatore Speziale is a computer technician at the CED INAF in Palermo, responsible for IT services of the administrative technical offices. Collaborate in the maintenance and conservation of assets museums of the Palermo Observatory giving support as a photographer. He is the creator and author the virtual tour of the museum and the 3D models of some instruments.

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POSTER 18

What do scientific instruments withhold? The preservation of use

Isabel Tissot[1] and Marta Manso[2]

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The conservation and restoration of scientific instruments comprise several challenges related to the chemical and physical stabilisation of their constituent materials and structure. In addition, this process should include the material evidence preservation of their use revealed by wear. Material evidence, such as specific coating corrosion, material modifications of components, inscriptions, etc., disclose features of instruments' use and experimental practices that are difficult to find in other sources of information. However, material evidence preservation has implications for the conservation intervention of scientific instruments (e.g. it can be revealed by the active corrosion of a metal part). Therefore, the material evidence characterisation is fundamental to defining the intervention methodology. In this context, analytical protocols can play a key role. These protocols, which already exist for other objects of cultural interest like paintings and sculpture, are still to be defined for the study and preservation of scientific instruments.

In this poster, using scientific instruments preserved in Portuguese museums, we present the potential of analytical-based studies for material evidence characterisation. Using techniques like X-ray fluorescence and Raman spectroscopies, vibration analysis and radiography, we could infer modifications in the instruments and reveal the marks of use. Data was taken into consideration by conservators when defining the conservation-restoration methodology.

The application of analytical protocols allows the definition of more accurate conservation methodologies, assuring the preservation of the information contained in scientific instruments. By unveiling and preserving the marks of use, we contribute to the detailed history of the instrument and the science made by using it.

Isabel Tissot is a metal conservator-restorer and researcher at LIBPhys-UNL, NOVA University, Lisbon. She holds a PhD in Physical Engineering and a Master in Applied Electrochemistry from the University of Lisbon. She graduated in Conservation-Restoration from NOVA University. Her research focuses on conservation-restoration of scientific, technical and industrial heritage.

Marta Manso holds a PhD in Physics from the University of Lisbon (UL). She is an invited professor at the Art and Heritage Sciences department from the Faculty of Fine Arts UL and a researcher at LIBhys-UNL in the strand line Analytical Techniques, Development and Application to Cultural Heritage.

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POSTER 19

The astronomical instruments of the Abbey of San Martino delle Scale

Maria Luisa Tuscano

SISFA - SIA

The ancient Monastery, now Abbey, of San Martino delle Scale houses not only traditional sundials and tower clocks, but also other instruments that are the subject of this report.

Along a corridor is the valuable dial of an astronomical clock from the early 18th century. Although lacking the time machine today, it testifies, with its detailed indications, to a high degree of expertise on the part of its builders.

On the exterior wall of the church, two enigmatic dials, engraved on the wall, one of which has been restored, show unusual time tracks consistent with a complex construction to obtain lunar indications without a conversion table.

Maria Luisa Tuscano is an independent scholar. She conducts research into cultural astronomy, especially the measurement of time. A member of SAIt for over 30 years, she has attended SISFA and SIA conferences with personal contributions, which have been published in their proceedings.

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POSTER 20

Instruments and Archive from the First Poland Cryogenic Laboratory, c. 1881-1927

Ewa Wyka

Institute for the History of Science Polish Academy of Sciences, Jagiellonian University Museum

In the spring of 1883, at the Jagiellonian University in Krakow, two Polish researchers - chemist Karol Olszewski (1846- 1915) and physicist Zygmunt Wróblewski (1845-1888) conducted research on the liquefaction of gases, the so-called permanent gases like oxygen, carbon monoxide, and others. The result of their research was the liquefaction of oxygen for the first time in a static state, i.e. with a visible liquid meniscus. It gave rise to the development of cryogenic research in Poland. In the years 1883- c.1927, the mechanicians of the Jagiellonian University made apparatus for liquefying gases and for testing the physical and chemical properties of liquefied gases.

Two types of sources documenting the development of the first Polish cryogenic laboratory have been preserved in the collections of Jagiellonian University. It is: 1. a collection of instruments for gas liquefaction by the cascade method and the method of adiabatic gas expansion, 2. a set of archival documents, scientific correspondence, notes on conducted experiments, photographs, and publications. What is of particular value to historians of science is the fact that both these sources of knowledge about low-temperature research in Krakow: instruments and archives, complement each other. This allows for detailed studies of Polish researchers and their contribution to world science.

Ewa Wyka – historian of science, curator of the Jagiellonian University Museum in Krakow. The scientific interest is: chemical and physics instruments, academic collections, and Polish makers. Recently published book (in Polish) *Artefakty nauki. Historyczne przyrządy naukowe w zbiorach polskich muzeów,* 2023 (Artifacts of science. Scientific instruments in Polish Museum Collections, 2023)

SESSION

20TH CENTURY INSTRUMENTS

Making Eddington's instruments visible at the solar eclipse station in Principe, 1919

Luís Artur Marques Tirapicos[1], Samuel Gessner[1] and Duarte Pape[2]

[1]CIUHCT/Faculdade de Ciência, Universidade de Lisboa, Portugal; [2]Paralelo Zero, Lisboa, Portugal

Observing the total solar eclipse of May 29 in 1919 showed agreement with Einstein's theory of general relativity. In this talk we bring into focus instrumental equipment, observational procedures and skill that allowed to photograph the stars surrounding the eclipsed Sun. How could such equipment so successfully be re-embedded by A. S. Eddington and E.T. Cottingham under the specific local conditions of the station erected in the equatorial island of Príncipe? These questions have been addressed by developing a digital 3D-model and visualization of the observing station *in situ* at the plantation headquarters of Roça Sundy. We present the methodology and sources used for and the results obtained with this 3D reconstruction. The latter is destined to serve as an outreach resource in the framework of the research project "Einstein, Eddington and the Eclipse. A global history of the total solar eclipse of 1919" (E3Global, 2022-2024, *Fundação para a Ciência e a Tecnologia*, Portugal), which builds on previous work which, among other outputs, already identified the precise location where the observations took place. E3Global aims at writing the first global history of the 1919 eclipse. Beyond the expeditions of the two British astronomical teams – one sent to Príncipe, then a Portuguese colony, the other to Sobral, in northern Brazil –, and the subsequent scientific publications, E3Global also scrutinizes in detail contacts, negotiation and interaction with national astronomical communities in Brazil and Portugal, and local communities of elite people and common citizens before, during and right after the observations of May 1919.

Luís Tirapicos interests are the history of astronomy in Portugal and Spain, Jesuit science, Iberian archaeoastronomy and the material culture of science. He is a former research intern of the Royal Observatory – National Maritime Museum, Greenwich and a former Fellow of the Linda Hall Library, in Kansas City.

Samuel Gessner specializes in the study of the material culture of science. In his current project 'Cultures of Mathematics', he focuses on the diverse mathematical cultures in medieval and early modern Europe and how they interacted by studying the role of mathematical instruments as conceived by both theoreticians and practitioners.

Duarte Pape is an Architect who graduated at the Instituto Superior Técnico. He is the founder of the architecture studio Paralelo Zero, whose practice is centered around projects and research on the Portuguese colonial heritage in São Tomé and Príncipe, along the equator line.

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The Birth and Development of Magnetron Technology in China（1940-1990)

Ke Zhao[1], Nianci Wang[1] and Hongyin Lv[2]

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Magnetrons, which generate microwave energy as diodes, served as crucial components in Radar during World War II. The Electronic Science and Technology Museum preserves a collection of magnetrons produced from the 1940s to 1990s by various countries, including the United States, the Soviet Union, China, Japan, and Korea. This collection of magnetrons epitomizes the birth and development of China's magnetron technology through a strategy of "aid-imitation-development-importation".During WW II, magnetrons were invented by Britain and then transferred to the United States. After the war, the United States and China cooperated briefly. And in the 1950s, China and the Soviet Union established friendly cooperative relations. The Soviet Union supported China’s basic industry through 156 projects, including the Factory 776, a professional facility for military microwave electric vacuum devices. A total of 21 Soviet experts went to the factory to guide the design, technology, and production. Additionally, a specialist in very-high frequency technology, Lebedev, was assigned to the Chengdu Institute of Telecommunications Engineering to improve education. With the drawings, equipment, and component that the Soviet Union provided, China imitated a number of magnetrons. Since then, magnetron technology germinated in China.

This paper examines the history of magnetron technology in China from the 1940s to 1990s, based on the objects, archives, and interviews. From the aspects of production and education, we focus on the flow mode of Soviet magnetron technology to China in the 1950s and discuss how China developed magnetron technology under assistance.

Ke Zhao is the director of the Electronic Science and Technology Museum, and an associate professor in University of Electronic Science and Technology of China. He earned his PhD in Microelectronics and Solid-state Electronics. His research interests include the history of electronic science and technology and university museums.

Nianci Wang is a researcher in the ESTM. Her research interests include history of technology and university museum.

Hongyin Lv is the head of the Publicity Department, and a professor in University of Electronic Science and Technology of China. Her research interests include higher education and history of technology.

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Cancer research through the Iron Curtain: Manfred von Ardenne, Felix Wankel and a very expensive "bathtub"

Dr. Martin Weiss

TECHNOSEUM / Landesmuseum für Technik und Arbeit Mannheim (Germany)

The self-taught German physicist and inventor Manfred von Ardenne had become legendary by the 1970s: One of the key figures in the development of electron microscopy and television technology, after World War II he spent ten years in the Soviet Union working on nuclear physics, before returning to Communist East Germany. There, he led a life of privilege and ran a large private research institute in Dresden, where he turned to cancer research and devised a "multi-step-therapy of cancer".

This came to the attention of another self-taught inventor in West Germany, Felix Wankel, who had made his name (and fortune) with the development of the rotary engine. Wankel subsequently bankrolled clinical trials of the new therapy in West Germany.

Drawing on previously unstudied correspondence from Felix Wankel's personal archives, this paper will reconstruct how two exceptional characters' paths intersected, and how their similar backgrounds and privileged positions proved stronger than the Iron Curtain. Special attention will be paid to a specifically constructed medical "bathtub", both as an instrumental part of the therapy process, but also as a Latourian "actor" in the unravelling of Wankel and von Ardenne's partnership.

Martin Weiss is a curator at the TECHNOSEUM in Mannheim, Germany. He received his PhD in the history of science from Leiden University in 2013. His interests lie with anything that can calculate, the Cold War, and the history of museums and collections.

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Automated Interplanetary Station (AIS) "Venus-4". Landing module

Gergana Todorivna Ivanova

Ukraine, Kyiv, State Polytechnic Museum named after Borys Paton

Our museum has a technological model of the Venus 4 lander, which descended into the atmosphere of the planet Venus on October 18, 1967.

The Venus 4 spacecraft can be classified as a scientific spacecraft, as it was the first in the world to measure the parameters of the Venusian atmosphere and transmit these data to Earth.

It was created at the Lavochkin Machine-Building Plant under the leadership of Chief Designer Georgy Babakin (1965-1971).

Venus 4's objectives were

- penetration into the atmosphere of Venus to the maximum possible depth, which is determined by the heat resistance and strength of the spacecraft

- to attempt to land on the planet's surface if the temperature and pressure limits are not reached

- transmission of telemetry information during the dive and after landing on Venus.

The main result of the Venus 4 mission was the first direct measurements of the temperature, density, pressure and chemical composition of the Venusian atmosphere. The lander crashed at an altitude of 28 km from the surface of Venus because its design was not designed to withstand the enormous atmospheric pressure. However, the data transmitted was later used to create more reliable vehicles capable of operating on the surface of Venus at an atmospheric pressure 92 times higher than on Earth and a temperature of +462 degrees Celsius. They were able to take the world's first and only panoramic photographs from the surface of the planet Venus ("Venus 13") and ("Venus 14").

Gergana Todorivna Ivanova received a bachelor's degree (2019) and a master's degree (2021). Since 2021, she has been working at the museum as a researcher. She is also currently studying for postgraduate in history and archaeology. Her research interests include museology, cultural studies, and the history of science and technology.

Glimmer in the Dark： the History of China's First Silicon Target Vidicon

Nianci Wang[1], Ke Zhao[1] and Deli Chen[2]

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During the Vietnam War, the mode of night warfare was changed with the emergence of night vision devices, causing heavy casualties in Chinese army. In order to address urgent problems for the military, six key institutions were designated to tackle problems in low-light-level camera tubes with silicon targets, which is the key component in night vision. In 1974, the Teaching and Research Group 502 of Chengdu Institute of Telecommunication Engineering developed China's first silicon target vidicon, capable of imaging under near-infrared light. It built the foundation of low-light-level camera tubes. During the following three years, it provided more than 100 tubes to over 50 institutes nationwide and promoted the development of television tracking, near-infrared television, and other fields. Subsequently, the Group 502 was recognized by Mahler in West Germany, one of the inventors of PAL, for its success in developing a low-light-level camera tube and low-light-level television system which enabled low-illumination image.

This paper will conduct research based on objects and archives in Electronic Science and Technology Museum, conduct interviews with relevant researchers from the R&D team, and finally, investigate the history of the first silicon target vidicon. Three topics are discussed: (1) The reasons why the Group 502 succeeded ahead of the other institutions, in the absence of funds and testing platforms; (2) How did the science mode promote the success of the Group 502, while two teams researching at the same time in the university. (3) The relationship between military, technology, and industry is reflected by its development.

Nianci Wang is a researcher in the ESTM. Her research interests include history of technology and university museum.

Ke Zhao is the director of the Electronic Science and Technology Museum, and an associate professor in University of Electronic Science and Technology of China. He earned his PhD in Microelectronics and Solid-state Electronics. His research interests include the history of electronic science and technology and university museums.

Deli Chen is a researcher in the University of Electronic Science and Technology of China. His research interests include education of university museum and science history.

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SESSION

TIME MEASURING

THROUGH AGES, CULTURES AND CONTEXTS

The landscape as a scientific instrument: Meton's observations from the Pnyx to determine the length of the solar year

Efthymios Nicolaidis

National Hellenic Research Foundation

In the fifth century BC the astronomer Meton determined the length of the solar tropical year which led to the determination of the famous 19 year cycle of Meton. This cycle, already known by the Babylonians, connects the solar calendar with the lunar calendar as after 19 years the lunar calendar roughly coincides with the solar calendar. A specific lunar month is found again almost at the same period of the solar year.

The 19 year cycle of Meton is found in many texts of ancient Greek astronomy and also appears on the Antikythera Mechanism. It is one of the basic constants of ancient Greek astronomy.

To determine this cycle Meton did not use a measuring instrument which he had constructed but the landscape. He observed from the hill Pnyx the sunrise on the hill of Lycabettus about 4 km away. In essence, he used the landscape as a huge and precise scientific instrument.

In this paper we will describe Meton’s observations based on insitu reconstruction of these observations. The foundations of Meton's ‘heliotropion’ from which he observed the sunrise near the summer solstice are located in the hill of Pnyx. We will show the importance of the relief landscape of Lycabettus for the accurate observation of the return of the sun at the same point in order to determine the length of the tropical year.

Efthymios Nicolaidis is Emeritus Director of Research, NHRF. Publications on the history of astronomy, the relations science - religion, the history of science in Byzantium and the Ottoman Empire, the spread of Modern European science. President of the International Union of the History and Philosophy of Science (2013-2017), Honorary Permanent Secretary of the International Academy of the History of Science.

A Case Study on a 17th-century Ottoman notebook on sundials: the Risâle-i tersim-i alât-ı hey'et

Gaye Danışan

Department of History of Science at Istanbul University

This presentation examines an anonymous Ottoman notebook (ca. 1647), including various sundials' descriptions and sketches. Although the notebook's author's profile still needs to be clarified, it provides clues about the Ottoman scholar's interest in European sundials in the 17th century since it contains drawings of sundials such as an equinoctial ring, a cylindrical sundial, which were widely used in Europe. Based on this case study, this paper will address the following questions: What factors determined the diversity of portable astronomical instruments in the Ottoman Empire? What is the reason for the widespread use of some instruments in the Ottoman Empire while others were less used or not preferred? To what extent did the Ottoman Empire follow and adopt the changes/innovations in portable astronomical instruments in Europe? Were the Ottoman scholars who determined all these processes only munajjims and muwaqqites, or is it possible to talk about the contribution of different Ottoman scholar profiles?

Gaye Danışan is an assistant professor at the Department of History of Science at Istanbul University. Her research interests are calendars, portable astronomical instruments, volvelles, navigation, astrology and astrometeorology in Ottoman history. Her research focuses on a project entitled "Portable Astronomical Instruments: The Processes of Adaptation and Diffusion of Medieval Islamic and European Examples in the Ottoman Geography (1500-1700)", funded by the Turkish Academy of Science- Outstanding Young Scientists Awards Program.

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Horse races, falling stars and artillery: Measuring thirds (60th of a second) around 1800 … or thoughts on the prehistory of Hipp's chronoscope

Richard L. Kremer

Dartmouth College, USA

At the end of the eighteenth century, measuring short time intervals became an increasingly urgent technical problem across a range of social contexts: artillery officers, horse racers, natural philosophers quantifying the 'speed of sound', astronomers exploring falling stars, popular lecturers seeking to confirm the daily rotation of the earth by dropping objects from tall towers. Long having made time pieces marking minutes and seconds, several clock and watch makers began making 'thirds counters' to meet these demands. This paper will examine the efforts (and surviving technical artifacts) of Johannes Klindworth (mechanic in Göttingen), Wilhelm Pfaffius (clockmaker in Wesel, near Duisberg), and Louis Moinet (watchmaker in Paris) to reliably measure thirds and, in line with the Palermo theme, will ask whether their devices should be called 'scientific instruments' in a period 50 years before the Swiss clockmaker, Matthias Hipp, started manufacturing a chronoscope that could measure milliseconds and quickly spread throughout the world's scientific laboratories.

Richard L. Kremer is professor emeritus of history at Dartmouth College, where he continues to curate that institution's collection of historic scientific instruments. He has published widely on the history of instruments, especially late medieval and early modern astronomical instruments, and is a past president of the Scientific Instrument Commission.

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Catalogue des instruments astronomiques et de mesure du temps en Algérie

(*Catalogue of astronomical instruments and sundials in Algeria*)

Ahmed Grigahcène, Hamid Sadsaoud and Zaki Cherif Grigahcène

Centre de Recherche en Astronomie, Astrophysique et Géophysique – CRAAG. BP 63, Route de l'Observatoire, CP 16340, Bouzaréah, Algiers, Algeria

Nous présentons dans ce travail le résultat d'une recherche que nous avons menée pour localiser les instruments astronomiques (astrolabes, quadrants) et de mesure du temps (cadrans solaires, clepsydres, sabliers) qui existent à présent en Algérie. Nous en avons trouvé plus de quatre-vingt (80). Les cadrans solaires sont de loin les plus nombreux. L'échantillon n'est en fait pas homogène, car notre état de connaissance n'est pas le même pour tous les objets. Nous avons pu voir ou même toucher certains, pour d'autres nous n'avons que de vagues informations bibliographiques. Mais, il nous paraît que ce travail est très important pour tout lancement d'étude détaillée spécifique ou thématique de ces instruments. Dans ce qui suit nous donnons le résultat de notre travail, en suivant un ordre plutôt chronologique. Cette étude fait partie d'un projet plus général que nous développons sur l'histoire de la pratique astronomique en Algérie.

We present in this work the result of a research that we carried out to locate astronomical instruments (astrolabes, quadrants) and for time measurement (sundials, water clocks, hourglasses) in Algeria. We found more than 80 items. Sundials are by far the most numerous. The sample is actually not homogeneous, because our state of knowledge is not the same for all the objects. We were able to see or even touch some, for others we only have vague bibliographic information. Anyway, it seems to us that this work is very important for any launch of specific or thematic detailed study of these instruments. In what follows we give the result of our work, by adopting a rather chronological order. This study is part of a more general project that we are developing on the history of astronomical practice in Algeria.

Ahmed Grigahcène is an astrophysicist at CRAAG(Algiers Observatory). He got a Phd in Astrophysics from the University of Granada (Spain). Expert on Stellar Physics, he participated in two major international missions, namely CoRoT (CNES-Europe-Brazil) and Kepler (NASA-Europe). He has more than 25 international publications and 50 publications in proceedings of scientific conferences. He has an extensive experience in astronomy outreach through regular participation in amateur meetings, with special effort in mass-media (newspapers, Radio program, TV programs-Canal Algérie). He was the main organizer of the CRAAG Conference cycle on the celebration of the International Year of Light 2015. He is actually conducting an original investigation on the history of Astronomy in Algeria.

Hamid Sadsaoud, see p. 177; **Zaki Cherif Grigahcène**, see Poster 8.

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SESSION

SCIENTIFIC INSTRUMENTATION IN PRE- AND EARLY-MODERN ISLAMICATE SOCIETIES. ASTROLABES AND WHAT ELSE?

Organizer's full names: Taro Mimura & Petra G. Schmidl

on behalf of the Commission on History of Science and Technology in Islamic Societies (CHOSTIS) in the International Union for the History and Philosophy of Science (IUHST)

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Session Abstract

When illustrating a book, in particular a more popular one, or displaying an exhibition on history of science in pre- and early modern Islamicate societies, covers and posters prompt that an astrolabe is a must-have. Highly elaborated and beautifully crafted examples shall catch customers', readers', and visitors' eye. Notwithstanding, these multi-functional, twodimensional models of the three-dimensional universe are fascinating objects of research and of marveling admiration. Their prominent presence, however, might make one forget about other artefacts and instruments in pre- and early modern Islamicate societies, be they also related to timekeeping and further astronomical, astrological, and mathematical 42nd Scientific Instrument Symposium 18 - 22 September 2023, Palermo, Italy Through Ages, Cultures, Concepts: Instruments in Collections, Books, Archives practices, or be they used in other branches of scholarly knowledge such as alchemy or medicine. This panel will bring together recent research on scientific instrumentation in pre- and early modern Islamicate societies. It will not only illustrate the broad variety of contexts and practices where these instruments and artefacts were used, but will also bridge disciplinary boundaries of modern specialization and institutionalization by highlighting that those scholars who made and used these instruments and artefacts were often versed in a wide range of what a modern look might rate scientific disciplines.

Rare Instruments in Textual Sources: Theoretical or Materialized

Taha Yasin Arslan

Istanbul Medeniyet University, Turkey

From the 9th to 16th centuries, astronomical instruments in the Islamic world were plentiful and more importantly quite diverse. Hundreds of extant astrolabes, celestial globes, and quadrants with many different features in museums and special collections provide plenty of evidence on their varied nature. However, these three types were arguably the most popular astronomical instruments, and their popularity did not come from their differences but commonness. For instance, all celestial globes have the same fundamental markings and engravings that allow almost any user manual to be utilized without a problem. The main diversity in the instrumentation, therefore, should be sought in rather rarer instruments. These are either rare but extant instruments such as the 15th-century spherical astrolabe, only one of its kind, or instruments that are described and/or illustrated only in textual sources. al-Jayb al-ghāʾib ("The Hidden Sine Graph"), designed by the 14th-century astronomer/instrument maker Ibn alSarrāj and al-rubʿ al-tamm ("The Complete Quadrant") invented by his contemporary astronomer Ibn al-Shāṭir are among many examples. Were these instruments only mental geometrical exercises or did they ever exist? How do you define an instrument as 'theoretical' or 'materialized' without a proof of an extant copy? This presentation will discuss these very questions about the rare instruments using several examples from different historical texts from the Islamic world.

Taha Yasin Arslan is a historian of science and deputy director of the Institute for the History of Science, Istanbul Medeniyet University. The focus of his research is astronomical instruments in the 13th-16th centuries Islamic world. As part of his studies and teaching, he makes replicas of historical scientific instruments.

Conceptualising Alchemical Instruments in Byzantine and Early Islamicate Sources

Vincenzo Carlotta

Università di Bologna

The history of alchemy is linked indissolubly to the history of the instruments and furnaces developed and used by the alchemists. Operations and procedures aiming at transmuting various material substances into silver and gold would be meaningless if alchemical instruments remained completely unidentified. But alchemical practice was also connected with theoretical endeavours to understand the properties of natural substances and justify the marvellous transformations promised by alchemy. Accordingly, the alchemical apparatus was frequently represented as a microcosm, a small-scale reproduction of the universe, where natural change can be replicated and controlled by the alchemist.

This paper will focus on the specific correspondences established between alchemical instruments and nature by considering textual sources from the Greco-Egyptian, Byzantine, and early Islamicate traditions. These correspondences were especially relevant for the textual description of the alchemical apparatus, in which technical instructions and nomenclature merge with references to various aspects of the natural world. Moreover, comparisons between the alchemical apparatus and nature influenced substantively the understanding of the operations occurring within specific instruments, sometimes challenging the boundaries between natural and artificial processes. The conceptualisation of alchemical instruments as both laboratory equipment and imitation of the natural world is grounded in the technical operations they were used for, but incorporates philosophical, religious, and cultural features that have deeply influenced the historical development of alchemy.

Vincenzo Carlotta is Research Fellow at the University of Bologna. His research focuses on the Greek alchemical tradition and its correlation with natural philosophy during late antiquity and the Byzantine period, with especial focus on alchemical works preserved under the names of Cleopatra and Stephanus of Alexandria.

Islamic surgical instruments. Between ideal and reality

Fabian Käs

University of Cologne, Germany

The medical instruments used in Islamicate societies are of greatest interest for the history of surgery, since they count among the precursors of modern tools. The most important sources of information are specialized Arabic texts, which are rather rare because surgery was not considered a part of the medical art in its strict sense by Greco-Arabic physicians, but the specialty of craftsmen. The most renowned exception is al-Zahrāwī, who described in eleventh century al-Andalus a vast number of instruments for various purposes.

Based on the information provided by him, popular scientific studies on medieval Islam still often draw the distorted picture of skilled medieval surgeons disposing of a highly specialized and innovative toolset. I am trying to show that al-Zahrāwī did, in fact, not describe the actual state of the art in his time, but a utopian ideal concept. However, other monographs on ophthalmology, surgery, and the treatment of wounds, as well as scattered accounts found elsewhere, show that the main types—that can mostly be traced back to antiquity—were indeed in practical use.

Fabian Käs (PhD, Munich 2008) is Research Fellow at the University of Cologne. His publications in the fields of Arabic medicine and mineralogy include *Die Mineralien in der arabischen Pharmakognosie* (Wiesbaden 2010) and *Ibn al-Jazzār's Zād al-musāfir. Books I and II* (Leiden 2022, with G. Bos and M. McVaugh).

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Political Role of the Armillary Sphere in the Fatimid Dynasty

Taro Mimura

University of Tokyo, Japan

al-Ashraf ʿUmar (d. 1296), the third Rasūlid sultan, composed Muʿīn al-ṭālib fī al-ʿamal bi-l-asṭurlāb (“The Student’s Aid on the Use of the Astrolabe”), a comprehensive work on astronomical instruments, in which he recorded that the sixth Fatimid caliph Ḥākim (985-1021) possessed a large armillary sphere comprising nine rings, each of which weighed 1000 kg. Notably, Dūnash ibn Tamīm (fl. 950), a Jewish physician serving the Fatimid caliphs, wrote a treatise entitled “Treatise on the Armillary Sphere”, the oldest extant Arabic work on the armillary sphere written in the Islamic West, where he delineated, and expounded how to operate, an armillary sphere consisting of nine rings. It is remarkable that this work was dedicated to Abū al-Ḥasan Muḥammad, a politically influential figure in Mahdiyya. Thus, the demand for the armillary sphere by political authorities impresses on us how the armillary sphere was politically significant in the Fatimid dynasty. In this paper, I will elucidate the political role of the armillary sphere in the Fatimid dynasty by analyzing Dūnash’s work as well as the episode pertaining to Ḥākim’s armillary sphere.

Taro Mimura is an associate professor of History of Science at the University of Tokyo. He was a researcher for the Institute of Islamic Studies 'Rational Science in Islam' project at McGill University (Canada), and on the 'Arabic Commentaries on the Hippocratic Aphorisms' project at the University of Manchester.

An accessory instrument to the astrolabe, made by a 10th-century craftsman

Pouyan Rezvani

Project PAL (Ptolemaeus Arabus et Latinus), Munich, Germany

In the introduction to his treatise on the applications of standard and some non-standard astrolabes, entitled Treatise on opening the way towards using the different kinds of astrolabes (Arabic: Maqāla fī al-taṭrīq bi-istiʿmāl funūn al-usṭurlābāt), al-Bīrūnī (973 – ca.1050 CE) briefly describes an instrument in connection with the astrolabe, produced by one of his young contemporaries to be dedicated to Abū al-ʿAbbās Khwārizm-Shāh (d. 1017 CE), the ruler of Khwārizm, as a gift. According to al-Bīrūnī, this instrument consisted of six hundred parts, although it was not so big. Al-Bīrūnī admires the superior intelligence of the craftsman, but criticises him for his inability in Arabic and lack of interest, without mentioning his name. No further information on this instrument and its inventor is given in other medieval Islamic sources, and its diagram is not depicted in the unique manuscript of al-Bīrūnī's treatise. In this talk, I will discuss how this instrument could be assembled on the back of a mixed astrolabe, called "scorpion-shaped" (Arabic: muʿaqrab), to present the moon phases. My elaborations will be illustrated with a diagram of the instrument, which I have reproduced based on my interpretation of al-Bīrūnī's passage.

Pouyan Rezvani is an Iranian postdoctoral researcher at the project PAL (Ptolemaeus Arabus et Latinus), Munich, Germany. He received his PhD from Utrecht University, the Netherlands, with a dissertation on two treatises on the astrolabe by al-Bīrūnī (973 – ca. 1050 CE) under the supervision of Prof. Dr. Jan P. Hogendijk.

The Algier workshop of astrolabes and an overview of Maghribi astrolabes

Petra G. Schmidl and Jan P. Hogendijk

Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany & former University of Utrecht, The Netherlands

In 2018 a three-day program on the astrolabe was held by a team from Utrecht University in Algiers, in ‘the Ecole Normale Sup\'erieure, Vieux-Kouba, and again at the Center of Research in Astronomy, Astrophysics and Geophysics. The core of the program consisted of four interactive workshops on (1) the astrolabe in general, (2) reading a 18-th century Maghribi astrolabe by al-Battuti and an 11-th century Andalusi astrolabe by Muhammad al-Sabban, (3) the Zarqali plate, and (4) constructing the astrolabe according to traditional Islamic methods. In addition, four introductory presentations were given by Jan P. Hogendijk.

Petra Schmidl will present the material for part of this program and also a webpage, based on the research of D.A. King on Western Islamic astrolabes, with many internet sources.

Petra G. Schmidl, research partner at the International Consortium for Research in the Humanities (IKGF), Friedrich-Alexander-Universität ErlangenNürnberg, Germany, is a historian of science with a focus on pre-modern astronomy, astronomical instruments, and astrology, prognostic practices, and occult sciences in Islamicate societies. Her recent research project aims at the edition, English translation, commentary and study of the Kitāb alTabṣira fī ʿilm al-nujūm written by al-Ashraf ʿUmar in 13th century Yemen.

The role of Arabic sources in the analysis of ancient timekeeping instruments

Anette Schomberg

Charité, Berlin

The remains of one of the last monumental Arabic water clocks are preserved in the old city of Fez in Morocco. This timekeeping instrument is one of the last representatives of a technology that was developed as early as Hellenistic Alexandria and flourished in Arabic times. At first glance it has little in common with a clock of modern design. There are no dial or hands. Instead, a facade has been preserved, which is primarily divided by 12 small doors. Even though nothing remains of the original technology hidden behind it, we can reconstruct it, in broad outline, from the writings of Arab engineers such as Ibn ar-Razāz al-Jazarī. Every hour, one of the doors opened and at the same time a ball fell into a bowl placed underneath - with a visual and acoustic signal, the clock indicated the respective hour. This connection of opening door and falling ball represents a kind of "leitmotif", by means of which the development of such instruments can be traced from the third century B.C.E. to the clock in Fez. If one analyzes the known texts anew and subjects the reconstructions, based on them, to a thorough revision, it becomes clear that this time-measuring instrument represents a unique example of a technological continuity spanning more than 1500 years and different cultural spaces.

Anette Schomberg studied Classical Archaeology and Ancient History at the Universities of Göttingen and Heidelberg. She received her PhD in 2011 with a study on innovations in ancient water technology. Afterwards, she was employed as a Postdoc at the Cluster of Excellence Topoi at the Humboldt-University Berlin. In addition to water technology, her research focuses on Roman steelyards and ancient technology in general.

An English Quadrant in 18th century Morocco: an anonymous Arabic translation of John Hadley's Treatise

Justin Stearns

New York University, Abu Dhabi

This paper is focused on a manuscript from the Moroccan Royal Library (M10831) that contains an Arabic translation and discussion of the work of the eighteenth-century English instrument maker John Hadley (d. 1744). This treatise is remarkable if not unique both for its being a translation in Arabic of an English work in the early modern period as well as its detailed discussion in Arabic of a nautical instrument in the eighteenth century. The paper argues that the translation demonstrates greater – and later – intellectual engagement between Moroccan scholars and European scholarship than previously thought and situates the translation in the context of a small body of early 17th century Arabic translations from Spanish on the one hand, and the 18th century Moroccan presence in English port cities on the other.

Timekeeping Practices in Cultural Context: Two Astrolabic Quadrants by Mizzī & Sutton

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In the previous SIC symposium in Athens, I presented my study on cataloguing the surviving portable astronomical quadrants; instruments that were employed for timekeeping and practical astronomy in the Islamic civilization and Western Europe for centuries. Astrolabic quadrants, whose principles can be obtained in theory by folding superimposed plates of astrolabes, constituted a set of instruments in that catalogue. In this year's contribution, I will introduce the study of two particular astrolabic quadrants and the practices as well as the cultural meaning connected with them. Among the most accomplished instrument makers of their respective cultures were Muḥammad ibn Aḥmad al-Mizzī in 14th century Damascus and Henry Sutton in 17th century London. For my PhD project, I am going to analyze the reckoning of the time with reconstructions of an almucantars-trigonometrical quadrant by Mizzī and a large quadrant by Sutton with the necessary adaptations to the latitude of Flensburg and the year of 2023. One research assumption is that we can develop a more thorough understanding of the cross-cultural contexts of historical timekeeping by using the instruments according to the primary source materials. In this talk, the two astrolabic quadrants and their reconstructions will be introduced. Then, I am going to exemplify a few timekeeping operations from the source materials to elaborate on this inquiry.

Enes Tepe is a Ph.D. student in the physics department at the Europa-Universität Flensburg, Germany. His research interests focus on the history of timekeeping and astronomy with specific emphasis on the instruments from the Islamic world and the Western Europe before the 19th century.

Khujandī's 'Comprehensive Instrument'

Beyzanur Topçuoğlu

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One of the consequences of the rapid development of mathematical sciences in the 9th century Islamic world was the flourishing of astronomical instrumentation. In the following centuries, astrolabes evolved into complex devices, new types of instruments for observations and calculations were designed, and scholars pushed the limits of geometry for innovation. One such instrument was called *Ālat al-Shāmila*. Invented by the 10th century scholar Abū Maḥmūd Ḥāmid ibn al-Khiḍr al-Khujandī, this instrument is regarded as one of three classical portable spherical astronomical instruments, along with spherical astrolabes and celestial globes. It consists of a disc and a hemispheric bowl on a stand. According to Khujandī, it is intended to combine functions of three different instruments: astrolabe, sundial, and armillary sphere. That is why he named it *Ālat al-Shāmila*, which literally means 'the comprehensive instrument'. He compiled a treatise titled *Book on the Construction of the Comprehensive Instrument and Its Use*. Besides the basic information on the instrument, he also mentions its deficiencies as well as features that require development. This presentation provides a description of the instrument based on Khujandī's account and discusses the impact of *Ālat al-Shāmila* on the astronomical instrument tradition in the Islamic world.

Beyzanur Topçuoğlu is a graduate student enrolled in an M.A. in History and Philosophy of Science at Istanbul Medeniyet University. Her academic interests primarily focus on astronomical instruments and timekeeping in the Islamic world. Currently, she is studying the user manuals of celestial globes in her thesis.

SESSION

COLLECTIONS

A Path between Continuity and Innovation: The Instruments of the Laboratory of Physics at Politecnico di Torino

Margherita Bongiovanni[1], Emma Angelini[2] and Francesca Gervasio[1]

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The collection of instruments and equipment for electrical measurements of the Laboratory of Physics is preserved at the Department of Applied Science and Technology of Politecnico of Turin. The collection includes electrometers, voltmeters, amperometers, galvanometers, valve and battery testers, power supplies, converters, and electrical analyzers, which were mainly used for didactic and research purposes from 1920 to 1960. Most of the historical material and scientific equipment come from the Department of Physics and from the laboratory for the Superior School of Electronics founded by Galileo Ferraris in 1888, transferred to the National Electronic Institute when it was established in 1934. The collection includes several significant instruments, such as the strained wire Perucca electrometer (1927), the astatic Galvanometer for d.c. by Nobili, and the mirror Galvanometer Ayrton-Mather. The Delco positive voltage booster and the differential Magrini detector for 2 winding converters are also noteworthy. The study of this collection allows us to reflect on the technological leap that occurred in the post-war years, which was substantial on the one hand, but only apparent on the other, as scientists have always found in the continuity of their culture the reason for their work and the development of updated instruments. This collection is evidence of the continuity and importance of the national scientific community's interest in the field of Metrology and in the scientific contribution of Galileo Ferraris, who sparked progress in the field of electrical applications. Even a century later, many advancements influenced by his work are still shared and discussed at national and international conferences.

Margherita Bongiovanni is an architect and has been operating since 1998 within the Museum and Historical Documentation Centre of Turin Polytechnic. Since 2020 she has been responsible for Conservation, Management and Enhancement of Historical-Scientific Heritage of Turin Polytechnic. Her activities range from projects to preserve, conserve and promote the Polytechnic historical heritage to the spread of new scientific cultural programs.

Francesca Gervasio is graduated in Conservation and Restoration of Cultural Heritage, is currently a research fellow at the Politecnico di Torino with a program aimed at developing innovative projects for the conservation and enhancement of historical and scientific collections, ultimately engaging with different audiences and addressing the issues of today's society.

Emma Angelini, see p. 127

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Huth and Parrot laboratories in Tartu/Dorpat

Lea Leppik

University of Tartu Museum

In Estonia, we cannot boast of old, well-preserved scientific collections. Before the value of old scientific instruments was noticed, 2 world wars, repeated evacuations and regime changes had passed, and until the 1960s, old scientific instruments were pragmatically seen as just spare parts.

But archives and libraries give an idea of what once was. The physics cabinet of the University of Tartu (Dorpat) founded by Georg Friedrich Parrot in 1802 contained 25 years later 455 names of scientific instruments for researching and teaching all fields of physics at that time. This is remarkable because such cabinets were not necessarily common in the German-speaking universities. Something of this collection is survived to this day, we can identify 25-50 items based on the inventories of Parrot's time.

At the beginning of the 19th century, there was another collection of scientific instruments in Tartu, which belonged to astronomy and mathematics professor Johann Sigismund Gottfried Huth. It was a purely private collection - the professor came to Kharkov at first and probably did not expect that the Russian Empire would offer him working tools. When he moved to Tartu, he also took his collection with him. We only know about this because the property of a professor who died in office (1818) had to be registered in the university court. Most of it was sold at auction to various persons, so only the auction list gives an idea of the whole. At least 5 items from this collection have also reached the university museum.

Lea Leppik, Phd, is curator at the University of Tartu Museum. She has curated different exhibitions and written about the history of the University of Tartu and history of sciences, mainly in the 19th century.

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The birth of the Astronomical and Copernican Museum in Rome

Francesco Poppi, Marco Faccini and Giangiacomo Gandolfi

INAF-Astronomical Observatory of Rome

The history of the Museum begins in 1873 with the celebrations of the 4th centenary of the birth of Copernicus, held in Rome at La Sapienza University. The occasion gave birth to the idea of founding a permanent museum dedicated to the memory of the famous Polish astronomer who had revolutionized the conception of the world. Despite the great interest that the initiative awakened from the very beginning, many years passed before a definitive location for the Museum was identified, which was associated with the Observatory of "Collegio Romano", then with the Astronomical Observatory of Rome in Monte Mario. The original collection of Copernican mirabilia was soon expanded by Artur Wolynski, the curator, and Pietro Tacchini, the director, with scientific material deriving mainly from Italian astronomical observatories. The Museum has thus become a complete compendium of astronomical instruments of a wide range of eras, ancient books and archival documents, which exhibit the evolution of astronomical knowledge from its beginnings to the present day.

The purpose of the contribution is to present the Museum's original collection with focus on selected ancient astronomical instruments in the moment of the reopening to the public during the International Year of Copernicus 2023.

Marco Faccini has been a technician at the INAF OAR since 2008. He has a background in astrophysics and science communication management. Today his effort is mainly devoted to Museo Astronomico Copernicano of the Observatory of Rome as registrar and also following its technical development. He has been responsible for several PO projects (also European) and events.

Giangiacomo Gandolfi is an Astrophysicist and Science Communicator. He worked as a Space Scientist in Rome for Telespazio srl and CNR, as a Planetarian in Planetario di Roma. Now he is Curator of the Library and Historical Archive of INAF - OAR. His interest is particularly stimulated by the interaction of sky and human culture in general, especially by its relationship with Art, Literature and Theatre.

Francesco Poppi graduated in Astronomy at the University of Bologna with a thesis on the history of Bolognese astronomy in the 19th Century, after the degree he became fellow of the University where he carried out historical research in the field of astronomy, promoting the Museo della Specola in Bologna. Since 2020 he is curator of the Astronomical and Copernican Museum in Rome.

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SESSION

INSTRUMENT MAKING AND MAKERS

Tools of Knowledge: tracking scientific instruments and their makers over time and space

Rebekah Higgitt[1], Sara Middle[1], Alex Butterworth[2], Duncan Hay[2]

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In the work of tracking instruments in physical collections and textual sources, and through time and space, digital tools are becoming increasingly important. This paper will present some of the outcomes of the Tools of Knowledge project, funded by the UK Arts & Humanities Research Council. The major part of the project has involved remodelling Gloria Clifton's SIMON database (Scientific Instrument Makers, Observations & Notes, containing information about makers in the UK and Ireland from 1550-1914), as a semantic database – that is, one that is structured to create relationships within and add meaning to data. This talk will introduce the new database, which has sought to make the rich information and implicit knowledge of SIMON newly accessible and searchable, along with ways in which the project has begun to visualise the data. The project has also sought to demonstrate how such data can be linked to additional sources about instruments and how we might record and visualise information about the 'lives', or itineraries, of individual objects. Our proof-of-concept work seeks to show how linked open data repositories can preserve and share existing research data and prompt new knowledge and enquiries.

Rebekah Higgitt is Principal Curator of Science at National Museums Scotland, having previously been Curator of History of Science at Royal Museums Greenwich, and a senior lecturer at the University of Kent. She is a Co-Investigator on the Tools of Knowledge project.

Alex Butterworth is a researcher in Digital Public History and emergent forms of digital narrative. He is Co-Investigator on the Tools of Knowledge project, at the Sussex Humanities Lab, and Co-Investigator and Digital History Lead on the Congruence Engine project at the Science Museum, where he is a Senior Research Fellow.

Duncan Hay is a Digital Humanities researcher whose work investigates the relationship between culture, space and technology. He is Senior Research Fellow at The Bartlett Centre for Advanced Spatial Analysis, UCL, and Research Fellow and Full-Stack Developer on the Tools of Knowledge project at the University of Sussex Humanities Lab.

Sarah Middle is a postdoctoral researcher on the Tools of Knowledge project, having recently completed a PhD on Linked Ancient World Data usability at the Open University (UK). Previously, Sarah worked as Repository Manager at Cambridge University Library and has a background in libraries, project management, and archaeology.

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Interpreting silences and overturning assumptions: women in the instrument trade of 18th-century London

Alexi Baker

Yale Peabody Museum

Women were involved in making and selling instruments in London during the long eighteenth century through a variety of roles and socioeconomic dynamics. Shops and workshops were commercial enterprises first and foremost. Most were embedded in and operated by households, often built on blood and marriage as well as craft and commerce.

Women, both relations and hired help, were vital contributors to these commercial enterprises. They were not considered incapable of nor morally barred from operating outside of private family spaces and activities. Direct and indirect evidence indicates women were makers and sellers of instruments and components, shop managers and assistants, and accountants and agents, among other roles. (Women's domestic labor, as well as their sometimes operating unrelated businesses, also enabled the successful funding and operation of family instrument shops.)

Surviving records do not reveal the identities and contributions of many people involved in the instrument trade, and this is likely even more true for those who presented as women. They were perceived and treated differently in legal and socioeconomic contexts. Some women also made a strategic decision to underplay or conceal their commercial roles - or gender.

However, we can interpret the direct and indirect evidence as well as the silences surrounding women and instruments within the context of how gender operated in commerce, crafts, and communities in early modern London. This requires overturning frequent assumptions made about early modern gender roles and questioning the ways in which historians have defined and valued instruments and instrumental people and practices.

Alexi Baker operates the History of Science and Technology collection at Yale University's Peabody Museum. She was previously a post-doc at the University of Cambridge on the Board of Longitude project (2010-2013) and at CRASSH (2013-2015). She has a D.Phil. and museum studies M.Sc. in History of Science from Oxford.

Instruments to think the personal equation

Loïc Jeanson

First assistant in digital humanities, University of Lausanne

In its quest for the most precise and absolute results possible, astrometry generated the notion of *personal equation*. It could only get rid of it at the cost of a change in the definition of the second and fully automated instrumentation. Since Maskelyne and Kinnebrooke in 1796, instrument makers and astronomers have been searching throughout the 19th and 20th centuries for material means to approach and better define this concept.

This paper will present an incomplete inventory of the different instruments designed to approach the personal equation: Which instruments were first thought to measure personal equations? What other instruments to control, limit and then seek to reduce it were used in the training of astronomers? What instruments to remove or get free of it, as much as possible, and make the instruments *impersonal*? What mathematical instruments were developed in parallel with or following the physical instruments? What instrumental traces of these efforts can still be found today?

This paper will first outline the history and geography of the personal equation in astrometry, with ideas and instruments being exported and confronted. It will also present the migration of this concept into other fields and other professional universes. Finally, it will be an opportunity to show that the concept of the personal equation, more than 200 years old, continues to raise mainly unsolved questions. The personal equation, nemesis of objectivity, is constantly emerging, despite the complex instrumentation that defines contemporary practices.

Loïc Jeanson is first assistant in digital humanities at the Faculty of Arts of the University of Lausanne. His research, at the crossroads of computer sciences, history of sciences and epistemology questions instrumentation, in 19th century astronomy, but also in the human sciences in the 21st century in digital humanities.

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What does "achromatic" mean? Refractions on the construction of early achromatic telescope lenses

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Drawing on the work of telescope collector and optical engineer Rolf Willach, we look at two central yet previously unexamined aspects of the transition from single-lens telescope objectives to doublet and triplet lenses made by John and Peter Dollond.Whereas the thorough, detailed investigation by Brian Gee (completed by Alison Morrison-Low and Anita McConnell) of the Dollond patent dispute focused on archival and printed sources about the innovation, studies by Willach and Duane Jaecks have concentrated on the subtle optical physics that distinguishes the new compound lenses from their predecessors. Still other work by Roger Ceragioli, and more recently by Huib Zuidervaart and Tiemen Cocquyt, has brought together archival and optical researches, to generate even deeper insights into this episode.

At the heart of the transition is the problem of chromatic aberration, which can be stated rather simply: when white light encounters a lens, different colors come to focus at different points, causing images with colored fringes and annoying prismatic bands. By the 1650s, the problem was widely lamented, and a solution was desired. In fact, many solutions were developed (both in theory and practice), were used, and were even advertised.

But what was the actual problem? And what did it mean to solve the problem? That is, what did it mean to be achromatic? To our surprise, the answers in the 1750s and following decades were surprisingly vague; rather curiously, recent scholarship has not discussed this at length either.

Willach's latest research explores, for the first time ever, a plausible method by which Dollond could have produced achromatic lenses using resources available to him, including simple algebra, well-known experimental methods, and (most significantly) carefully made prisms. Our efforts to clarify his analysis also highlight the need to address a seemingly simple question: what does "achromatic" mean?

Marvin Bolt and Michael Korey have teamed together to pull telescopes apart for the past 20 years. Marv is currently extending and summarizing this work while on a research fellowship at the Technische Universität Berlin. When not tending to optics, Michael is busy making mischief with Renaissance planetary clocks and the app BEHIND THE STARS at the Mathematisch-Physikalischer Salon in Dresden.

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On a 17th century grinding machine invented in a Capuchin monastery and corresponding very special lenses found in early Dutch telescopes

Wolfgang Engels

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Some years ago, a telescope was discovered during excavations in Delft that could originate from the first half of the 17th century. The instrument is suggested to represent a surviving sample of one of the oldest in the Netherlands. The principle of these terrestrial telescopes is the use of a planoconvex objective lens and a planoconcave eyepiece. Surprisingly, the very unusual shape of the planoconvex objective lens of the find corresponds nicely to a grinding method that was suggested by the Capuchin monk Anton Maria Schyrleus of Rheita in 1645 (*Oculus Enoch et Eliae*…). The appearance of the original front lens is that the polished curvature is situated only in the centre of a flat pane, leaving the edge of the cornered piece of glass flat and unpolished. Rheita claimed that his apparatus was designed to machine both spherical planoconvex and hyperbolic lenses. Based upon Rheita's publication, the machine has been replicated and some lenses have been produced. In addition, by combining these lenses an early Dutch telescope has been reconstructed. During the talk some experiments, optical measurements, and results will be presented.

Wolfgang Engels is Chief Executive Officer of HistEx GmbH, Oldenburg. He took studies in engineering, physics, and history of science (TU of Hannover and University of Oldenburg). He is a research associate at physics department (Physics Education and History of Physics and Philosophy of Science, University of Oldenburg).

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SESSION

19TH AND 20TH CENTURY INSTRUMENTS

150 Years theory of image formation in the microscope

Prof. Dr. Ing. Timo Mappes

Deutsches Optisches Museum (D.O.M.) and Friedrich-Schiller-Universität Jena, Jena, Germany

Ernst Abbe (1840-1905) started working for Carl Zeiß (1818-1888) in 1866 and revolutionized the production of microscopes and their optics by describing their physical theory. Now it is 150 years that Abbe published the theory of image formation in the microscope in 1873, which is still the base for today's optical design in widefield-microscopy. When celebrating his 25th working anniversary at the ZEISS company, Abbe got a carefully crafted wooden cabinet as donation from his colleagues. This wooden artefact is showing all mayor optical items designed by Abbe as carvings: The Abbe-Refractometer, the Apertometer after Abbe, the illumination apparatus after Abbe, a microscope designed entirely after Abbe's approach, and four microscope objectives built after Abbe's design. The talk will discuss both, the cabinet and the individual scientific instruments illustrated – and the impact all of these inventions have to date.

Timo Mappes is professor for the history of physics with a major in science communication at University Jena, Germany. He serves as founding director of Deutsches Optisches Museum (D.O.M.). With his team he is creating a highly interactive museum. His research interests are German made microscopes 1800 – 1950.

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The life process of an Amsler integrator

Yolanda Muñoz Rey

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Scientific instruments are essential in the development of science and in the functioning of scientific institutions. In this sense, the Royal Observatory of the Navy of San Fernando (Cádiz), one of the most important scientific institutions in Spain in the last 250 years, has always had a policy of constant acquisition of instruments from the best instrument makers in Europe. Many of these instruments have been preserved *in situ* and are currently on display at the ROA as part of its museum collection. Among them is the integrator *Amsler*, of which we present in this work a monographic study, after reviewing the associated bibliography, the historical documents related to the piece and the direct study of the instrument. The purpose is to make known, not only its existence and use, but its vital process within the institution and the contextualization of this type of instrument within the History of Science. The instrument had been acquired in 1885 by Cecilio Pujazón, director of the ROA, from the Swiss manufacturer *Amsler* through an intermediary in Paris, to be used in geodesic works and in the training of Navy officers. Its operation has been verified and the diagnosis of its state of conservation has been favorable.

Yolanda Muñoz Rey: Doctor in Art and Humanities, Master in innovation and Research, Master in Conservation of Heritage, Grade in Fine Arts and Grade in History of Art. Lecturer at the University of Cádiz and researcher at HUM726 Group. Researching about museology of science and historical instruments.

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An Early X-Ray Machine in the Ottoman Empire by Esad Feyzi and Osman Rıfat

Kevser Rukiye Karabuğa Hatipoğlu

Istanbul Medeniyet University

German physicist Wilhelm Röntgen detected electromagnetic radiation in short wavelengths and branded them X-rays in an article in December 1895. Without a doubt, this was a revolutionary breakthrough for medical operations. Esad Feyzi and Rıfat Osman, two late 19th - early 20th century Ottoman scholars, were enthused over this discovery and wanted to use its technology in their medical lectures in Istanbul. In less than a year, in 1896, the two scholars constructed an X-ray machine called 'Foreign Objects Device' used to obtain the first medical radiography in the Ottoman Empire. During the Ottoman – Greek War in 1897, this machine was used to film the battle wounds of the Ottoman soldiers, therefore making this war the very first one of which an X-ray machine was employed. After obtaining experience and collecting enough data, Esad Feyzi compiled his studies on X-rays in a work titled 'Röntgen Şuʿāʿātı ve Taṭbīḳāt-ı Ṭıbbiye ve Cerrāḥiyesi' in 1898. This work includes the basic knowledge on X-rays, the parts of the machine, images hand-drawn by Esad Feyzi, and photographs of twelve X-ray films in their original dimensions. In this talk, I will talk about Esad Feyzi and Osman Rıfat's efforts to build one of the earliest X-ray machines in the world, certainly the first in the Ottoman Empire, and provide details of Esad Feyzi's accounts in his work.

My name is **Kevser Rukiye Karabuğa Karabuğa**. I graduated from Istanbul University, Department of History of Science. I am a graduate student at İstanbul Medeniyet University, writing a thesis on application examples of artificial intelligence. Currently, I am doing research on computer systems, artificial intelligence and physics.

From the Mines to the Museum: Vilhelm Carlheim-Gyllensköld

Karl Grandin

Royal Swedish Academy of Sciences

In 1918 a museum for the exact sciences in Stockholm was a new idea of Vilhelm Carlheim-Gyllensköld (1859-1934), but of course this was very much typical of the times. Three years later the museum was established based on the collections of the Royal Swedish Academy of Sciences – its earlier physics cabinet. The talk will give an outline of this museum and a biographical presentation will be given of the somewhat peculiar man behind it. Carlheim-Gyllensköld was a geophysicist, playing an important role in the establishment of the huge iron ore mine in the North of Sweden at Kiruna (from the sapmi word for black grouse). He was also from 1910 member of the Nobel Committee of physics and he was close personal friend with the well-known Swedish author August Strindberg (1849–1912). After his death another (peculiar) physicist took over the responsibility of the museum, Gustaf Ising (1883–1960), most known for his paper from 1924 on multistep acceleration for an accelerator, later picked up by Widerøe and later by Lawrence. After Ising's death the museum was closed and eventually the collections were stored in the attic of the Academy in banana boxes. These collections are now in proper storage and out of the banana boxes, managed by the Academy's Center for History of Science. The talk will investigate how Carlheim-Gyllensköld's interests evolved from his early measurements of variations in the Earth's magnetic fields to his ideas of unit measures manifested in his historical brick collection.

Karl Grandin is director of the Center for History of Science at the Royal Swedish Academy of Sciences. His research has mainly dealt with the history of modern physics. He has experience of international collaborations, especially dealing with scientific heritage and from digitizing projects.

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SESSION

VISUAL REPRESENTATIONS:

MODELS, DRAWINGS, PHOTOGRAPHS AND PAINTINGS

Knowing by drawing: geometric material models, graphical representations, and instruments in 19th century France

Frédéric Brechenmacher

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This paper investigates several collections of geometric material models, drawings, photographs and other types of graphical representations in Paris at École polytechnique, Institut Henri Poincaré and Musée des arts et métiers.

The practice of model drawing played a key role in the development of the teaching of descriptive geometry and, more generally, of mathematics from the mid 18th century to the beginning of the 20th century. For a long time, material models were competitors of teachers and model drawing an alternative to lectures. Historical sources such as drawings (and later photographs and films), models (of all kinds, including relief drawings) and instruments, highlight the key role played by specific forms of non-textual knowledge in the teaching of mathematics. These collections raise many questions : questions concerning the role played by instruments in mathematics and its relation to other sciences, techniques and industry, but also to the fine arts. To be sure several instruments originated from the practice of geometric model drawing. More importantly, models and drawings themselves came to be considered as specific types of instruments by the end of the 19th century : graphical instruments.

Frédéric Brechenmacher is a professor of the history of science at École polytechnique. His research activities are devoted to the history of mathematics from the 18th century to the 20th century. He recently supervised the development of a University museum at École polytechnique: the mus'x.

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On the Representation of Geometric Solids in Different Contexts

Peggy Aldrich Kidwell

National Museum of American History, Smithsonian Institution

Objects in the shape of geometric solids like cubes, cones, and spheres have been part of the natural world for eons. They also have been fabricated to form a wide range of goods. Moreover, at least from the time of Euclid, such solids have been the topic of mathematical study. However, it seems to have been only in eighteenth century Europe that such solids were seen to be a useful aid to instruction, not only in geometry, but in the new science of crystallography. By the nineteenth century, models sold widely for young children in kindergartens and elementary schools, for introductory geometry, for university courses in mineralogy, and for budding artists. While a few eighteenth-century models had been made of elegant ivory and brass, later ones tended to be carved from wood or folded from paper, as befit the more modest resources of their users. Surviving object collections, maker's catalogs, occasional correspondence, and images of polyhedra on display attest to the diverse contexts in which such solids appeared.

Peggy Aldrich Kidwell is curator of mathematics at the Smithsonian Institution's National Museum of American History. She is much interested in mathematical instruments, mathematics education, and history of computing.

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Illustrating the Unknown - Visual representation of demonstration & research in the collections of the Royal Institution of Great Britain

Charlotte New

Royal Institution of Great Britain (Ri)

The Royal Institution has been a place of scientific discussion and demonstration since 1799. Lectures have been recorded in illustrated print, alongside an archive of scientific notebooks, manuscripts, correspondence, and film which has survived in situ with an extensive collection of scientific apparatus.

While much research into the collections has occurred, including by Paulo Brenni, the archive remains still largely separate from the physical objects. In this talk, I will discuss the role of the written archive, including illustrations, in understanding on how a piece of apparatus was developed or indeed the context of how it was used.

As an example, a letter written by William Grove (October 1842) to Faraday in which Grove describes in detail his development of a voltaic pile into what can now be inferred as the first fuel cell, shows he understood the significance of his experimentation and the need to record it in a visual way. His description 'I cannot but regard the experiment as an important one both as to a chemical & other theory of the pile…' is completed with a 'rough figure' or detailed illustration.

I will present examples from the Ri's rich archive, showcasing demonstrations and experiments through descriptions, illustrations and scientific apparatus with the goal of making the masked visible and seeking collaborative insight into furthering the understanding of this collection.

Charlotte New, Head of Heritage and Collections at the Royal Institution (Ri). Charlotte is investigating the collections of the Ri to complete the catalogue and marry the extensive archive with the scientific object collection, building on previous research of historians of science including Paolo Brenni and Frank James.

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Scientific Instruments, Art and Photography: the study of clouds from nineteenth to early twentieth century

Maria Estela Jardim

CFCUL; CQE; University of Lisbon

In nineteenth century culture, dramatic scenes representing atmospheric phenomena were common as visual objects. Some of the most gifted photographers of early nineteenth century, Gustave LeGray and Roger Fenton obtained photographs of clouds in the period 1850-1860. Earlier, in 1802, the English meteorologist Luke Howard had published a scientific classification of clouds. His paper inspired the English painter John Constable to make some painting studies of clouds during the years 1821-1822. In the 1st International Meteorological Congress in Vienna (1873), delegates decided to encourage institutes and observatories to publish through photography or painting, pictures of different types of clouds. Following this decision Swedish meteorologist Hugo Hildebrandsson, director of the observatory of Uppsala in Sweden, produced in 1879, a publication containing photographs of clouds, obtained using the wet collodion photographic technique. In the International Meteorological Congress in Rome (1879), which was also attended by the Portuguese meteorologist Brito Capelo from the Observatory Infante D. Luiz, it was then determined that an exclusive use of photography should be used in order to prepare an International Atlas of clouds. However the first version of this Atlas (1890), was illustrated with heliotypes and oil paintings of clouds reproduced by photomechanical processes. It was also acknowledged by metereologists that measurements of altitude, velocity and the movement of clouds were important in order to have a complete record of states of the atmosphere. In this paper, the study of nephoscopes, instruments designed for these measurements, from Portuguese collections kept in museums and scientific institutions, will be presented.

Maria Estela Jardim is a member of the Center for Philosophy of Sciences, University of Lisbon (CFCUL) and associate member of the Centre of Structural Chemistry (CQE). Her main research interests are: History of scientific photography, non-destructive analytical techniques of historical photographs, historic scientific cinema and science and art.

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Lauding science through Veloso Salgado's artworks at the University of Porto

Marisa Monteiro

Museu de História Natural e da Ciência, Universidade do Porto, Portugal

Two large oil paintings adorn both sides of the monumental staircase erected in the early 20th century in the oldest building of the University of Porto. Commissioned by the young Faculty of Science, born out of a former Polytechnic Academy, from one of our most accomplished historical painting artists, they were intended to extol the disciplines taught within those walls. The various branches of Mathematics (Calculus, Algebra, Geometry...) loom on the western side of the stairs; Physics, Chemistry, Biology and the Engineering sciences on the eastern side. Little is known about the creative process employed by José Veloso Salgado (1864-1945) in producing these artworks, of whose disclosure to the public a local paper gave news on July the 13th 1917. However, the approximately twenty scientific instruments depicted in the painting dedicated to the natural and exact sciences have been recognized as existant in the historical collections of the Faculties of Science and Engineering. The latter painting has been addressed, on more than one occasion, as an opportunity to divulge the scientific instruments presently in the care of the Natural History and Science Museum: either live recreating the scene, with the corresponding actual artifacts or actual people, or exhibiting one instrument at a time, referring the visitor to its depiction in the painting, while evoking its historical relevance and informing about its purpose and operation.

Marisa Monteiro graduated in Physics and has been a curator since 2000, with the former Science Museum and the present Natural History and Science Museum of the University of Porto, researching and cataloguing its 19th c. – early 20th c. exact science collection, having contributed to several interactive and historical science exhibitions.

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SESSION

MID-18TH TO MID-19TH CENTURY INSTRUMENTS

Paper or Brass? A budget instrument from the mid 18th century.

Johan Törnsten's observations of the transit of Venus, part 2.

Olov Amelin

Jamtli Foundation, Östersund, Sweden

In 1769 Johan Törnsten, land surveyor, was entrusted with the task of observing the transit of Venus from the county of Jämtland, Sweden. He was provided with lenses for a 16 foot telescope and a 2 foot telescope as well as a pendulum clock. He was supposed to assemble the instruments himself, within a few weeks. A tricky task was to construct a quadrant for measuring the altitude of the sun and other angular measurements. Törnsten got preliminary instructions from the astronomer who co-ordinated observations in Sweden, Pehr Wilhelm Wargentin, and constructed a quadrant out of wood, with a scale made out of brass. In a letter from Wargentin to another Swedish astronomer, Frederic Mallet, it turns out that Wargentin had recommended a paper quadrant, but his letter arrived too late to Törnsten. His wood quadrant was almost finished. The paper model was described in detail by Wargentin. My paper deals with the interface between astronomical practice and what we can find out by analysing the instruments used. In this particular case we don't have preserved instruments, but descriptions on how these instruments should be put together and the observation notations done by the observer. The argument I would like to put forward is the importance of studying the scientific practice. Instruments could be the result of a tight budget and shortage of time where pragmatism becomes guiding principles for instrument design. Quite far from the delicate quadrant made by John Bird for James Cook's observations of the transit of Venus from Haiti.

Olov Amelin, Director, Ph.D., Jamtli Foundation, Östersund, Sweden. Amelin has focused on 18th century Swedish science and instrument makers. He is currently investigating networks in the northern periphery, and how knowledge was shared between this part of the country and the capital, especially the Royal Swedish Academy of Sciences.

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The eudiometer you can use without Getting a finger wet

Jan Tapdrup

Hauchs Physiske Cabinet, Sorø Academy, Denmark

In 1793 the Danish scientist Adam Wilhelm Hauch published an article in the Proceedings of the Royal Danish Academy of Sciences and Letters on an improved eudiometer or 'air tester'. Based on the principles of Fontana, Hauch had constructed a eudiometer which measured the content of air oxygéne in an air sample by combining it with salpeterluft (nitric air). The reduced volume of the combined gasses indicates the oxygen content of the air sample. Hauch pointed out that the instrument had the advantage, that you do not have to 'get your fingers wet, let alone bringing your hands and arms under water'.

In Haunch's cabinet, we still find his eudiometer, and eudiometers of Scheele, Volta, and Guyton Morveaux, as well as various eudiometer parts.

In the paper, I intend to analyse Hauch's eudiometer based on his paper and the instrument, to place it in the context of other eudiometers (Hauch refers to eudiometers by 16 different scientists, and in his textbook on natural philosophy, to those of Volta, Priestley, Fontana and Scheele), and to describe the motivation for construction the eudiometer.

Jan Tapdrup is Research Associate at Hauchs Physiske Cabinet, Centre Administrator at Copenhagen Centre of Geometry and Topology, and Parttime Lecturer at the University of Copenhagen. He studied history of science and technology at the universities of Oxford and Aarhus. He previously worked as a curator and a museum director.

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Analysing and contextualizing John Robison's experiment on the force-distance-relation in electricity (1769?)

Peter Heering

Europa-Universität Flensburg, Institute for Physics and its Didactics and History

In his article "Electricity" for the Supplement to the 3rd edition of the Encyclopedia Britannica, the Scottish natural philosopher John Robison claimed that he had experimentally demonstrated the force-distance relationship for electrical charges already in 1769. Robison claimed that the force varies inversely with a proportion somewhat greater that the square of the distance, he actually gave a ratio of $1/x^{2.06}$. The force-distance-relationship is nowadays attributed to the French military engineer Charles Augustin Coulomb, who, however, started his researches in electricity only in 1784 and who published a paper formulating the relation one year after that. Consequently, the question arises as to how justified Robison's (apparent) claim to priority had been.

My contribution addresses on the one hand Robison's device and its handling, this part is based on Heiko Beneken's analysis of Robison's work by means of the replication method. On the other hand, archival material will be used to discuss the context in which Robison made his measurements. From this analysis, it becomes evident that Robison developed his instrument and his measurements in a context similar to that of Coulomb – the question of lightning rods.

Peter Heering is professor of physics and its didactics at the Europa-Universität Flensburg. His research focuses on the history of science, where he employs the replication method, on using the history of science in science education, and on the history of science education. He participated in several previous SIC-meetings.

A Mysterious Coulomb Torsion Balance in the collections of the Deutsches Museum

Daniel Liu[1], Jesse Garrison[2], Julien Gressot[3] and Elisabetta Rossi[4]

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At a recent (March 2023) workshop on "Material Culture in the History of Physics" held at the Deutsches Museum we were presented with a mystery object from the museum's historical collection (DM 1182), which has previously been in the Bavarian Academy of Sciences (BAdW) since at least 1850, if not earlier. Although the museum catalog describes it as a "Coulomb torsion balance with Yelin's modifications," the apparatus bears no resemblance to the very famous and oft-reproduced instrument by Charles-Augustin de Coulomb from 1784. It has no wires, no suspended items, and no scales for measuring. The instrument itself presents additional questions: its unusual red paint (only inside), imprecise construction, evident damage, apparent and missing pieces/parts of the apparatus, lack of documentation, and longevity in the collection all present analytical problems. The aim of our contribution is to present the steps we have taken to analyze this artifact, and attempt to establish better provenance, identification, and contextualization. We will start with a description of the object, then try to understand the missing parts and the principle to arrive at hypotheses of functioning. We will draw on several sources, including archival documents from the BAdW, historical catalogs by Ludwig Boltzmann and Georg Simon Ohm, comparison of this instrument with contemporary electrical devices and with other instruments from the BAdW collection), and with the writings of Julius von Yelin, to whom the instrument has been attributed since 1850.

Jesse Garrison is a PhD candidate in the Department of Science and Technology Studies at University College London. His research centers around nineteenth century science, with a particular focus on astronomy. His thesis looks at British solar eclipse expeditions in the nineteenth and early twentieth centuries.

Julien Gressot is PhD student in history of science and technology since 2018 at the University of Neuchâtel. His work deals with time measurement. He is also scientific mediator in the Laboratoire Temps-Fréquence. He is currently co-editing a special issue in the Cahiers François-Viète on meridian circles.

Daniel Liu is a postdoc and research associate in the Historisches Seminar at LMU Munich, working on the DFG-funded project "Living Matter Under the Microscope."

Elisabetta Rossi graduated in Astrophysics and Cosmology at the University of Bologna. She is now a PhD student in Historical Studies at the University of Milan, part of the ERC TACITROOTS group: her research concentrates on the experimental activity of the Florentine Accademia del Cimento (1657-67).

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Nomadic geochemistry in mid-19th century Ottoman Empire: John Lawrence Smith's moving laboratory

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John Lawrence Smith (1818-1883) was an American mineralogist and chemist who was particularly educated in Paris (under the guidance of Armand Dufrénoy and Elie de Beaumont) and Giessen (under the guidance of Justus von Liebig). He was a skillful scientist who was interested in various subjects such as soil chemistry, agriculture, toxicology, mineralogy-chemistry, and general geology. He was invited to the Ottoman Empire in 1846 to reveal the problems of cotton production. But soon after he arrived, he contradicts another American expert in the "sublime porte" and worked as an exploration geologist and chemist. He investigated the thermal waters of Asia Minor and beyond and conducted the first geochemical analysis on different springs. He also investigated different mineral resources and frequently used classical physical mineral interpretation techniques, such as hardness and streak. Apart from that, he moves his laboratory with him which consists of Bunsen burners, agate mortars, different crucibles (Hessian and Beaufay brands), portable furnaces, lamps, and glass tubes which we learned from the papers that he has published. He frequently experimented on the different mineral species to efficiently characterize them and tried to improve the analysis techniques during his time in Ottoman Empire. He analyzed different substances, found the vast emery deposits along western Anatolia, and discovered new mineral species such as ephesite, liebigite and medjidite despite his movements and scientific efforts frequently being limited by the sultanate. He left the Ottoman Empire in 1850 but created a good legacy that covers both mineral resources and geochemical techniques.

Gönenç Göçmengil, Assistant Prof., Ph.D., History of Science Department, İstanbul-Turkey. Gönenç has focused on the history of natural sciences and natural history museums. He is particularly interested in museum collections and their historical impacts on the development of science and culture.

Fatma Gülmez, Assistant Prof., Ph.D., Geological Engineering Department, İstanbul Technical University, İstanbul-Turkey. FG is a hard-rock geologist. Her research mainly focuses on the investigation of magmatism and geothermal processes.

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SESSION

OPEN CHALLENGES IN THE CONSERVATION OF SCIENTIFIC INSTRUMENTS

Organizer's full names: Maria Rosalia Carotenuto (University of Palermo), Giuseppe Lazzara (University of Palermo), Anna Giatti (Fondazione Scienza e Tecnica, Florence), Emma Angelini (Polytechnic University of Turin)

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Session Abstract

Scientific instruments have often faced unhappy conservation conditions after fall into disuse. Once obsolete they were usually set aside and sometimes partly dismembered to recover pieces still reusable. In most cases, they were accumulated in non-friendly environments for years. It is now clear that their conservation conditions must be well evaluated to preserve them as scientific heritage.

The peculiarities of the scientific instruments make their conservation very challenging. They are usually made of different materials that response differently to the environmental conditions and together may activate deterioration products not yet fully known.

Their conservation encompasses different approaches. One is the preventive conservation, which is nowadays considered a mandatory practice to ensure the sustainable protection of the scientific heritage and to diminish invasive interventions on it.

Other approaches imply direct actions on the instrument to arrest current damaging processes (remedial conservation) or to restore its lost significance due to past deterioration (restoration). These actions are necessary when the condition of the object could lead to its loss in a relatively short time.

This session intends to cover the various facets of the conservation through the proposed contributions.

The critical issues related to the conservation and enhancement of scientific instruments, the gaps still present today in tools and programs for their management and in the knowledge on proper conservation methodologies are just some of the topics that will be discussed. The session aims at offering a debate opportunity on issues that still need to be implemented…by working together!

Assessing the conservation status in scientific instrument collections: strategies and tools

Anna Giatti

Fondazione Scienza e Tecnica, Florence, Italy

One of the main objectives of museums and galleries is the preservation of their collections for future generations. In order to achieve this goal, several actions are required, which may concern the whole collection or individual objects. In any case, one of the key elements for successful activities is the planning of actions according to defined schedules and periodicity. Planned and documented actions also help to ensure continuity despite staff turnover.

In the presentation, some working tools and practices, implemented in collections composed of apparatuses and instruments of historical scientific and technological interest to control the state of preservation and contain certain types of degradation, will be shared and discussed. Particular attention will be paid to Integrated Pest Management experiences in scientific instrument collections since the widespread use of wood as a constituent material makes the control of wood-boring beetles' infestations crucial.

While in large museums, especially those that preserve collections of artistic interest, there are already well-established programs for monitoring, controlling and preventing deterioration, in smaller museums it is more difficult to monitor and keep under control environmental conditions, such as microclimate and pest attacks, due to the lack of resources and specialized technicians. This is why the sharing of tools and procedures is of great help, especially today when transformations, such as climate change, make appropriate interventions more necessary.

Anna Giatti is the curator of the Cabinet of Physics at the Fondazione Scienza e Tecnica in Florence, and restorer of historical scientific instruments. Her interests include investigation on the materials of the scientific instruments, history of scientific experimental practices, preventive conservation, cataloguing, and popularization of scientific culture.

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Conservation practices on working instruments. A case study from the Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

Marianna Cappellina and Luca Reduzzi

Museo Nazionale Scienza e Tecnologia Leonardo da Vinci

In 1961, an electro-medical device, maybe used for producing ozone at the beginning of the Twentieth Century, was added to the collections of the Museo Nazionale Scienza e Tecnologia Leonardo da Vinci as a working exhibit in the Physics Gallery. For over three decades it was one of the main attractions of the museum, as is the tradition of technical scientific museums around the world.

In the first report the museum officer who discovered the Bipolar Tesla coil in the Farfa Abbey (near Rome), described it as a "magnificent device for generating electric oscillations at very high frequencies […] The discharges are noisy […] exceeding two meters in length […] This device would be a worthy addition to the museum's galleries to arouse curiosity and admiration in visitors."

From this perspective, the maintenance of the object - not yet defined in the museum as preservation - served the purpose of keeping the machine functional. In 2007 the object was dismantled and taken to storage, mainly for safety reasons but also because of the ongoing renovation of the exhibition plan.

Today the museum is investigating how to reinterpret this artifact in its whole biography, made of different stories and uses: as an historical scientific instrument, as a popular attraction in a famous heritage site, and as a museum exhibit.

We think that a case study of a scientific instrument used for demonstration purposes in a museum can open a fertile discussion on conservation practices on scientific and technological heritage.

Marianna Cappellina is a cultural heritage conservator specialized in metal and alloys. After graduating, she worked as a freelancer in the conservation of all inorganic materials ancient and contemporary. Over the years she steps into conservation of scientific and technological heritage and today is responsible for preservation at Museo Nazionale Scienza e Tecnologia in Milan.

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Master thesis: Study and chosen restoration of ten electrostatic machines from the Rijksmuseum Boerhaave in Leiden

Mathilde Sneiders

Atelier conservation-restauration Sàrl, Monthey, Suisse

During a master thesis in 2022, ten electrostatic machines from the Rijksmuseum Boerhaave in Leiden were studied. It allowed to have a good overview of the friction and induction models in the collection.

The machines date from 1788 to around 1950. Sometimes a better dating of the scientific instrument was possible by identification of the constituent materials (wood, glass, brass, hard rubber, Shellac, etc.) and research about the manufacturers.

Major or significant alterations could be highlighted and linked to this type of object: crystals on the hard rubber, corrosion between the metal and the hard rubber, corrosion of the metallic parts (brass, nickel, tin), falling of the tin foil of the sectors or Leiden jars.

The restoration treatments were carried out on three electrostatic machines representative of these alterations. The main objectives were to stabilize the degradation and permit the manipulation of the objects.

A good first overview of these electrostatic machines could be provided through this thesis. Not all the information they contain has yet been revealed. Some questions remain about some objects' particularities or elements' material. The study and treatment carried out in this thesis is a beginning.

Other lines of research can be deepened, particularly concerning certain alterations and possible conservation-restoration treatments. For example: the question of corroded nickel ferrous alloys; the question of hard rubber and its non-uniform lightening after treatment; the blistering phenomenon on tin elements (on sectors and Leiden jars).

Mathilde Sneiders graduated as a conservator-restorer from the HE-Arc of Neuchâtel in 2022. She is specialized in technical, scientifical and watchmaking objects. Since then she has opened her workshop in Switzerland and has helped Museum or private clients regarding preventive conservation, restoration and mountmacking.

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“A WARNING FROM MARS”. Climate risk assessment in the Museo della Specola, Palermo

Maria Rosalia Carotenuto[1], Giuseppe Lazzara[1], Giuseppe Cavallaro[1], Bartolomeo Megna[1], Dario Camuffo[2], Antonio della Valle[2] and Fernanda Prestileo[3]

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Museum microclimate play a key role in the conservation of scientific instruments on display. Finding appropriate values of temperature and relative humidity to guarantee the safeguard of entire collections is a difficult task. Each object responses peculiarly to the environment depending on its composition, conservative history, and its adaptations to the environment variability over years. At times, the different materials coexisting in a scientific instrument can also develop pathologies not yet fully known. The question become even more challenging if it is considered that microclimate management is not easy, especially in buildings not designed for conservation purposes.

The *Museo della Specola* in Palermo has recently face these critical issues. The museum is in the ancient Observatory, built in 1790, on the top of the 12nd-century Royal Palace. Although efforts have been made to protect the scientific collection over the years, there is still much to be done. An exhibited object had clearly stated the urgency of an environment management improvement. It is a 19th-century painted wooden globe reproducing the surface of Mars: in less than two years, damages of its pictorial layers have occurred at a slow but progressive rate. Conservation measures have been adopted to stop the serious deteriorating processes of the globe, but the risk of further deterioration phenomena involving other scientific instruments is expected to increase substantially if no actions are taken.

This contribution intends to present the results of the study of the thermo-hygrometric values measured in the museum over recent years to assess microclimate risks to the exhibited objects. Specific actions to improve climate conditions will be proposed.

Maria Rosalia Carotenuto is a conservator. Since 2022, she is a Ph.D. student at the Physics and Chemistry Department of the University of Palermo. In collaboration with INAF-Astronomical Observatory of Palermo, she is carrying out a research project on the preventive conservation of scientific heritage of astronomical interest.

Giuseppe Lazzara is an associate professor at the Department of Physics and Chemistry, University of Palermo. His scientific activity falls within the field of physical chemistry of large interphase systems. He is involved in projects aimed at the development of new materials, based on nanotechnologies, for the preservation of art objects.

Giuseppe Cavallaro is an assistant professor at the Department of Physics and Chemistry, University of Palermo.

Dario Camuffo is a physicist specialised in Atmospheric Physics, Climate and Conservation of Cultural Heritage. Until 2008, he was Research Director at the CNR – ISAC in Padua, where he is now Senior Associate after his retirement. He carried out scientific research activities applied to cultural heritage and climate change.

Antonio della Valle is a researcher at the CNR – ISAC in Padua. His research field concerns the study of the Microclimate for the conservation of cultural heritage.

Fernanda Prestileo, conservation scientist and researcher at the CNR – ISAC in Roma. She deals with research, study and teaching on issues related to indoor deterioration processes of artworks, especially stone and paintings. Her research activity mainly aims at investigating methodologies and techniques for diagnostics and microclimatic monitoring of Cultural Heritage.

Bartolomeo Megna, see Poster 16.

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Preserving Palermo University's scientific legacy

Marco Di Bella

Cultural Heritage conservation course, Department of Physics and Chemistry – University of Palermo

Since its foundation, the Cultural Heritage Conservation Course of the University of Palermo aimed at preserving the vast historical legacy of the University's scientific activities and production. In particular, the curriculum in books, records and photo conservation soon started to engage with the conservation of a variety of books, manuscripts and historical photos from different collections. The added value of such activities, and the importance for the academic community, lays in the uninterrupted connection of those collections with the teaching and research activities carried out since the establishment of the first "study academy" (1778), even before the institution was raised to the status of university (1806). The course being offered by the Department of Physics and Chemistry was a natural choice to concentrate often on the conservation of science related heritage. Historical glass plate negatives documenting the 1905 eclipse expedition to Sfax, personal diaries of Giuseppe Piazzi, several books Historical Library of Chemistry, drawings from renown architects, labels describing the use of scientific instruments and rare teaching posters are among the most interesting items conserved so far. Under treatment are extremely important early records of scientific instruments purchases that will shed light on the interests of the professors and researchers and will help identify the remains, of such items, carefully collected and preserved in many of the Department's museums.

Marco Di Bella is an accredited books conservator, graduated at the European Course for Conservators-Restorers of Book Materials in Spoleto (Italy) in 2001, has worked in conservation, assessment and training projects in Europe and the Middle East; since 2007 regularly lectures book and manuscripts conservation at the University of Palermo.

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In situ physicochemical investigations for knowledge and conservation of scientific instruments : case studies

Leila Es Sebar

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The preparation of a preservation/restoration intervention on Cultural Heritage artefacts, as scientific instruments, begin with a comprehensive characterization of the chemical composition of the bulk of the constituent materials and/or of their surface.

Thanks to the impressive improvements, over the past decades, of the analysis and investigation equipments, in situ non-invasive characterizations may be performed by means of X-ray fluorescence (XRF) spectroscopy and Raman spectroscopy with portable instruments, as well as electrochemical characterizations by means of electrochemical impedance spectroscopy (EIS).

Case studies are presented dealing with the characterizations of instruments for electrical measurements, electrometers and galvanometers of the Laboratory of Physics preserved at the Department of Applied Science and Technology of Politecnico of Turin. Different corrosion morphologies related to the different metallic materials and to the different exposure conditions to the environment have been found. Phenomena of galvanic corrosion resulting from the coupling between alloys of different nobility, as copper-based and iron-based alloys or gilded elements, have also been observed. EIS, XRF and Raman spectroscopy made it possible to determine the composition of the metallic alloys and of the corrosion products grown, of organic and inorganic pigments, varnishes present in some cases, as well as to assess the electrochemical behaviour and the protective effectiveness of the corrosion patinas or of the coatings on the artefacts. On the basis of these characterizations, recommendations are provided on the selection of tailored conservation approaches and materials to decrease the degradation phenomena.

Leila Es Sebar, graduated in Science and Technology for Cultural Heritage, PhD in Metrology obtained in 2020, works with a research grant in the Department of Material Science and Technology in Politecnico di Torino. Her research areas are safeguard of Cultural Heritage and 3D photogrammetry.

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The lacquering and relacquering of scientific instruments: an interdisciplinary approach to the characterization of layered coatings

Miriam Truffa Giachet, Julie Schröter, Laura Brambilla

Haute Ecole Arc Conservation Restauration, HES-SO University of Applied Sciences and Arts Western Switzerland

The application of lacquers on copper alloy objects is an ancient practice carried out for aesthetic purposes and for the protection of the metal underneath. Scientific instruments, in particular, were often lacquered to guarantee the reliability of the measurement by protecting the metal from corrosion that could develop during manipulation. The materials and techniques used for surface treatment were characteristic of their period and they testify to a technical, historical, economic, and social context. These coatings are, therefore, an integral part of the cultural heritage, and their preservation needs to be addressed. The identification of the original varnish is not always simple because of its compositional complexity and physicochemical alteration, as well as the potential presence of newer protective coatings resulting from undocumented relacquering. In our contribution we present the results of various research projects concerning the implementation of non-invasive analytical techniques for the identification of coatings on copper alloys, as well as the discrimination between the ancient varnish and newer protective coatings applied on top. The characterisation protocol was designed based on analytical campaigns on scientific instruments from different collections, an international online survey targeted to specialists in conservation, and experimental research on mock-ups in laboratory. The survey, combined with a thorough bibliographic research, was essential for the design of the experimental procedure, with regards to the choice of the materials and the parameters of their application. The main diagnostic tools used both in the experimental section and the analytical campaigns on collections were UV fluorescence imaging and FTIR.

Miriam Truffa Giachet has a PhD in prehistoric archaeology from the University of Geneva, Switzerland. Trained as an archaeometrist and conservation scientist, she joined the R&D department of the HE-Arc CR as research assistant in 2020 for the Verilor project, and in 2022 for the ongoing Cleanlab project.

Julie Schröter has a PhD in art history from the University of Paris1 Panthéon-Sorbonne, France. She is a freelance conservator specialised in metal objects since 2010, and in 2014 she joined the research team of the HE-Arc CR where is currently project leader of the Cleanlab project.

Laura Brambilla has a PhD in chemical sciences from the Università degli Studi di Milano, Italy. She is currently project leader of the Corint project in the R&D department of HE-Arc CR where she has been working since 2013, first as a scientific collaborator and, from 2017, as a professor.

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Preserving the Past, Navigating the Future: Conservation of 19th Century Terrestrial Globe

Michael Maggen

Former Head of Paper Conservation of the Israel Museum

The 19th century was a time of great scientific and technological advancement, and the terrestrial globe was an important tool in this era. However, over time, the varnish coats on these globes oxidized and became dark and obscured, reducing their usefulness as educational tools. In order to restore the globe's original appearance and utility, the varnish coats had to be removed.

The restoration process is crucial to preserving the value and significance of these 19th-century terrestrial globes. The writer describes the process of removing the varnish coats, which involved cleaning and stabilizing the globe, and repairing any damage or deterioration. The result is a beautifully restored piece of history that can be study as enjoyed for years to come.

In conclusion, the 19th-century terrestrial globe was a significant scientific instrument that played an important role in our understanding of the world. The conservation and restoration of these globes not only ensures their survival but also helps to preserve the history of science and technology.

Michael Maggen holds first a degree BFA in fine arts and MA degree in paper conservation. During his many years at the Israel Museum, Michael took part in the preservation of the Dead Sea Scrolls, rare medieval Jewish manuscripts. Michael restored the diary remains of the first Israeli astronaut Ilan Ramon which recovered from the Columbia disaster in 2003.

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An open issue: remove or maintain the alteration layer on the scientific instruments

Panayota Vassiliou

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The importance of preservation of old scientific instruments is largely recognized in the field of cultural heritage. However, for years their restoration was carried out focussing mostly on repairing and replacing parts of the instruments in order to maintain their functionality rather than on maintaining their integrity. Recently, more attention has been paid to the characterisation and conservation of original surfaces, evidencing a lack of knowledge on the conservation methodologies.

Dealing with the metallic parts of the scientific instruments, atmospheric corrosion induces the formation of alteration layers of different entity, depending on the metal or alloy and the environmental factors. These layers might be protective on copper alloys, these are called patina, or more rarely on iron, however, in any case, they change the appearance of the surface, which becomes 'rusty'. When the scientific instruments are to be exposed to the public, the usual procedure is to remove the corrosion layers in order to bring back the original appearance. Several questions are raised: does the patina have to be removed or maintained? if yes, to which extent? The mechanism of formation of the patina will be illustrated, the atmospheric corrosion principles, as well as the proper procedures for a controlled removal and protection methods of the metallic substrate. Several case studies are complex because many artefacts are multimateric, consequently the degradation of one material may influence the degradation of the others. Analytical portable techniques such as X-ray fluorescence spectrometry (XRF) and Raman spectroscopy are employed for the identification of substrates and alteration layers, meanwhile the electrochemical impedance spectroscopy for the conservation assessment.

Panayota Vassiliou is full professor in Chemical Engineering. Her research areas are electrochemical metal corrosion study, sea corrosion of steel and aluminum, corrosion and protection in saline environment, protection of monuments and artifacts.

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Low temperature plasma for protective coatings deposition on metallic cultural heritage assets

Emma Angelini

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Methodologies and materials outside the traditional conservation framework are needed for the preservation of scientific instruments, due to their peculiarities, as being multi-material assets, of variable dimensions, and with the presence of complex mechanisms. After the assessment of the instruments conservation state, proper restoration and conservation methods have to be developed. The restoration procedures have to be non-destructive, reversible, as well as preservers of the aesthetic appearance of the artefact. Low-temperature plasmas, the so-called cold plasmas, exhibit some major advantages that suit perfectly their application in the field of Cultural Heritage. They can be applied directly on the exterior or the interior of complex shapes; plasma etching is controllable and selective at the nanoscale and very mild; they may be utilized as alternative methods for the cleaning every type of material, from stones to metals, to glasses, to completely remove surface films, leaving contamination and surface residues behind, where conventional methods often fail. Using efficient plasma cleaning systems eliminates the need for using chemical solvents, having consequently an entire process operator friendly and environmentally friendly. Examples are given of the application of the Plasma Enhanced Chemical Vapour Deposition (PECVD) technique on artefacts made of iron, copper and silver based alloys. The PECVD deposition carried out using silicon containing organic compounds, as hexamethylendisiloxane (HMDS) or tetraethoxysilane (TEOS), allows to obtain SiO_x thin films, that notwithstanding the low thickness (10-1000 nm), definitely improve the corrosion resistance of metallic alloys. They are dense (low permeability to water and gases), amorphous, chemically inert, with low electrical conductivity or are insulators.

Emma Angelini is full professor of Applied Physical Chemistry in Politecnico di Torino, President of the ICC - International Corrosion Council. Her research areas are corrosion and protection of metallic materials, plasma chemistry, safeguard and valorization of Cultural Heritage, environmental monitoring. She is involved in the intercultural dialogue activities between different audiences.

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SESSION

PERSPECTIVES OF ENGAGING WITH INSTRUMENTS

Things that Talk: On a new perspective for engaging with scientific instruments

Ion Mihailescu and Jérôme Baudry

Laboratory for the History of Science and Technology (LHST), EPFL

Our contribution will propose a new approach for engaging with scientific instruments inspired by a recent exhibition which we have designed and organized. Inverting the current trope of presenting history through many objects, the exhibition weaved together various surprising stories around a single object from the UNIL-EPFL Collection of scientific instruments. The goal was not to tell the continuous history of this object (such as its construction or use by specific disciplines), but rather to show how it came to be embedded in multiple layers of context with different social, economic, cultural or aesthetic dimensions. This curatorial approach, which though centered on the object engaged with it from an oblique perspective, has suggested a new historical method.

We will illustrate this method by discussing the measurements taken with the Régnier dynamometer by the naturalist François Péron during the Baudin expedition to Australia. Péron believed that his measurements proved the physical superiority of Europeans over the indigenous populations, and thus disproved Rousseau's claim that civilization brought with it degeneration. While the usual historical approach would focus on contextualizing and deconstructing their pretended objectivity, we will reconceptualize these measurements as an account produced by the dynamometer itself and only transcribed by Péron. In this oblique perspective the dynamometer ceases to be a mute historical actor to be talked about (something that needs to be explained). Instead, it becomes a witness capable of capturing a historical reality which requires historical interpretation and is not to be confounded with the "objective" reality produced by instruments when regarded from a purely scientific perspective.

Ion Mihailescu is a post-doctoral researcher in the Laboratory for the History of Science and Technology at the Swiss Federal Institute of Technology in Lausanne (EPFL). His research is focused on the use of graphical methods in the physical sciences, and the development of self-registering instruments.

Jérôme Baudry is Assistant Professor of History of Science and Technology at the Swiss Federal Institute of Technology in Lausanne (EPFL). His work focuses on intellectual property, on the textual and visual languages of technology, and on amateur practices in science and technology.

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Recollecting collections: using oral histories to create social, sensorial, and emotional histories of school science equipment

Rosanna Evans

University of Leeds and the Science Museum

Beyond scientific knowledge, those who studied science at school recall the social, emotional and sensory experience of having used instruments in the school laboratory. Capturing this when researching classroom instruments builds detailed and democratic histories of equipment: how students used equipment in class, and how memories crystallise into a narrative. The whole formative experience affects later actions, and later actions retroactively affect those formative memories. More than tools for learning science, these are tools for experiencing and developing: feelings, associations, relationships and skillsets.

Histories of British school science in the 19th and 20th century have previously demonstrated the development of schools, legislation, curriculums and examinations. Accounts have rarely focussed on practical work, despite its historical and ongoing significance to the British science education, and have not yet explored the meaning of these developments for staff and students at the time.

Using the Van de Graaff generator as a case study, this paper will use oral histories to construct a snapshot of the experience of doing practical work at school between 1944 and 1988. I will demonstrate how using school science equipment has social, sensorial, and emotional implications, in addition to educational ones – both in the moment, and as memories throughout peoples' lives. These case studies show the depth and democracy of employing memories as a valuable source of information about how equipment was used, and the impact of that use.

Rosanna Evans is a PhD candidate at the University of Leeds and the Science Museum. Her thesis explores school science equipment between 1944 and 1988 and is due to be submitted at the end of 2024. Rosanna also manages the schools programme at the Fitzwilliam Museum, University of Cambridge.

The Art of Experiences: from the material culture of Nolletian physics to the didactics of Fisicademos (1738-2022)

Aitor Rodríguez Moreno

Alicante University (UA)

During the 18th century, the teaching of experimental physics was established, and demonstrations of phenomena and laws of nature before an audience were an essential element of communication and learning. Linked to these demonstrations, several didactic instrument makers and experimental performers such as the abbé Nollet conceived an instruments catalogue which gradually established a more or less common repertoire in all experimental physics courses and which we can clearly see in the collections of European Physics Cabinets. This paper, which stems from an Erasmus+ internship experience in the Museu da Ciência of the University of Coimbra, studies and relates didactic instruments from the Pombaline collection of the Physics Cabinet of Coimbra with the most notable works of Nollet and standard didactical repertories of the following centuries such as those of Ganot, the Harvard Physics Proyect and the Fisicademos of the Universitat de València. The presence of a sample of 6 instruments from the Physics Cabinet of Coimbra in different periods of time is analysed through these educational resources and their transformations (both in form and meaning) they have undergone are discussed. It concludes by corroborating a displacement of the didactic instruments as the backbone of physics teaching and recognising certain elements in the demonstrations that have survived to the present day.

Aitor Rodríguez Moreno studied physics in the University of València and Teacher Training in Physics and Chemistry in La Laguna University. He did a Master in History of Science and Scientific Communication and focused his work in material culture and didactics of physical instruments. He has participated in a traineeship at the Museu da Ciência of the Coimbra University appreciating closely his collection of Pombaline instruments.

3D Collection – Making the hidden accessible

Roberta Flora Spano

Collection of scientific instruments and teaching aids, ETH Library, ETH Zurich

The Collection of Scientific Instruments and Teaching Aids was founded in 2019 at ETH and is now part of the library. It collects scientific instruments, models and other teaching aids that were used in teaching and research at ETH since its foundation in 1855. These include, for example, astronomical, geodetic, physical or geobotanical instruments, but also devices from the fields of computer science or electronics.

In 2022, the Collection of Scientific Instruments and Teaching Aids digitised 20 selected objects in 3D using photogrammetry. They have been annotated and are further contextualised and described in blogposts. This new type of digitisation complements the existing photographic digitisation and cataloguing of the collection. On one hand, it should enable a more in-depth examination of individual objects on the other hand it should also be used for educational projects and further developments in the field of VR / AR.

The relevance of digitised collections and online presentations has been beyond question - not only since Covid-19. The presented project also attempts to put this trend to a test and to ask questions about the opportunities and challenges of 3D digitisation for cultural-historical collections: How can 3D digitised material be used by research and teaching? What are the opportunities and challenges and where are the limits? Such questions accompany the project and will also be asked in the planned presentation.

Roberta Spano (1989) is a historian who has been working in the Collection of Scientific Instruments and Teaching Aids since autumn 2020. Before that she worked in other collections and museums in Switzerland. To deepen the field of cultural heritage and digitisation, she completed a CAS in “digital cultures” in 2022.

Science through the keyhole: revealing scientific practices through workspaces

Jane Desborough

Science Museum, London

This paper will share the core findings of three workshops which will be held over the first half of 2023 as part of an AHRC (UK) funded research network aimed at bringing together people from a range of disciplines to challenge what we mean by 'science' and 'workspace'. The aim being to improve our understanding of scientific practice, the diverse spaces it has taken place in and the full range of people who have enabled science to take place in those spaces from the late-nineteenth century to the present day.

Museum displays have traditionally championed the role of a lead scientist and sometimes their graduate students and while recently efforts have been made to spotlight the role of technicians, very little attention has been given to other roles on which scientific practice relies. This research aims to redress this imbalance and inform our approach to future exhibitions and galleries.

Objects are at the heart of our displays, but our existing collections of scientific instruments and equipment do not always allow us to represent a fully inclusive history. This research network will consider the ways in which we might supplement objects in our displays. We will consider how we can authentically recreate scientific spaces and evoke a sense of others while ensuring we represent the broad range of people who were active in those spaces.

This research network will be led by the Science Museum and Royal Holloway (University of London) with project partners at Royal Museums Greenwich, Museum of the Home, and the University of Cambridge.

Dr Jane Desborough is Keeper of Science Collections at the Science Museum in London. She is Principal Investigator on the *Science through the Keyhole* research network. Recent publications include *The Changing Face of Early Modern Time, 1550-1770* (Palgrave)*; The Role of Women in the Science City* (co-authored with Dr Gloria Clifton, Science Museum e-journal).

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From DATAMI to SCIAME

SciArt Heritage Museum Expanded at JRC Ispra - Site

"Museums as Cultural Hubs: The Future of Tradition"

Cristina Fiordimela[1] and Freddy Paul Grunert[2]

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Le projet SciArt -science art- Datami Resonance III, flagship de la Commission européenne, est le bien fondé de cette proposition: la vision d'une nouvelle 'forme' de musée des instruments scientifiques dans le Joint Research Centre de Ispra, dont le concept book du livre-archive Datami est le support. La vocation muséale du JRC Ispra site se dévoile pendant la mises au point des oeuvres SciArt, produites par la coopération entre les artistes en résidence et les scientifiques du JRC, selon le concept Datami, conçu par le philosophe et curator Freddy Paul Grunert et exposé par l'architecte Cristina Fiordimela (co-auteurs).

Datami is a mixture of meet-ups/dialogues/laboratory/residences/ festival/exhibition: an 'expository' hybrid activated by what we called *opera,* plural of the latin *opus*: the common effort by artists and scientist to conceive and realise works blending art and science in intricate ways, sharing the same space-time in the Ispra - Site.

Within this useful/campus-museum, we want to draw the attention to the unanticipated disclosure of a hidden/missed immaterial heritage that emerged from these two years of activity on the Ispra campus. This has led to the idea of realising an *active museum conversion*: the wealth of laboratories, itineraries, archives that connect different buildings, also abandoned ones, such as nuclear reactors, complete with closed laboratories, specific tools, that still have a historical significance, instruments and archival records of different types (images/text/ experimental, probabilistic data).

We call this museum *activated,* because the 'incorrect' use of the places and obsolete instruments are reactivated by this artistic incursion of the SciArt *opera* that activates a narrative media on the passage of the nuclear to post-nuclear society, up to the ilLimited languages of AI. We call this *activated* museum SCIAME – Science Heritage Art Museum Expanded. Beyond the opposition tradition/future it proposes the fluid interface of the present as a threshold of blue print of experienced (embedded) knowledge: History, language, values and, inevitably, a 'culture-bond nature' tying up all viewpoints, jointly create a new vision on what we could call 'real curved space'.

Cristina Fiordimela (PhD Interior Architecture and Exhibition Design) is adjunct professor at Politecnico di Milano, she is designer for Dipartimento di Matematica uniMI, Dipartimento di Fisica uniMI - INAF, Scuola MNF uniGE and she is SciArt design expert for the Joint

Research Centre in Resonances III Datami European Commission. She publishes regularly on museography in several scientific journals and books.

Freddy Paul Grunert is a theorist, founder of several foundations, and a curator involved with trans- boundary leading institutional research. He collaborated with JRC European Commission, ZKM Karlsruhe, Venice and Sharjah Biennale, International Panel on Climate Change (Rio de Janeiro, Copenhagen, Strasbourg), Science Gallery Melbourne, MAXXI (Rome), Potsdam Institute for Climate Impact, SEJF Supranation- al Environmental Justice Foundation (Venice). Recent Book: https://noemalab.eu/wp-content/uploads/2022/11/HumaniTies-and-Artificial-Intelligence-v1.1.pdf

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What can 16th century artillery instruments tell us as pieces of decorative art?

Olga Neuymina

Independent researcher, St. Petersburg, Russia

The artillery instruments of the 16th century fully reflect the late Renaissance, an era in which science was closely intertwined with art. The era determined the duality of artillery devices, which were both military instruments and decorative objects. Existing research today is mainly concerned with the history of technology and science, without looking at the artistic side. However, for the Renaissance, which valued the aesthetic element, this side is no less important and represents a significant part of the creative method of the instrument makers of the time. Craftsmen, responding to the tastes of their princely and scholarly customers, sought not only to make an instrument in accordance with all the rules of military science, also to match the dominant style characteristics of the 16th century. The study of artillery devices as works of art, using formal and stylistic, iconographic and iconological analyses, makes it possible to fill in the existing gaps and draw a complete picture of their use. The art historical analysis of some artillery instruments from European, American, and Russian museum collections conducted in this study has shown that certain meanings and images were imprinted into the instruments by the craftsmen, often foretelling the triumph of the victor to their owners. The study has identified Renaissance and Mannerist style characteristics of the instruments and revealed a group of similar devices in terms of style and design in various museum collections, suggesting their common origin and creating prerequisites for further clarification of the attribution.

Olga Neuymina: I have a master's degree in mechanics from St Petersburg Polytechnic University, and am currently studying art history at the St Petersburg Academy of Fine Arts. My main interests are scientific instruments and mechanisms as art objects. My research on artillery instruments has been presented at several conferences in St Petersburg.

Scientifish or scientific instruments – instruments in technical academia

Laila Zwisler

History of Technology, Technical University of Denmark

Instruments play important roles in technical academia. They are used, created, altered, damaged, cannibalized and destroyed. The Technical University of Denmark have more than 200-years history of instruments in the historical collection, which contains many instruments –or at least traces of them - and much archival material about them.

In this paper, I will show examples of the different roles of instruments through time and how the instruments are entangled in the emergence of technical academia and engineering sciences. The collections displays the blurry boundaries between natural sciences, technical sciences and industry as instruments played diverse roles and were meaningful in many spheres.

Some instruments have a lot of history and they are connected to other artefacts in the collection. Others are silent. When possible I will explore the diverse casts of actors both locally and internationally connected to the instruments and the forms of knowledge, which are connected with the instruments. I will also explore if anyone drives and controls the processes.

I will also discuss in what sense is it meaningful to call these instruments scientific and if there are gatekeepers around scientific instruments? In turn, this raises interesting questions about the nature of science, the meaning of scientific inquiry and science as applied technology. Does technical academia deal in scientifish instruments rather than scientific instruments?

Laila Zwisler is the Head of the history Technology Division at the Technical University of Denmark. Her main research and interpretation interests are university history, technical academia, university heritage, shared memory, identity as well as knowledge history and history of technology. She teaches History of Technology and Knowledge History.

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Reflections from Stephen Hawking's office on the mundane, the ephemeral, and the 'authentic'

Dr. Juan-Andres Leon Gomez

Science Museum, London

In this second installment of a series on Stephen Hawking's Office, the author follows the adventure of accessioning this collection in all its messy detail, and invites discussion on the foreseen tensions in the process of creating a permanent display.

Nowadays, collecting by science museums is not limited to stellar items or discovery highlights, but the broader context of scientific practice. Besides instrumentation and rare manuscripts, recent acquisitions include ephemera, non-durable consumer technologies, traces of social interaction, even food and other reminders of our bodily realities. In short, what historians and anthropologists of science have been writing about for generations.

However, museum practices of acquisition, valuation, conservation and documentation still reflect an expectation of accessioned objects as treasures to preserve for eternity. This creates an unsolved tension with our new curatorial perspectives: How do we collect the mundane without implying a 'saints' relics' approach of zealously guarding anything ever touched by our 'heroes'? And how do we adapt our practices and limited collection management manpower to these collections of 'everything'?

These considerations then invite curatorial discussion on the feasibility of museum displays with pretensions of originality and authenticity around the messy material culture of research: is our threshold higher for displayed objects to be 'original'? Are contextual reconstructions a 'snapshot' in time, or an idealized 'best moment'? Does an object exist if it is in a closed drawer? What about those we know existed but we no longer have? And what do we write on a wiped blackboard?

Juan-Andres Leon Gomez is curator of physics at the Science Museum in London. He is in charge of Stephen Hawking's office and works on the variety and 'messiness' of research cultures. He also recently co-wrote the book "Astrophysics, Astronomy and Space Sciences in the History of the Max Planck Society" (Brill).

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The instruments of French Big Science photographed, drawn and ... preserved?

Jean Davoigneau

French ministry of culture - Directorate-General for Heritage and Architecture

In 1942, Robert Doisneau (1912-1994) was not yet the famous photographer of the *baiser de l'hôtel de ville*. As a freelance photographer, he was asked to purpose a part of the illustration of a book that the Vichy administration wished to dedicate to French science. On this occasion, he took several portraits of Irène (1897-1956) and Frédéric (1900-1958) Joliot-Curie, as well as reports on the research facilities of the two Nobel Prize winners: a report on the electric pulse generator in the atomic synthesis laboratory, another on the cyclotron in the chemistry laboratory at the Collège de France, and a final one at the Radium Institute. Some of these photographs illustrate the book *Les Nouveaux destins de l'intelligence française* published at the end of 1942. In the post-war years, they also illustrated numerous publications on French nuclear research: the magazines *Atomes* in 1946, *Regards* 1948, etc. Doisneau made new reports in the Joliot-Curie laboratories in 1955 and 1956. These new photographs, as well as numerous shots of the instrumentation taken in 1942, illustrate the CNRS brochure devoted to *the Atomic Synthesis Laboratory* and the 10 volumes of the encyclopaedia l'*Ère atomique*. These publications join the important documentation of the comic book author Edgar P. Jacobs (1904-1987), he then integrates during the 1950s the instrumentation photographed by Doisneau in several albums of *Blake and Mortimer*. In our contribution, we will return to the instrumentation of the Joliot-Curies, its photographic representation, its integration in albums of the 9th art, and its patrimonial preservation.

Jean Davoigneau, a historian with a scientific background, works for the *Mission Inventaire général du patrimoine culturel* at the French Ministry of Culture, where he is the specialist in scientific and technical heritage.

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SESSION

19TH CENTURY INSTRUMENTS

Les instruments du cabinet de physique du lycée Saint-Joseph d'Istanbul

(*Instruments of the physics cabinet of the St. Joseph Lyceum in Istanbul*)

Feza Günergun

Istanbul University

Cette communication vise à faire connaître les projets entrepris pour inventorier, cataloguer et exposer les instruments du cabinet de physique du Lycée Saint-Joseph d'Istanbul. Le Lycée Saint-Joseph est un lycée français privé fondé en 1857 à Istanbul par « Les Frères des Écoles Chrétiennes ». La collection est conservée dans le bâtiment construit en 1870 où l'enseignement se poursuit actuellement. Les travaux d'inventaire ont commencé en Mai 2022. Plus de 300 instruments, éléments et accessoires ont été photographiés. La plupart des instruments ont été identifiés et classifiés. Les fiches d'inventaire rédigées en Français et en Turc comprennent principalement des informations sur la fonction, le mode opératoire et aussi l'histoire de l'instrument (l'invention, la fabrication et les savants qui ont expérimenté avec). Un premier aperçu montre qu'une grande partie des instruments indispensables pour réaliser les experiences les plus essentielles étaient présents dans le cabinet durant les dernières décennies du 19 e siècle. Le but de l'exposition est de souligner le poids de l'expérience dans les cours du physique du lycée. Elle comprend 80 instruments groupés selon différents thèmes ; les vidéos, informations en QR codes sont à la portée du visiteur. Catalogues en Turc et en Français sont en voie de préparation. Les photographies des instruments seront disponibles sur le site de l'ASEISTE.

Feza Günergun mène des recherches sur la transmission des sciences et des techniques développées en Europe au XVIIIe et XIXe siècles vers la Turquie. Elle compte parmi les éditeur·rice·s de Science Between Europe and Asia (Springer), Scientific Instruments Between East and West (Brill), et Entre □rois Mers (IFEA & ARKAS).

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A Harmonium with the Mathematically Precise Scale at the Royal Institute of Physics in Roma

Miriam Focaccia[1] and Giovanni Organtini[2]

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"For a long time I have wished to construct a harmonium with fixed and sustained sounds, with the mathematically exact scale, to study experimentally the many problems that pertain to it and to judge *de auditu*, to what point theory and practice coincide": thus the physicist Pietro Blaserna, founder and first director of the Royal Physics Institute of Rome, wrote in 1889 about this instrument. It was not an instrument for a concert hall, but for a laboratory, fitted with four keyboards, each capable of playing a different scale: it allows one to study the laws of sound with precision.

The occasion had been, in 1887, the establishment in Panisperna of the Central Office of the International Diapason, a metrological center for the conservation of the sample tuning fork and popularisation of the reference frequency; but Blaserna had long since begun to deal with music theory and the relationship between science and music.

In 1875 he wrote *The theory of sound in its relationship with music*, inspired by the studies by von Helmholtz, whose goal was to create a link between the two disciplines.

The instrument, commissioned in Frankfurt by Appun, is still preserved in the Museum of the Physics Department of Sapienza in Rome.

The harmonium was restored in 2018: disassembled and cleaned in all its parts, the bellows were rebuilt, allowing the air to be blown for the reeds.

We can also hear its voice for the first time since the harmonium has been kept in the museum!

Miriam Focaccia: Researcher and historian of science at the CREF, she is an expert in the history of scientific institutions and research laboratories and the author of the biographies of some protagonists of post-unification science. She also deals with the relationship between women and science in Italy starting from the 18th century.

Giovanni Organtini: Associate Professor of Experimental Physics at Sapienza Università di Roma; member of the CMS Collaboration at the CERN LHC; member of the PADME Collaboration at INFN-Frascati. Director of the Physics Museum of Sapienza from 2014 to 2019, he is also deeply involved in outreach and lifelong learning activities for teachers.

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The Astronomical Spectroscope as a Field Instrument

Thomas Hockey

University of Northern Iowa

In 1860, Gustav Kirchhoff formalized rules of spectroscopy. Meanwhile, Warren De la Rue established (to the satisfaction of most) that features visible only during a total eclipse of the Sun [TSE], *e.g.*, solar prominences, are intrinsic to the Sun. A synergy of the two discoveries was the notion to transport a spectroscope to a TSE, in order to better understand the Sun's morphology only visible during totality. Unfortunately, for several years thereafter, the paths of the TSEs that occurred were difficult for Victorian, Second Empire, *etc*. astronomers to reach.

During this time, stellar spectroscopy became well-established. The astronomical spectroscope was an accepted adjunct to the telescope. However, the astronomical spectroscope of the day was intended to be a stationary device, one mounted at the end of a large, fixed telescope, housed within an observatory.

An astronomer could not wait until a TSE passed over such a telescope/spectroscope: Spectroscopy of a TSE required transforming the conceptual astronomical spectroscope into a *field instrument*. The idea of astronomers on expedition was itself relatively new; this instrumental practice seemed an anathema to scientists used to working with, and taking care of, delicate, expensive, precision instrumentation.

An approach was to go to great lengths in order to protect one of the still rare astronomical spectroscopes while it was in transit. Another was to co-opt a physicist's *laboratory* spectroscope for an unintended purpose. I will discuss these two approaches, and their relative success, as they were undertaken for the TSE expeditions of 1868, 1869, and 1870.

Thomas Hockey resides in the midwestern USA. The recent total eclipse of the Sun, and other upcoming eclipses—all with paths through the region--motivate him to study the science/sociology of similar ones belonging to the Gilded Age. Lately, he's attempting to locate extant telescopes used for expeditions to these eclipses.

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Crossing contexts:

locomotive vibration recorders and seismology in the late 1800s

Alexandra Rose

Science Museum, London

Three vibration recording instruments in the collections of the Science Museum, London, provide a case study of instruments crossing contexts: disciplinary, geographical, and cultural. Though designed for recording the vibrations of rail locomotives, the instruments were a product of research into earthquakes in Meiji-era Tokyo, a subject of close interest for expatriate and Japanese scientists and engineers based there. The Science Museum's devices were made in Britain, though seemingly struggled for support from British engineers because their design was tuned to the characteristics of Japanese railways. For their designer, British geologist John Milne, the instruments served multiple functions beyond their potential to address practical engineering concerns. He hoped they could help to bolster both his finances, and his reputation in Britain at a time when his employment in Japan was becoming precarious. His efforts to demonstrate the practical benefits of seismology through devices such as the vibration recorders became central to his campaign to establish a worldwide network of seismographs from the mid-1890s.

The legacy of Milne's use of the vibration recorders to argue for the wide applicability of seismological techniques is reflected through the devices' later lives in the Science Museum. In the 1930s, upon discovering the existence of the vibration recorders, Museum curators displayed them alongside the Geophysics instruments rather than amongst the engineering collections. They remain thus classified today, a testament to their liminal status between disciplines.

Alexandra Rose is Curator of Earth Sciences and Astronomy at the Science Museum, London. Her interests as a researcher and museum practitioner include the history of geophysics, museum history, and the contemporary role of museums in the climate crisis.

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Santini, the Meridian Circle and the Paduan Catalogues. The improvement of the modern astrometric data with the use of 19th century stellar catalogues

Federico Di Giacomo, Simone Zaggia and Valeria Zanini

INAF – Astronomical Observatory of Padova

Hipparcos and Gaia missions have revolutionized modern astrometry. With the last release, Gaia allowed milli-arcsec precision on the positions, parallaxes and proper motions for 1.8 billion stars down 20° magnitude. However, Gaia offers poorer astrometry for the bright sources (G150yr). In this framework the five Paduan Catalogues obtained by G. Santini with the use of the Starke's Meridian Circle, one of the main instruments of Observatory of Padova, can play an important role. The Paduan Catalogue, one of the most important works of classical astronomy completed in the 19th century in Italy, collect the positions and visual magnitudes of over 10,000 stars up to magnitude 10.

In this talk we will describe and analyze the scientific and technological value of Meridian Circle and its contribution to the improvement of astrometric science. We will also describe the analysis that we are carrying out on the catalogues, already praised at the time for their great precision. The first results show that the data collected by the Paduan astronomers were very accurate and could now make it possible to update the positions and proper motions of the brightest stars observed by Gaia. Furthermore, it will be possible to carry out a specific study about some stars which show variability or apparently anomalous movements from the mid-XIX century to the present.

Federico Di Giacomo: Since 2015 he has been working at INAF – Observatory of Padova in the field of outreach and cultural heritage. He has been working on a research project devoted to the study some ancient stellar catalogues, from the end of XIX century, comparing them with more modern ones.

Simone Zaggia: PhD in astronomy is staff researcher at INAF-Osservatorio Astronomico di Padova. He is expert in galactic archeology studying especially stellar clusters, dwarf galaxies and the Milky Way.

Valeria Zanini: Research Technologist INAF. She is Head of the Museum "La Specola" and Cultural Heritage at the INAF-Astronomical Observatory of Padua. Her current research interests focus on the history of astronomy in the 17th-19th centuries and on the scientific instruments of the same period. She is involved in INAF Museum Service.

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SESSION

LATE MEDIEVAL TO EARLY MODERN INSTRUMENTS

The concept of globes as instruments in the age of al-Idrisi

Harald Gropp

Heidelberg University

It is true that the discoveries of Ceres and Technetium were important in the scientific history of Palermo. Perhaps even more important is the century long role which Palermo played in the center of the Mediterranean Sea. In particular, it was the Muslim period and the following Norman period of Sicily in which at the royal court in Palermo important scientific objects of world importance were fabricated. The two eminent rulers were the kings Ruggero II (1095-1154) and Federico II (1194-1250).

The focus of this talk will be on globes as instruments, celestial globes as well as terrestrial globes in the time of al-Idrisi (ca. 1099-1165), the chief scholar at the court of Ruggero II. It is not only the globe as a physical model but also as a concept in order to understand the earth and the surrounding universe. Whereas only a small part of the sky was unknown in the Mediterranean world, big parts of the terrestrial sphere were still unknown in Palermo in the 12th century.

The production of al-Idrisi consisted of a map, of an atlas, and of a book. They influenced the later development of maps and globes and geographical descriptions in different parts of the world in quite different ways. At last, the better or worst knowledge of the earth in connection with a reasonable knowledge of the sky prepared the politics of explorations during the following centuries.

Harald Gropp is a mathematician and a historian of mathematics, astronomy and cartography mainly interested (among other subjects) in the development of maps and globes in connection with the political and cultural history of explorations and “discoveries”. A particular interest is in the concept and realization of maps and map-like diagrams.

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A clever but short-lived instrument type from fifteenth-century Erfurt: the *Theorice Novelle*

Samuel Gessner

CIUHCT/Faculdade de Ciências, Universidade de Lisboa, Portugal

The heydays of intricate paper instruments were still to come in the sixteenth century, but a new type of equatorium emerged in the universities of Erfurt and Leipzig already in the 1450s. Astronomers in the Latin West had been familiar with equatoria instruments for figuring out planetary positions, using eccentric discs and graduated epicycles based on the Ptolemaic heavenly orbs. The Erfurt *Theorice Novelle* were a novel type of equatorium that visualized mathematical terms such as 'minuta proportionalia' and 'diversitas diametri', which do not correspond to any celestial entity but refer to astronomical tables and were part of routine computational techniques. Emmanuel Poulle categorized them as 'mathematical' equatoria, as opposed to 'geometrical' ones. The advantage of these new instruments was that they required only two concentric volvelles for each planet, making their production easier than traditional instruments.

This contribution offers a fresh perspective on these rare mathematical instruments by highlighting their clever inventiveness and exploring the university contexts in which they emerged. It also proposes possible reasons for their disappearance as the century drew to a close.

Samuel Gessner specializes in the study of the material culture of science. In his current project 'Cultures of Mathematics', he focuses on the diverse mathematical cultures in medieval and early modern Europe and how they interacted by studying the role of mathematical instruments as conceived by both theoreticians and practitioners.

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Sands of Time: A 16th-Century Treatise on the Hourglass

Afra Akyol

Medeniyet University, Istanbul

One of the most neglected time pieces in the history of astronomy is the hourglass or sand clock. Although they were known to ancient civilizations, these devices only became common in Europe after the 14th century and were effectively used until the late 18th century, if not later, in astronomy, navigation, timekeeping, and daily life applications. The introduction of mechanical clocks without pendulum to astronomical applications did not stop the use of hourglasses. On the contrary, clocks and hourglasses were used together to help make accurate measurements of time. The use of hourglasses in Europe is a relatively well-documented topic. There are also numerous extant European hourglasses in world museums. Their use in the Islamic world, however, remains somewhat unexplored. This may be because the first-hand sources are quite scarce. One of the rarest surviving treatises on hourglasses is titled *al-ʿİlām bi-shadd āl-bankām* (*Teaching of winding [sand]* clocks) and was compiled by the 16th century astronomer Shams al-Dīn Muḥammad b. Abi'l-Fatḥ al-Ṣūfī who conducted observations and prepared astronomical tables known as *zīj*es. This treatise deals with the making of hourglasses in great detail such as the know-how on the cleaning and thinning of the sand as well as the balance of the glass and its life span. This presentation will discuss the use of the hourglass in astronomy in the Islamic world and provide details on the treatise.

Afra Akyol, graduated in Information Systems and Technologies, currently is a graduate student in History and Philosophy of Science at Medeniyet University in Istanbul. Her research interests are cryptology and instruments for measuring time.

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SESSION

SCIENTIFIC INSTRUMENTS IN TEXTS AND ARCHIVAL SOURCES

Extraction of Arrows in Graeco-Roman Antiquity: Instruments and Methods in Texts

Hatice Şeyma Selbesoğlu, Tuncay Zorlu and Aytekin Çökelez

Istanbul Technical University

This study aims to evaluate the earliest texts and archaeological findings related to the treatment of arrow wounds and the process of removal of arrows from the body in ancient Greek and Roman civilizations, which has not been a focal topic for medical historians and classicists, since the incongruity between the classical texts and the modern equivalents of medical instruments, make it challenging to correctly identify and understand the uses of these medical instruments. Surgical instruments such as those used for extracting arrows, also defined under military surgery, are an important topic that requires research from various cultural, technical, and etymological perspectives in the field of scientific instrument history. The Spoon of Diocles, designed by Diocles to remove foreign objects such as arrows, or arrowheads from soldiers wounded, is an interesting example to study. Both Eastern and Western classical texts provide information on ancient surgical instruments. For instance, "De Medicina" by the Roman physician Celsus, "On Surgery and Instruments" by Albucasis (Al Zahrawi) as well as medical works written by Paul of Aegina, Rufus of Ephesus, Oribasius, Aetius of Amida and Hippocrates contain specific information about the extraction of arrows.

These surgical instruments were not only used in military surgery, but also in civilian surgical operations in ancient times for the same purpose as described in Eastern and Western classical texts, and their use represents an important development in the history of medicine and modern surgical techniques.

Hatice Şeyma Selbesoğlu is a PhD candidate and RA at Istanbul Technical University, specializing in ancient medicine, history of science, and medical historiography. Her research focuses on the examining primary sources in Latin, Greek and Italian, and includes a study on Italian memoirs related to the plague in Türkiye.

Tuncay Zorlu is a professor at Istanbul Technical University where he teaches History of Medicine, Science and Technology and History of Maritime Technology. He is a member of the executive board of the Turkish Society for History of Science and corresponding member of International Academy of History of Science (IAHS).

Aytekin Çökelez is Professor at the İstanbul Technical University. He teaches History of Science and Technology. He is a member of the TBTK. After graduation from the Department of Chemical Engineering, he received his M.S. from Joseph Fourier University in 2001 and Ph.D from Victor Segalen University in 2005, respectively.

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Scientific Instruments in the Travelogue of Ulrich Jasper Seetzen

Meltem Kocaman and Barışcan Ersöz

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For centuries, the Ottoman Empire was an attractive destination for travellers of European origin. Among them were adventure-seekers as well as naturalists who were after improving their knowledge about nature, or collecting specimens. A German physician Ulrich Jasper Seetzen (1767-1811) was one of those men of science. Starting from Istanbul, traveling through different parts of Anatolia, and moving on to the Levant, he explored Ottoman lands between 1802 and 1810. Seetzen's curiosity and enthusiasm for science and technology enabled him to interact with many people from different walks of life; from engineering students to clockmakers, and dervishes to pashas. One remarkable aspect of this interaction is its involvement with scientific instruments and materials. Seetzen brought along some instruments for astronomical observations and other scientific pursuits to use in his journey and sought local instruments used in the Ottoman realm. On many occasions during his journey, these scientific instruments became a topic of conversation and created room for intellectual and cultural exchange. So, in this paper, we locate the scientific instruments at the heart of our investigation of Seetzen's travelogue (*Tagebuch des Aufenthalts in Konstantinopel und der Reise nach Aleppo, 1802-1803*). By limiting ourselves to the sections covering Istanbul and Anatolia, we will dwell on the experiences of Seetzen and of the local people he interacted with in relation to the scientific instruments. Both instruments themselves (types, functions, etc) and the individual and cultural meanings attributed to them are the issues we will address.

Meltem Kocaman (Associate Professor) is currently working at Istanbul University, Department of the History of Science. Her main research field is the history of science and engineering in the Ottoman Empire. She published a chapter on scientific instrument retailers in Istanbul in the 19th century.

Barışcan Ersöz, PhD. is currently working at Istanbul University, Department of the History of Science. His research is mainly focused on the history of biology, genetics and agricultural sciences in modern Turkey. He recently finished his doctoral thesis on the plant breeding institutions in Turkey.

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Recent rediscovery of the original manuscript of Cavendish's paper: "To determine the Density of the Earth" (1798)

Pierre Lauginie

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Rien ne subsiste de la formidable « balance à peser les mondes » de Cavendish décrite extensivement dans le célèbre article de 1798 « Expériences pour déterminer la densité de la Terre » incorporant de nouveaux standards de rigueur, précision et méthodologie. Or, le manuscrit original a été récemment redécouvert. Voici comment. Lors de notre présentation à la SIC-2018 concernant des erreurs ou fausses interprétations dans quelques articles historiques, nous rejetions la critique sévère émanant de scientifiques et historiens connus, concernant une erreur mineure dans une série préliminaire de résultats par Cavendish. Son résultat final était confirmé, mais l'origine de l'erreur demeurait inconnue. Un réexamen attentif du texte montre que l'erreur ne provient pas d'une mauvaise interprétation des données expérimentales, ni d'une faute de copiste, mais – étonnamment – d'une erreur dans le calcul de la moyenne de six valeurs. Soupçonnant une possible confusion de chiffres susceptible de l'expliquer (un 5 pour un 4 ?), nous avons recherché des spécimens de l'écriture de Cavendish. C'était une fausse piste. Suite à cette recherche, le manuscrit original a finalement été redécouvert dans le fonds d'une importante bibliothèque (qui sera révélée pendant la présentation). Qu'il est émouvant de relire ce célèbre article dans la belle et lisible écriture de Cavendish ! Bien que le texte principal soit très similaire à la publication, la table manuscrite finale révèle des étapes non publiées de corrections entre les données expérimentales et la liste de résultats, illustrant un « Cavendish au travail ». Cette affaire d'erreur touche aussi à la déontologie de la critique scientifique.

Nothing remains of Cavendish's huge torsion balance – the balance for "Weighing the World"– extensively described in "Experiments to determine the Density of the Earth", a famous 1798 paper in which new standards of rigor, accuracy and methodology were implemented. Its handwritten manuscript has been recently rediscovered. This is how it happened. In our SIC-2018 report on errors or misinterpretations in some historical science papers, we opposed the harsh criticism of well-known scientists and historians concerning a minor error in a preliminary series of Cavendish results. Though Cavendish's final mean density of Earth was ultimately confirmed, the error remained unexplained. Now, re-examining carefully the published paper, the error is shown not to lie in a misinterpretation of the experimental data, nor in a misprint of a copyist, but – surprisingly – in a miscalculation of the mean of six results by Cavendish himself. Suspecting a possible confusion in figures (a 5 for a 4?) that could explain the error, we searched out specimens of Cavendish's handwriting. It was a false lead. Eventually, following this search, the original handwritten

manuscript of Cavendish was rediscovered in the collection of an important library (to be revealed during the presentation). How moving it is reading this famous paper in Cavendish's beautiful and legible handwriting! Though the main text appears quite similar to the published one, the final handwritten table of results reveals several unpublished stages of corrections between the set of experimental data and the final list of density of Earth results, showing "Cavendish at work". Furthermore, this "error affair" comes close to ethics of science criticism.

Pierre Lauginie, former lecturer and researcher in Physics, has developed an experimental approach to History of science teaching based on adaptations of historical experiments. His present interests are on history of instruments and popularization of science.

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“Falling into a swamp I damaged, alas! not myself, but my last barometer” – Descriptions of scientific instruments and their use in Alexander von Humboldt's correspondence and travel diaries of his expedition to Russia, Siberia and Central Asia in 1829

Florian Schnee

Berlin-Brandenburg Academy of Sciences and Humanities (BBAW), Long-term Academy project "Travelling Humboldt – Science on the Move"

As an empiricist, Alexander von Humboldt was convinced that the laws of nature could only be explored by means of observation, measurement and data collection. Astronomical and geomagnetic measurements, the determination of air and water temperature, the barometric determination of relative heights and, last but not least, the comparison of measured values and series of measurements were essential for him and his research. For this reason, he attached the greatest importance to the instruments he took with him on his expeditions to America, Europe, Russia and Central Asia, and to the way they functioned as accurately as possible.

The letters and travel diaries that Humboldt wrote during his journey to Russia, Siberia and Central Asia in 1829, which have so far only been published in excerpts, together with the printed travel report of his companion Gustav Rose, provide detailed information about the instruments he took with him and their use during the expedition. They also show how the instruments, but also the measuring methods, had to be adapted to the special conditions of the journey and how the enormous speed (by the standards of the time) at which the journey was carried out (Humboldt covered around 18,000 km within eight months) influenced the use of the instruments and the measurements. And they reveal the importance that both the instruments and the measurement results from other explorers (earlier and contemporary) had for Humboldt.

Finally, the newly introduced register of Humboldt's instruments in the digital edition of the travel diaries (https://edition-humboldt.de) will be briefly presented.

Florian Schnee, editor and research associate at the Long-term Academy project "Travelling Humboldt – Science on the Move", Berlin-Brandenburg Academy of Sciences and Humanities (BBAW), Germany. He has collaborated on scholarly edition projects on Goethe, Humboldt and Schleiermacher at the Goethe and Schiller Archive, Weimar, and at the BBAW and is currently editing Humboldt's "Fragments of the Russian-Siberian Travel Diaries" (1829).

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From inside the archive: modeling the history of the reaction key

Alina Volynskaya

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The digital turn opens the door to a never-seen-before number of scientific instruments from holdings and repositories of research institutions. Digital collections display the representations of the instruments, render them *visible*, yet do not offer ways for their interpretation and contextualization. In this paper, I will put forward some reflections on how to make sense of a scientific instrument in/ through the digital archive.

To that end, I will offer three models for describing a scientific instrument within the archive: "biography" (tracing its production, circulation and usage), "assemblage" (highlighting how it enters into relations with other agents), "mediation" (focusing on the connection between the instrument and the phenomenon under study). Each of these models is grounded in certain STS and history of science approaches, and offers a distinct perspective for contextualizing the instruments within the archive.

I will show the models in action using the example of one particular scientific device, the reaction key. The reaction key is a family of instruments that was used extensively, first in the early experimental psychology of the late 19th century and later in the cognitive sciences, to capture a subject's response to some kind of stimuli. I will demonstrate how the archival representations of the reaction keys can be contextualized through "biography", "assemblage", and "mediation" models and further displayed in a digital exhibition.

Alina Volynskaya is a PhD candidate at the Laboratory for the History of Science and Technology at EPFL (Lausanne). Situated at the intersection of the history of science and the Digital Humanities, her research questions the digital archives of science as an agency of memory and knowledge production.

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SESSION

RECONSTRUCTIONS AND REPLICATIONS

Rediscovering Optics in the Ottoman era: Taqī al-Dīn's Experiments Replicated

Sena Aydın

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The history of physics in the Ottoman classical period (14th-16th centuries) is an understudied topic. There is neither a proper list of scholars of physics from this period nor a complete catalogue of their works. Although some recent individual efforts shine light on what to expect, the depth of the scholarly works of the Ottoman period requires more attention. Undertaking this is one of the goals of the Institute for the History of Science, Istanbul Medeniyet University. It is a newly established institution which focuses on research on science in the Islamic world including the Ottoman era. As part of this goal, an interdisciplinary research project I am involved with is currently being prepared which aims to publish critical editions of manuscripts on physics from the Ottoman period as well as producing virtual and physical replicas of experiments discussed and proposed in these treatises. A scholar that deserves attention is the 16th-century polymath Taqī al-Dīn Muḥammad ibn Ma'rūf his treatise titled '*Nawr ḥadīqat al-abṣar wa-nūr ḥaqīqat al-Anẓar*' which contains 49 optical experiments. With the instrument-making skills of Dr. Taha Yasin Arslan, my colleague in the institute, we will try to replicate all 49 experiments and provide technical analysis during the project. This presentation will provide a brief description of these experiments, explain the project's context, and present the results of some of the replicated experiments already being conducted.

Sena Aydın is a historian of science at the Department of History of Science in Istanbul Medeniyet University. She studied the problems of rainbow, halo, and colour in Ottoman science (1300-1600) for her PhD. Her research focuses on the history of optics in the Ottoman era.

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Re-assessing a historic microscope collection through the re-enactment of observations

Tiemen Cocquyt

Rijksmuseum Boerhaave, Leiden, The Netherlands

Microscopes constitute a significant part of many historic instrument collections. This ubiquity reflects the wide popularity the instrument has witnessed over centuries in science and society. Included in instrument collections, microscopes have often been studied as well-engineered optical instruments, characterized primarily by their magnifications and resolving powers. But as no other instrument, the microscope has from the very beginning been deployed in a wide variety of research contexts, the implications of which on instrument design are often taken for granted.

Rijksmuseum Boerhaave, in cooperation with the Huygens Institute, Amsterdam, and Bibliotheca Hertziana, Rome, is currently carrying out a research project on the material and visual culture of seventeenth-century microscopy. We aim to access the usage practices of early microscopes through the visual representations in which discoveries were packed and circulated. The research takes place at the borderline of visual culture and instrument studies. We started off the 6-year research project with a series of re-enactment workshops in which historic observations are recreated using original instruments, working our way through historic manuals, and hoping to arrive at a result that somehow resembles the iconic visualizations of seventeenth-century microscopy (or not).

In my talk, I will set out some of the insights gathered in these workshops. To what extent did research goals and context influence a preference for a specific microscope design in the early modern period? Can the study of visual culture add to what we know from instrument studies? And what can we learn from re-enactment (and what not)?

Tiemen Cocquyt is curator of early modern natural sciences at Rijksmuseum Boerhaave, the national museum for the history of science and medicine in Leiden, the Netherlands. He researches the museum's collections of optical, experimental philosophical, and mathematical instruments.

A 19th century icon at the King's College London: reconstruction and learning from Wheatstone's stereoscopic demonstration apparatus

Andreas Junk

Europa-Universität Flensburg

The instrument history of stereoscopic measurement devices as developed and used from the early 20th century on cannot be understood without looking at the research on the physiology of vision a century earlier. Among the pioneers to be recognised for their contributions to this then heavily investigated field is Sir Charles Wheatstone (1802 – 1875). Wheatstone designed a demonstration apparatus to visualise, that a spectator's spatial awareness can be tricked by the use of carefully designed, two-dimensional drawings. The apparatus was rather a research instrument before it rose to fame on occasion of the London World's Fair in 1851.

One of the originals of the stereoscope is today available at the King's College London and was most prominently displayed during the *Arts and Humanities Festival 2016.* The instrument allows to demonstrate, how Wheatstone's accomplishments can still be found in modern day Virtual Reality setups and hence even goes much further than my research focus on stereoscopic measurement devices.

Since our research at the University of Flensburg in the field of experimental history of science is based on the replication method, I went to London to take all the necessary measurements of Wheatstone's original apparatus. Together with my candidate Eike Stehr, we made a reconstruction of the London instrument to verify, what we could or could not perceive with our instrument following Wheatstone's own description made in his paper from 1838. It showed that a number of seemingly odd effects could indeed be reproduced, some of which even gave a foreshadowing to developments being made long after the initial presentation of the stereoscope.

Andreas Junk: I am a trained experimental physicist and switched my focus to history of physics for my PhD thesis. I am currently lecturer at the University of Flensburg. My focus of is the development history of instruments for stereoscopic imaging. Other interests comprise photographic techniques and the Standard History of Nanotechnology.

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Reconstructing Scientific Discovery – A Case Study of Faraday's Electric Motor

Prof. David S. Ricketts

Harvard University

The discovery of rotary motion using electric current by Michael Faraday in 1821 has been praised as a breakthrough in science. The original apparatus that Faraday used no longer exists, as it was simply made from bits of wire, wax, a shallow cup and some mercury, all of which were available in the laboratory. Faraday himself commissioned a professional version, which is shown in his publication (of the same year) and which now sits in his laboratory at the Royal Institution. The final apparatus demonstrates the operation of the motor, but does not demonstrate the ideas that led to it.

Faraday was meticulous in recording his work on a daily basis in his scientific laboratory notebooks. The notebooks show his approach and results (often unsatisfactory) and include hand drawn images of the bits of wire and wood he used. Using the original notebooks of Faraday, the discovery process of the electric motor was recreated exactly as Faraday had done himself. The goal was to bring to life the discovery process and also to understand how Faraday thought and approached science. By reconstructing each step, the contextual meaning of Faraday's notebook summaries became as visible as the scientific principles on which they were based. In this talk I will share both the reconstruction of his ideas and how these have been used to teach the public about science and Faraday's scientific process.

Prof. David S. Ricketts is an Innovation Fellow in the Technology and Entrepreneurship Center at Harvard University. He teaches on the topics of technology, science and innovation. He recently spent his sabbatical at the Royal Institution researching the work, process and demonstration methods of Michael Faraday.

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Bringing history to Modern Science Engagement through scientific instruments

Michael Cutts[1], Charlotte New[1] and Prof. David Ricketts[2]

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The Victorian era heralded in a new form of science communication, namely the demonstration and spectacle of scientific ideas, explanations, and phenomena to the public. The Royal Institution played an important early role in engaging the public in science through demonstration of scientific instruments, those involved directly in experiments that advanced scientific development, and those specifically designed to break apart complex scientific concepts for audiences to better understand, and even disproving psychic phenomenon (eg séances and table-turning!). Fast forward 200 years and those same instruments now are either in an archive and only seen by researchers or on display to be viewed.

Reconstruction of scientific instrumentation is not new, however integrating this into modern science engagement is challenging. The question is what can the integration of scientific reconstruction into live science engagement do to teach both science and history? And, how should they be integrated?

The demonstration team at the Royal Institution has been bringing science alive through science demonstrations for 224 years, most notably in their annual Christmas Lectures (since 1825). Recently, collaborations between the science engagement team and the archives have led to an incorporation of artefacts in regular science demonstration. This talk will discuss the role of scientific instruments in modern demonstration and how they can be used to teach science and engage the public in the historical context and significance of the instruments.

Michael Cutts works with Heritage and Collections at the Royal Institution, interpreting and reconstructing scientific instruments. Also part of the Demonstration team, he engages with a global community on a broad spectrum of science communication. His work focuses on explaining and communicating complex science through the creation of demonstrations.

Charlotte New see p. 107

David S. Ricketts, see previous abstract.

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SESSION

WITHIN THE MARKET: ON THE IDENTITY OF DEALERS IN SCIENTIFIC INSTRUMENTS AND THE NATURE OF THEIR COMMODITIES

Organizer's full names: Sibylle Gluch (Independent Scholar), Rossella Baldi (Université de Neuchâtel), Martina Schiavon (Université de Lorraine), Céline Fellag Ariouet (Université de Lorraine & Bureau international de poids et mesure)

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Session Abstract

The multiple ways in which scientific instruments have changed hands between the 18th and early 20th century were described in an almost similarly entitled compilation of essays published in 2016.1 Picking up the theme, this panel wants to broaden our understanding of the individuals and goods involved by reverting to Pierre Bourdieu's notion of the "market of symbolic goods".2 Thus we mean to examine the diverse social and professional identities of the individuals who facilitated the production, sale and acquisition of scientific instruments. The panel seeks to elucidate the dynamics and reasons that compelled these people to act as agents or dealers as much as it will discuss the social, economic, scientific and/or symbolic dimension of the profits thus gained. Furthermore, we seek to scrutinize the role of instruments within this "market of symbolic goods". Instruments facilitated relations between different disciplines, actors and institutions. In addition, they could be used to promote scientific careers as much as to substantiate claims for credibility and authority. Hence, can instruments be interpreted as agents or go-betweens in their own right?

Vendre la précision horlogère à la fin du 18e siècle : les agents de Josiah Emery

Rossella Baldi

Université de Neuchâtel

Entre 1782 er 1794, l'atelier londonien de l'horloger Josiah Emery produit une quarantaine de chronomètres de poche équipés avec l'échappement à ancre conçu par Thomas Mudge. Aux dires des contemporains, ces montres atteignent des niveaux d'exactitude qui font d'elles les plus précises sur le marché. Bien qu'issues des recherches techniques qui accompagnent l'émergence de la chronométrie de marine dans la seconde moitié du 18e siècle, elles sont essentiellement destinées à des relevés géodésiques.

Leur prix très élevé limite fortement leur diffusion au sein de la communauté scientifique. Dès lors, ces objets appartiennent majoritairement à des amateurs fortunés et à quelques astronomes seulement : autour de ces garde-temps prend vie une communauté élitiste, qui se constitue sur le mode de la cooptation. Pour assurer le fonctionnement de ce groupe, ainsi que sa sociabilité spécifique, quelques personnalités se chargent de promouvoir, de vendre et de tester les montres Emery.

Notre contribution se penchera sur deux d'entre elles. Premièrement, le comte Hans-Moritz de Bruhl, ambassadeur de la cour de Saxe à Londres ; figure incontournable du monde horloger londonien de l'époque, on lui doit notamment l'idée d'adopter l'échappement à ancre pour la fabrication de garde-temps. Secondement, le scientifique d'origine portugaise Jean-Hyacinthe de Magellan, qui assure les transactions vers la France, l'Espagne et le Portugal. Ces deux hommes jouent un role primordial dans la propagation des instruments Emery et, par conséquent, dans celle de l'innovation technique qu'ils matérialisent. À travers leurs deux exemples, ce sont les dimensions symbolique, économique, technique et sociale du rôle des agents et des intermédiaires que notre étude se propose de mettre en évidence.

Rossella Baldi is former head of the Institut l'Homme et le Temps at the Musée international d'horlogerie in La Chaux-de-Fonds (Swizerland). She is currently associated with the interdisciplinary research project "Botanical Legacies from the Enlightement" lead by the University of Neuchâtel. She is also part of the team of the French research project "The Bureau of longitudes (1795-1932): from French Revolution to Third Republic" and the project dedicated to The Mniszech brothers and the "Description des montagnes et des vallées qui font partie de la Principauté de Neuchatel et Valangin" at the University of Warsaw.

Making Surgical Instruments and Crafting Reputation: The Dynamics of Camillus Nyrop's Work in Danish Medicine

Kristin Halverson

KTH Royal Institute of Technology Library

Danish surgical instrument maker and bandagist Camillus Nyrop (1811 – 1883) was a well-known figure in medical circles in Denmark, and contributed frequently to Danish medical serials, despite having no formal medical education. Although his livelihood, Nyrop was clear in being motivated by the advancement of medicine, not economic interests, and occupied a privileged position. Studies that have examined nineteenthcentury surgical instrument makers and their endeavors have typically focused on their role in the medical marketplace and commodification of medicine. However, I will show that framing Nyrop's work as part of a commodity market would be oversimplified, and that his status benefited by more than financial gain. While economic incentives cannot be ignored, Pierre Bourdieu's "market of symbolic goods" might help in further scrutinizing the work of Camillus Nyrop, and the dimensions of the incentives received by his work, beyond the mere economic. This paper will use Bourdieu's market of symbolic goods to highlight the dynamics of Nyrop's endeavors, position in the Danish medical community, and legitimacy in relation to other instrument makers. I will show that these dynamics were enacted by Nyrop through his instruments more specifically, highlighting that instruments might be interpreted as agents.

Kristin Halverson is a PhD in the History of Ideas, with a particular interest the relationships between instruments, knowledge, and practice in nineteenth-century medicine in Sweden and Denmark.

The Hartmann comparator: a go-between artillery & sciences instrument

Schiavon Martina[1] and Fellag Ariouet Céline[2]

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Named after its inventor, Major Gaston Louis Hartmann (1851-1922), the Hartmann automatic comparator and recorder was used in the late 19th Century to carry out highly accurate verification or control operations on military objects. Although largely unknown to historians, this instrument played an essential role in French industry and allowed its inventor to build a reputation as a developer of precision instruments.

Focusing on the unpublished correspondence between the director of the Bureau International des Poids et Mesures and the Section Technique de l'Artillerie, we propose to study both the material and symbolic exchanges surrounding the comparator, as well as the modifications made to the instrument between the year of its entry into service (around 1895) and a large part of the 20th Century. By comparing archives and publications about the instrument, as well as the careers of actors from the scientific and military worlds, our aim is to look again at the role of this precision instrument in the construction of a scientific discourse as well as Hartmann's scientific credibility and legitimacy within the metrology community.

Martina Schiavon is historian of science and technology (H.D.R.) at the University of Lorraine (France). Between 2016 and 2022, she was general coordinator of the ANR project "Le Bureau des longitudes (1795-1932): de la Révolution française à la Troisième République". She recently published, with Frédéric Soulu: “Tracking Down the Itinerary of a Scientific Object through the Minutes and the Data of Instruments of the Bureau des longitudes", Artefact. Techniques, histoire et sciences humaines, 17-2022, 177-216 https://journals.openedition.org/artefact/13195.

Céline Fellag Ariouet is currently completing a PhD thesis in history of science on "The International Bureau of Weights and Measures from 1875 to 1975", under the supervision of Dr Martina Schiavon. She has participated in several research projects, published a dozen articles and co-edited issue 27 of the journal Philosophia Scientiae dedicated to the “Vichy parenthesis? Trajectories of academics and disciplinary reconfigurations during the Occupation and the immediate post-war period” (2023).

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Dealing the 'Islamic world' to Europeans: Strategy and identity at the turn of the 20th century

Sumner Braund

History of Science Museum, University of Oxford

The turn of the 20th century saw significant developments in the European discipline of Oriental scholarship, notably an interest in creating a hegemonic understanding of the 'Islamic world' and its aesthetics. In this context, certain scientific instruments, like the astrolabe and celestial globe, served as representations of a refined scientific and artistic 'Islamic' sensibility from a distant past. Against this backdrop, how did turn-of- the-century dealers in scientific instruments, based in Europe, legitimise instruments from the Islamic world to collectors?

Through a case study of one collector, Lewis Evans, and his purchase of two astrolabes from two different dealers in London in 1921, this paper will examine the strategies deployed by dealers to legitimise historical scientific instruments from the Islamic world. In these two purchases, we find a collector-dealer exchange in which the astrolabe's provenance history (namely, its reputed ownership by an Amir of Afghanistan) acted as legitimiser and an exchange in which the dealer's own identity as a naturalised British citizen, formerly of the Ottoman Empire, played a key role in assuring the instrument's authenticity.

This paper will investigate these strategies using Evans' correspondence with the two dealers, preserved in the Lewis Evans manuscript archive at the History of Science Museum, Oxford. The correspondence, complemented with archival material from the National Archives (UK), reveals a complex environment in which personal identity, institutional affiliation, and access to objects all played key functions in legitimising – and interpreting – instruments from the Islamic world.

Sumner Braund, Research Fellow at the History of Science Museum (Oxford), leads the Finding and Founding Project, generously funded by the John Fell Fund. This project investigates the provenance of the museum's founding collection, donated in 1924, with a particular focus on the instruments from the Islamic world.

The Art Market and Discovery in mathematical Instruments

Anthony Turner

Independent scholar

Because scientific instruments are collected they are the matter of trade. This may take place at many levels from the local junk sale to the international antique salons. The art market has long been a fruitful resource for art historians, but has been less exploited for the study of instruments and several important discoveries of recent years have yet to be fully integrated into the mainstream of instrument history. In this paper four examples of such from different periods and regions will be presented.

Anthony Turner is an independent scholar and freelance consultant to museums and auction houses. He researches in the history of horology, scientific instruments, and the social history of ideas. Current projects include a bio-bibliographical dictionary of French and Swiss instrument makers, French enamelled watches in the 17th century, collecting natural history in late 17th century England, and the *Ancien regime* concept of the *mécanicien*.

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SESSION

EARLY MODERN INSTRUMENTS

The Jagiellonian Globe as an early mechanical armillary sphere, a history, provenance, and a technical review

Małgorzata Taborska

Jagiellonian University Museum, Krakow, Poland

The mechanical armillary sphere was made in France in the early 16th century as a universal clock. The mechanism cover is also an early terrestrial globe, made in 1510. Together with Hans Lenox's NYPL globe, they are historically the second such representation of the Earth, after Martin Bechaim's globe (1492). The object is made of brass, but the map is engraved on copper plates. The clock mechanism is original. It was altered in the 18th century, as a result of which the instrument had to be placed on a base instead of being suspended from a collet. The object has a well-known provenance, having been donated to the Library of the Collegium Maius of the University of Kraków by its professor, Johannes Broscius (1585-1652), in the 17th century. The object, its construction, and its history will be presented.

Małgorzata Taborska, Ph.D., biologist and surveyor, curator at the Jagiellonian University Museum. Research areas are the history of natural sciences and geodesy and meteorology and the development of scientific instrument construction.

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The Sixteenth-Century Primum Mobile: Instrument, Concept, Data

Floor Koeleman

University of Lausanne

This paper examines the concept of the Primum Mobile as it was understood and used during the sixteenth century. The Primum Mobile was a hypothetical mechanism believed to be responsible for the motion of the celestial bodies in the universe, and it was a central concept in medieval and Renaissance cosmology. This paper focuses on the ways in which the concept of the Primum Mobile was applied and developed during the sixteenth century, including the various instruments, representations and techniques that were used to gather data and support the theory. The paper explores the work of notable figures such as Peter Apian and Ignazio Danti, and highlights the significance of the Primum Mobile concept in shaping our understanding of the cosmos. Through an analysis of visual sources and the *Instrumentum primi mobilis* (Nuremberg: 1534), the paper provides a detailed account of the role played by the Primum Mobile in sixteenth-century astronomy, music and art, and sheds light on the broader cultural and intellectual contexts in which these ideas were developed.

Floor Koeleman is an art historian with expertise in digital humanities. She is a postdoctoral researcher at the University of Lausanne. Her research interests include the history and philosophy of art, science and instrumentation.

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Some Assembly Required: Instrument Volvelles and Interaction in Giovanni Paolo Gallucci's *Theatrum mundi et temporis* (1588)

Stephen Johnston

History of Science Museum, University of Oxford

Giovanni Paolo Gallucci (1538-1621) was a Venetian tutor, academician and prolific author. His translations and editions were extremely diverse: from the catechism to the natural and moral history of the New World; from astrological medicine to military discipline. His own writings particularly focused on practical mathematics, and his texts were illustrated with a wealth of sundials and other astronomical and mathematical instruments. He enthusiastically recognised the pedagogical potential of volvelles and it is this interactive dimension of the conference theme of "instruments in books" that is examined here.

Volvelles posed particular challenges in a period when printed books were typically sold unbound. How could the correct cutting, placing and assembly of complex parts be assured in a volume? Gallucci has been little studied compared to earlier figures such as Johannes Regiomontanus and Peter Apian, whose books with volvelles are judged more innovative, popular and/or spectacular. But he provides an especially instructive case study because, although his work was largely elementary, he included literally dozens of volvelles in the *Theatrum mundi et temporis* (1588).

Recognising the likely difficulties posed by such a substantial assembly task, Gallucci and his printer strived to provide both textual and visual instruction for binders and buyers. Surviving copies of the book nevertheless suggest – in ways that are often both amusing and melancholy – how frequently reality fell short of the author's ideal. More significantly, they underline the challenge of producing a truly interactive form of book learning without full control of the means of production and distribution.

Stephen Johnston: My research interests have centred on instruments and the mathematical arts and sciences, and I am currently focused on time and astrology in late medieval and Renaissance Europe. I have been at HSM Oxford since 1995 where I am now Senior Research Curator.

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The Mathematical-Physical Cabinet and the Collections of the Early Modern Cologne Jesuits as a University Collection of European Rank?

Henrike Stein, M. A.

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Abstract: The Mathematical-Physical Cabinet is a scientific teaching collection that was established in the 17th century in the Cologne Gymnasium Tricoronatum, a Jesuit-run institution that belonged to the Artistic Faculty of the old Cologne University founded in 1388. Thus, the collection can be considered one of the oldest Cologne University collections (of Jesuit origin). The cabinet is the focus of a dissertation in history that illuminates the collection's history from the 17th to the early 19th century and examines the cabinet in relation to teaching, the collection and the objects. The teaching instruments – globes, astrolabes, sundials, electrifying machines, thunderhouses, air pumps, telescopes, anamorphoses or pyrometers – stem from different times and disciplines, have different functions and histories, and open up different perspectives on the Mathematical-Physical Cabinet. Today, around 150 objects are still preserved, while the historical collection once contained over 1.000 instruments and could compete with collections from the same era (in Göttingen or Ingolstadt, for example). In addition, there was an extensive collection of graphics, books and manuscripts, natural objects, coins and rarities, which were, however, severely decimated by the French art theft. Cologne's Mathematical-Physical Cabinet has so far been rather unknown, both amongst Jesuit collection research as well as amongst research on European cabinets, which is why my paper is intended to offer new perspectives and opportunities for comparison with international collections.

Henrike Stein was a research assistant at the Chair of Early Modern History of Prof. Gudrun Gersmann at the University of Cologne until March 2023. Since 2017, she was part of the chair team and worked on research and publication projects. As part of a third-party funded project on the cultural heritage of the former Jesuits of Cologne, she is doing her doctorate on the Mathematical-Physical Cabinet and is currently in the final phase of her dissertation, which she will defend in June 2023. She holds degrees in art history, history and Latin from the University of Cologne and the Karlsruhe Institute of Technology.

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Force, lifting machines, and the perpetuum mobile from Descartes to Smeaton

Jip van Besouw

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Machines designed to lift weights, such as levers, inclined planes, and pulleys, were the central subject of the well-defined, mathematical Renaissance science of "mechanica". This science assessed the working of such simple machines in terms of their equilibrium conditions, based on the law of the lever and the center of gravity. Since Galileo and Stevin brought "mechanica", what we now call statics, to maturity, scholarship on later developments in the study of simple machines is virtually non-existent.

In this paper, I will first argue that this is unwarranted and that the study of simple machines played an important role particularly in the conceptual development of the notion of force, and did so while moving far beyond the consideration of equilibrium conditions. I highlight how Descartes' "Traité de Mechanique" (1637) introduced a new measure of 'force' in his analysis of machines. Although this measure was largely ignored by Descartes' contemporaries and his own later work, I show, that the notion became important again after being reconfigured by Leibniz as 'living force'.

Among other things, the new measure of force grounded a number of early instruments in early eighteenth-century cabinets of physics. These instruments were used to visualize the working of various machines. However, treatises by, for example, W. J. 's Gravesande and John Smeaton, show the instruments were also used in investigations of machine efficiency. Experiments carried out with these instruments were designed such that they gave a physical argument against the possibility of a perpetuum mobile.

Jip van Besouw is a Postdoctoral Researcher at the Vrije Universiteit Brussel. His research is concerned with the physical sciences from the late sixteenth to the mid-eighteenth century. Jip focuses particularly on the use and impact of physical instruments and mathematical techniques on the practices of physics.

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SESSION

OBSERVATORIES

De l'observatoire astronomique au Laboratoire Temps-Fréquence. Étude, inventaire et patrimonialisation des instruments scientifiques de l'Observatoire de Neuchâtel

(*From the astronomical observatory to the Time-Frequency laboratory. Study, inventory and capitalization of the scientific instruments from Neuchatel Observatory*)

Julien Gressot and Gaetano Mileti

Institut d'histoire et Laboratoire Temps-fréquence de l'Université de Neuchâtel

La mesure du temps a connu de grandes transformations entre les XIXe-XXe siècles. Passant du mouvement de rotation de la Terre sur elle-même en se référant au passage apparent des astres sur une ligne méridienne à l'oscillation des atomes de Césium comptée par des horloges atomiques. Au cours de cette période, disposer de l'heure précise devient un enjeu majeur rattaché à la constitution des États-nations et des empires. Dès lors, les observatoires acquièrent une importance centrale pour l'action de l'État, ce dont témoigne l'augmentation du nombre de ces institutions scientifiques. Cette présentation entend examiner l'évolution des moyens méthodologiques et épistémiques de la mesure du temps à l'Observatoire cantonal de Neuchâtel à partir de ses instruments scientifiques. Pour ce faire, nous présenterons les démarches qui ont été réalisées pour identifier et inventorier les instruments du Musée international d'horlogerie de La Chaux-de-Fonds en partant des rapports de directeur de l'Observatoire.

Cela nous permettra d'exposer les différentes chaînes opératoires de la mesure du temps afin de saisir l'évolution de la culture matérielle et la transition de l'observatoire vers un laboratoire temps-fréquence. Cette évolution illustre la transformation de la recherche et des savoirs liés à la mesure du temps : de l'astronomie à la physique atomique d'une part, de la mécanique à l'électronique d'autre part. En 150 ans, la relation entre l'observatoire de Neuchâtel et l'Université d'une part et le monde industriel d'autre part subit elle aussi des changements majeurs.

Julien Gressot est doctorant en histoire des sciences, des techniques et de l'innovation depuis 2018. Son travail touche à la mesure du temps. Il est aussi médiateur scientifique au sein du Laboratoire Temps-Fréquence (LTF). Il co-édite actuellement un numéro spécial dans les Cahiers François-Viète sur lescercles méridiens.

Gaetano Mileti est professeur de physique et directeur adjoint du LTF. Ses recherches concernent la spectroscopie laser et micro-onde, et ses applications aux instruments de précision. Il a participé aux développements des horloges atomiques pour le système de positionnement et navigation par satellites européen GALILEO et à l'étalon primaire suisse.

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Les Quatre Instruments Principaux de l'Observatoire d'Alger

(*The four main instruments of the Algiers Observatory*)

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L'Observatoire d'Alger, datant du 19e siècle possède les quatre instruments principaux (Lunette Coudée, Équatorial photographique, Télescope de Foucault et Lunette Méridienne) sur son site alors que d'autres observatoires construits à la même époque ne possédaient qu'une variante des trois instruments. Par ailleurs, l'Observatoire a été doté en l'année 1957 de l'Astrolabe de Danjon De même, l'observatoire d'Alger pilotait, sous la responsabilité du directeur Charles Trépied, le projet de la Carte du Ciel qui regroupait vingt (20) observatoires.

Hamid Sadsaoud est Docteur de l'Université de Nice-Sophia Antipolis, France (option: Astronomie, Astrophysique), Responsable d'équipe de recherche " Variabilité et Instabilité des Etoiles", et Responsable du projet "Observatoire d'Alger: Jouvence des instruments astronomiques et création d'un fonds d'archives astronomiques"; il a 7 publications et conférences sur les Instruments Historiques de l'Observatoire d'Alger.

Ahmed Grigahcène, see p. 77

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The old is reborn: an interwar observatory and astrograph at the crossroads of history

Monika Ramonaite, Julija Jonusaite, Agne Poskiene

Vilnius University Museum

In 1919, Vilnius was occupied by Poland and the Vilnius University (then called Stephen Bathory) was re-established nearly 90 years after its closure. Many scientists came from Poland to the newly re-opened University, including the famous Polish astronomer Władysław Dziewulski. After he arrived in Vilnius, Dziewulski began to build a new observatory and bought equipment, including two astrographs made by Carl Zeiss company. From the beginning, the Observatory has been actively involved in photometric research, published the periodical "Bulletin de l'Observatoire Astronomique de Wilno" and started to collect an astronomical library. Famous astrophysicist Wilhelmina Iwanowska - a pioneer in astronomical spectroscopy and the first woman astronomer in Poland - worked at the Observatory and used the Carl Zeiss astrograph for her research. The surviving Iwanowska's photographs made by astrograph are used in educations. In the 1930s, the growth of the city and the expanding light pollution began to affect the work of the Observatory, however, the outbreak of the Second World War ceased its operation. Nevertheless, the Observatory and its conducted research are considered one of the greatest achievements of Stephen Bathory University during the interwar period. In this presentation, we will try to answer the following questions: what challenges did Dziewulski face in setting up the new Observatory, and what role did the astrographs play in its operation? We will share our experience of why it is worth restoring an old Observatory and its scientific instruments. Why is it an attractive and inclusive tool for various educational activities?

Monika Ramonaite is Director of Vilnius University Museum and PhD candidate. Her PhD thesis focuses on the History of Medical practitioners` services in the Grand Duchy of Lithuania. She is interested in Cultural, Science and Education History, Jewish Heritage research.

Julija Jonusaite is a Museologist at Vilnius University Museum, a second-year student in History master's degree. Her master's thesis focuses on the history of Lithuanian public health during the interwar. She is interested in Lithuania's interwar period architecture, culture, social and economic history.

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Instrumental architecture: Lost and found in the Observatory of Oslo

Anne Vaalund and Bjørn V. Johansen

Museum of University History, University of Oslo

The University Observatory of Oslo opened in 1833. For a century, the scientific activities spanned from local weather observations or finding the coordinates of the Norwegian capital to participation in a variety of international networks and projects. As an architectural artefact and scientific infrastructure, an observatory is created in symbiosis with its instruments. The building supplies material support or solutions to specific scientific needs. Thus, rooms or special zones may have individual designs which can act as valuable historical sources for understanding the activities of the past. In our proposed talk, we would like to share the history of three different rooms and their instruments: The wing of the meridian circle, the observation tower and the reception hall which was converted into a lab for studying earth magnetism. During the afterlife of the Observatory, designed infrastructure was supposedly lost – later to be rediscovered and revitalized. Today, instruments have been reinstalled at their original sites, although one significant piece is forever lost, being melted down after WWII. What consequences does this have for the overall understanding of the facility, and what challenges – or possibilities – does its absence create for present day teaching and museum use? These and other questions will be addressed in the talk. Our approach will reflect our background as humanists without expert knowledge in the field of scientific instruments or natural sciences. However, in the company of the conference, we hope to encourage a discussion on which stories we may share in the Observatory, with architecture and instruments as prisms. Lost or found?

Anne Vaalund is a historian and curator at the Museum of University History. She is working with collections of scientific instruments and teaching objects from the different natural sciences, odontology and medicine, and has a good overview of the academic heritage of the University of Oslo.

Bjørn V. Johansen is an art historian specializing in university architecture and museum studies. Since 2004 he has been manager of the University History Museum in Oslo. He has also been curator of the National Museum of Norway and a researcher at the Norwegian Institute of Cultural Heritage Research (NIKU).

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The Heart of the Observatory: The Stockholm Observatory's 3,5-foot Bird Transit Instrument

Johan Kärnfelt

University of Gothenburg

In 1772, ten years after the instrument arrived at the Stockholm Observatory, a 3.5-foot transit instrument made by John Bird was finally installed on its marble pillars in the refurbished eastern wing of the observatory. Together with a regulator clock made by master clockmaker Peter Ernst, the transit would serve the astronomers well into the 1820s. In this paper, I will discuss how the instrument was integrated into observatory activities and focus on the astronomer's constant battle to keep the equipment in working order.

This paper is the third instalment in an ongoing, and recently funded, research project on the history of Stockholm Observatory, from its inauguration in 1753 until it was closed in 1931. Using object biography as the main tool, the aim of the project is to write the history of the observatory from the bottom up, i.e., by way of its instrumentation.

Johan Kärnfelt is associate professor in History of Ideas and Science at Gothenburg University, Sweden. He has previously done research on popular science, time standardization, and the history of the Royal Swedish Academy of Sciences but has during the last couple of years turned to instrument studies.

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SESSION

BIOGRAPHIES

Charles Fievez, pioneer spectroscopist in Brussels

Ricardo Manuel Pires Barbosa

Royal Observatory of Belgium

Charles Fievez was an astronomer at the Royal Observatory of Belgium from 1877 to 1890. Having been sent to study spectroscopy with Janssen in the Meudon Observatory, he became very skilled. Back in Brussels, he set up a spectroscopy laboratory, and published numerous studies including an Atlas of the Solar Spectrum. This Atlas had 2400 lines in the visible part of the Solar Spectrum, quite an improvement from the 1000 lines published previously by Ångstrom. He was also the first to notice the broadening of the spectral rays of sodium under a magnetic field, which later became known as the Zeeman effect.

His premature death at the age of 45 cut short his carrier as a skilled observer and instrument designer.

We will take a look into what survives of his instruments, giving us an interesting peek into a late XIX century spectroscopy laboratory.

Ricardo Barbosa has worked in the Lisbon University's National Museum of Natural History and Science, the Lisbon Astronomical Observatory, and collaborated with the Science History Museum of Geneva. He is presently at the Royal Observatory of Belgium where he has been studying its 19th and early 20th century collections.

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The surveying instruments and surveying methods by Friedrich Simony

Petra Svatek

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The library of the Austrian Academy of Sciences contains several books dealing with the surveying work of Friedrich Simony (1813-1896). Simony was the first professor of geography at the University of Vienna and achieved an excellent reputation as a surveyor of Austrian glaciers and lakes. In his books he not only described his surveying methodology, but also gives an insight into the construction of his own surveying instruments. Based on the books, this lecture will analyze in more detail the practice of his surveys and the surveying instruments he built for this purpose. Special attention will be paid to Simony's depth measurement of Lake Hallstatt and the survey of the Hallstatt Glacier, the largest glacier in the Dachstein Mountains. For surveying the glacier, Simony developed his own apparatus with which horizontal and vertical distances could be determined and angle measurements and other trigonometric tasks could be carried out. For his depth measurements, he designed his own sounding apparatus, which was combined with a depth thermometer. He took soundings every few meters and determined the exact sounding points by counting the number of oar strokes. The lecture will conclude with an assessment of the quality of Simony's surveys. While he was able to deliver considerable research results with his depth measurements, even internationally, and his sounding apparatus was also used by other geographers, his glacier measurements were all the less precise. Because of the lack of exact data, he did not draw maps, but only map-related representations.

Petra Svatek studied geography and history at the University of Vienna. Since 2006 she has been employed on several projects at the University of Vienna and the Austrian Academy of Sciences. Fields of interest: history of cartography in Austria in the 19th and 20th centuries (research methodology, connection to politics).

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Maria Cunitia as a User of Astronomical Instruments and Inspiration to Johannes Hevelius

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A Silesian astronomer, Maria Cunitia (1610?–1664) became known as the author of *Urania propitia* (*Beneficent Urania*, 1650) i.e. astronomical tables based on Johannes Kepler's *Rudolphine Tables* (1627) which she adapted to facilitate their use. However, little has been said about Cunitia's observations of the sky with the use of advanced astronomical instruments. In this paper I intend to use all extant printed and manuscript sources to draw a picture of Maria Cunitia as an active astronomer engaged in astronomical observations. Considering the fact that in the years 1648–1654 Maria and her husband, Elias von Löwen (Crätschmair, 1602?–1661), exchanged a number of letters with Johannes Hevelius (1611–1687), I shall proceed to argue that Cunitia could have been an inspiration of sorts to Hevelius who sought the assistance of his second wife, Elizabeth (née Koopman, 1647–1693) married in 1663, in his own astronomical endeavours.

Jarosław Włodarczyk is a professor at the Institute for the History of Science, Polish Academy of Sciences, Warsaw. He has published on e.g. the armillary astrolabe, the *camera obscura* and the torquetum and their use in ancient astronomy. He is currently taking part in a collaborative project on the correspondence of Hevelius.

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Edward Hutchinson Synge- Hutchie- The inventor of the near-field optical microscope

Denis Weaire and John Donegan

Trinity College Dublin

A supposed limit to optical microscopy that was long associated with Lord Rayleigh asserted that no detail could be discerned on a scale below the wavelength of light. In [1], Edward Hutchinson Synge, living in obscurity in Dublin, showed how this Rayleigh criterion could be surpassed. He corresponded with Einstein on the subject who expressed the view that the idea was correct but unpractical. Decades later, the instrument that he conceived in isolation– the SNOM - was realised (in ignorance of his prior publication). It took its place in today's nanotechnology laboratories. Synge suffered from Asperger's Syndrome; despite this he published this and several other conceptual breakthroughs in Philosophical Magazine on subjects such as twinkling of stars and the development of a multi-mirror telescope. The tragic story of his life has been recounted [2]; here we examine the elements of originality that were essential to his daring design.

[1] E.H. Synge, Philosophical Magazine 7, 356-362, (1928).

[2] "Hutchie: The life and works of Edward Hutchinson Synge", Living Edition, Austria.

Denis Weaire is Emeritus Professor of Physics, Trinity College Dublin. He is noted for his ground breaking work on foam structures in soft condensed matter. He has had an abiding interest in the history of Physics and worked with colleagues John Donegan and Petros Florides in bringing the works of Edward Hutchinson Synge to light.

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Drôles de marées sur le Lac Léman

(*Curious tides on the Lake of Geneva*)

Fischer Stéphane

Musée d'histoire des sciences de Genève

D'étranges marées surviennent parfois sur le Lac Léman. Subitement son niveau s'élève de plus de trente centimètres à Genève à l'extrémité ouest du lac alors que dans le même temps, il s'abaisse du côté du Valais, 80 km plus à l'est.

L'explication de ce phénomène, totalement indépendante de l'influence de la Lune et du Soleil comme c'est le cas dans les marées océaniques, a été apporté durant la seconde moitié du 19e siècle par une poignée de savants lémaniques dont François-Alphonse Forel, pionnier de la limnologie (l'écologie des eaux douces continentales) moderne. Ces marées lémaniques sont provoquées par de brusques variations locales de pression atmosphérique survenant lors d'orages ou de tornades, générant des vents capables de charrier les eaux d'une région du lac vers une autre. Quant les vents cessent, les eaux retournent à leur équilibre par un lent mouvement de balancier décroissant.

Plusieurs appareils développés et utilisés par Forel et ses collègues lors de leurs mesures des variations du niveau du lac sont aujourd'hui conservés au Musée d'histoire des sciences. Certains d'entre eux ont été retrouvés il y a quelques années parmi un lot d'instruments anciens cédés par l'Institut de physique de l'Université. En piteux état, ils ont fait l'objet d'une restauration partielle pour être à nouveau fonctionnels.

Strange tides occur sometimes on the Lake of Geneva. Suddenly its level rises by more than thirty centimetres in Geneva at the western end of the lake, while at the same time it falls on the Valais side, 80 km further east.

The explanation for this phenomenon, which is totally independent of the influence of the Moon and the Sun as is the case with ocean tides, was provided during the second half of the 19th century by some local scientists, including François-Alphonse Forel (1841-1912), the pioneer of modern limnology (basically, the ecology of continental freshwaters). These tides are caused by sudden local variations in atmospheric pressure during thunderstorms or tornadoes, generating winds capable of carrying the water from one region of the lake to another. When the winds died down, the water returns to its equilibrium in a slow downward swing.

Some devices developed and used by Forel and his colleagues in their measurements of lake level variations are now preserved in the Museum of the History of Science. Some of them were found a few years ago among a batch of old instruments donated by Institute of Physics

of the University of Geneva. In bad condition, they have been partially restored to be functional again.

Stéphane Fischer is assistant curator at the Museum of the History of Science, in charge of the Museum's collections and their valorisation through various media: publications, exhibitions, reconstructions, etc.

Assistant conservateur au Musée d'histoire des sciences, Stéphane Fischer est en charge des collections du Musée et de leur valorisation par différents médias publications, expositions, reconstitutions, etc.

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