KEYNOTE LECTURE

The Cultural Heritage of Observatories and Instruments in the Baltic

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Astronomical clocks, typical for the Hanseatic region, or the Gottorf Globe, made in Schleswig in the baroque period, are extremely interesting in terms of cultural history. Special mention should be made of famous astronomers and their discoveries: Copernicus, Tycho Brahe, Ole Rømer, Friedrich Georg Wilhelm von Struve, and Wilhelm Bessel. Several remarkable university and private observatories were founded in the Hanseatic cities around the Baltic; the oldest are the "Specula" in Rostock, 1662, or Hevelius' Observatory in Danzig (Gdańsk), 1649. In the International Astronomical Union's List of Outstanding Astronomical Heritage (OAH), the cultural and scientific value of these astronomical observatories is identified in a comparative analysis.

An additional highlight is the impressive Fraunhofer refractor in Dorpat (Tartu) Observatory, the largest and very innovative refracting telescope of that time. Owing to Friedrich Georg Wilhelm von Struve (1793–1864), Dorpat became a leading astronomical institution. He also initiated and organized the Struve Geodetic Arc (1816–56), which was added to the UNESCO World Heritage List in 2005.

KEYNOTE LECTURE

The Philosophical Significance of Instruments in the Chemical Revolution

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In the history of chemistry, as in the history of physics, the development of new instruments and metrology is often necessary for theoretical progress. Sometimes this is because of the need for increased accuracy in the measurement of something that can already be measured to some extent—examples include improved mass balances, and sometimes it is because an entirely new experimental possibility must be realised—examples include the pneumatic trough. Both of these instruments were of critical importance in the Chemical Revolution and reflection on the role of instruments is essential to understand it.

The Telescope and the Reformation of Knowledge in the Early 17th Century

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The news of the novel celestial landscape revealed to Galileo through his telescope traveled rapidly, unsettling the very foundations of the notion of what knowledge is. This paper traces how Johannes Kepler and Galileo Galilei came to terms with the epistemological challenges the telescope set to European systems of knowledge. The telescope obliged these two

prominent mathematicians to rethink the role of instruments, especially optical instruments, in producing knowledge. The telescope required Kepler to rethink his optics and remold it into the new vessel and its lenses. This process of rethinking is at the core of *Dioptrice*, a small treatise Kepler published in 1611 that is considered the first systematic explication of the theory of the telescope. Writing *Dioptrice* was an act of translation, wherein Kepler remade his older optics of shadows cast on a screen into new optics of refracted images. This translation had ramifications beyond optics, suggesting a new scientific modus operandi and a new way to produce knowledge. The telescope posits the refracted image at the core of the new optics as both a production of light and its motions and an artificial and mediated production of human manipulations. In 1623, at the culmination of his five years of polemics with the Jesuits concerning the nature and location of comets, Galileo, in *The Assayer*, followed this line of thought to its radical conclusion. Consigning the telescope a primary role in producing knowledge while relegating the eyes to a secondary place enabled Galileo to establish a new mode of instrumental empiricism to replace the traditional empirical attitudes based on immediate and direct experience with natural phenomena. Thus, the telescope provided Galileo with the ability to redefine the meaning of observation and visual experience altogether.

Symmetry and Interpretation in Newtonian Gravitation: The Importance of Interaction(s)

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This talk pays homage to Friedrich G. W. von Struve’s experimental work on geodesy and double stars by considering a cluster of philosophical issues that arise when one reflects on the nature of classical gravitation. Newtonian gravitation theory is often claimed to exhibit an important symmetry with respect to its inertial structure, a symmetry that allows one to draw the distinction between inertial structure and gravitational field in indefinitely many ways. Philosophers of physics have used this fact to conclude that both features ought to be interpreted as conventional choices without underlying physical significance, and thus that there really are no gravitational fields posited by the theory. Instead, they argue, gravitation ought to be “geometrized away,” using mathematical techniques originally developed by Elie Cartan and Kurt Friedrichs. This paper provides a counterpoint to this view: I defend the postulation of a genuine distinction between inertial structure and gravitational field. I contend that the argument for the conventionality of the gravitational field contains an implicit premise that turns out to be false—namely, the premise that the formulation of Newtonian gravitation theory in terms of Poisson’s equation is theoretically equivalent to the formulation in terms of the Law of Universal Gravitation. They are not theoretically equivalent, and I substantiate this claim by providing examples of physical systems that are models of one formulation but not the other. Moreover, I argue, attempts to reconcile the formulations succeed only at the price of destroying the symmetry upon which the conventionality argument is based. Along the way I defend the claim that, despite current consensus, Newtonian cosmology is inconsistent. These claims are then marshaled in support of a broader philosophical lesson regarding the relationship between symmetry considerations and theory interpretation.

Walking the Endless Trail and the Stars of Decision: Exploring Native American Cultural Astronomy and Star Lore of the American Southwest

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Cultural astronomy investigates the diversity of ways in which cultures, both ancient and modern, perceive celestial objects and integrate them into their view of the world. Star lore is a vernacular expression of cultural astronomy folklore; it represents some of most important elements of Native American cosmovision and describes the foundations of the sacred relationship between the people and the environment. Star lore also represents foundational cultural elements such as timekeeping, ritual, navigation/orientation, and knowledge transmission. Indigenous cosmovision sees the sky itself as the archive of traditional knowledge and the ability to safeguard it is essential to cultural survival.

Through collaboration with the University of Tartu, the Society for Cultural Astronomy in the American Southwest, and the Museum of Prehispanic Astronomy, I have done extensive fieldwork with contemporary Southern Ute, Mexicayotl, Navajo, and Lakota communities in North America. Drawing from ethnographic interviews, autoethnography, participant observation, and visits to relevant archeological sites, I investigate how star lore is rooted in the foundation of contemporary indigenous communities and woven into the fabric of their daily lives. I will demonstrate how traditional star lore contributes to solidifying traditional family bonds and how cultural astronomy facilitates the continuity of this knowledge for future generations. Utilizing Nancy Maryboy and David Begay's comparative astronomy framework, I have created a Digital Codex to facilitate knowledge transmission and serve as an educational resource for detribalized native communities. I draw upon remote sensing data, computer modeling, and original artwork to illustrate star lore elements for enhancing the availability of educational resources and establishing the first of its kind digital cultural astronomy archive.

Secrets Hiding within Early Modern Scientific Instruments: A Study in Materiality

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This paper aims to reveal some ways in which we can build up a picture of the production of early modern scientific instruments when supporting archival material has not survived. It is well known that the 'signature' or name of the master maker (who was often also the end retailer) was often inscribed into metallic instruments, but who else played a role in the instrument's production? After all, it is also well known that many additional craftsmen contributed to production either by making parts or undertaking essential processes. And yet, these individuals are rarely discussed. I will use the example of a compendium by Elias Allen and a sector by Edmund Culpeper from within the Science Museum's collections to reveal how much the instruments alone can tell us when we look more closely. In contrast, instruments with a high content of organic materials, such as microscopes of the same period, do not bear makers' signatures to the same extent as metallic instruments, but nevertheless some evidence of their makers' production techniques can be revealed by examining their interiors where possible. I will use some examples of microscopes from the Science Museum's collections to demonstrate this. At the end of the paper, I will offer some conclusions concerning the secrets contained within the materiality of early modern instruments, which are regularly missed by those historians who choose to focus exclusively on archival material. I will advocate for richer object analysis in future histories of scientific instruments.

The Main Fields of Research of the Southern Research Institute of Marine Fisheries and Oceanography (in the Second Half of the 20th Century)

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The article highlights some areas of research conducted by Ukrainian scientists of the Southern Research Institute of Fisheries and Oceanography. This research, based on data summarization, demonstrates that during its almost 100-year history of existence, the institution has gone from an ichthyological laboratory to a scientific research institute. The institute conducted research on the World Ocean in the second half of the 20th century and represented Ukraine in international organizations. The goal of the article is to identify and summarize the value of the research conducted by the Ukrainian institution before the annexation of the Ukrainian Crimea by Russia in 2014. The institute had gone beyond the Azov-Black Sea basin in their research. In 1967, the first scientific research expedition was carried out to the islands of the Kerguelen Archipelago, marking the beginning of a systematic comprehensive study of the biological resources of the coastal zones. Since 1972, the research area covered almost the entire Indian sector of the Antarctic up to the coast in the south. The main object of research in the ocean zone was the Antarctic krill. Since 1982, regular research began in the Cosmonaut and Lazarev seas with the aim to asses fish resources that were previously insufficiently studied. Since 1988, the institute has been the only research institution in Ukraine that, in accordance with the international obligations of the state, has submitted to international organizations statistical data on the use of marine living resources of Ukrainian ships in the World Ocean and the Azov-Black Sea basin. The paper analyzes scientific communication and cooperation with the Antarctic Marine Living Resources Conservation Commission, the Northwest Atlantic Fisheries Organization, and the Food and Agriculture Organization of the United Nations.

Academician Nikolai Gamaleya: The Lecturing Activity

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At the end of the 19th century, Pasteur's discovery of the "infinitely large role of infinitely small creatures" marked the beginning of the birth of the new science of microbiology, and Nikolai Gamaleya became one of the supporters of this science.

After graduating from the Faculty of Physics and Mathematics of Novorossiysk University in 1881, he entered the St Petersburg Military Medical Academy. Having received the title

of doctor in 1883, Nikolai Gamaleya organized a laboratory in his house in Odessa. There he began work related to I. Mechnikov's research in the field of phagocytosis. In 1886, the second anti-rabies station after the one in Paris was opened in the same basement. The director of this station was I. Mechnikov, and his deputies were N. Gamaleya and Ya. Bardakh.

Over the next two years, Gamaleya performed a number of original studies in microbiology and epidemiology. From 1888 to 1892, he lived in Paris, working in the laboratories of Pasteur, Bouchard, and Strauss. Returning from abroad, Gamaleya organized a bacteriological laboratory in St Petersburg and lectured a course on bacteriology to students at the Military Medical Academy. In 1893, he defended his doctoral dissertation, and in 1896 returned to Odessa, where founded the Bacteriological and Physiological Institute in his house, where he lectured on bacteriology. At the same time, since 1898, he lectured a course in general microbiology at the dental school of I. Margolin. In 1906–1909, he lectured a course in bacteriology, as a private assistant professor of the Department of General Pathology at Novorossiysk University.

During the period 1911–1913, he lectured on hygiene, bacteriology, general pathology, and epizootiology at the University of Dorpat. Here, from 1912 to 1913, he took the position of a private assistant professor of hygiene and bacteriology at the Faculty of Medicine. During 1938–1949, he was a professor at the Department of Microbiology in the Second Moscow Medical Institute.

Scientific Instruments in the Old Astronomy Observatory of Vilnius University

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The paper discusses the astronomical instruments which were used in the old Vilnius University Observatory since its opening in 1753 until it was closed following the fire of 1876. The history of this institution has been reviewed in many publications in Lithuanian, Polish, and English, which the paper will contribute to by adding information from archival sources.

At Vilnius University, astronomy has been studied as a part of the philosophy course at least since the beginning of the 17th century. The first instruments used by the university's staff came from donations. Later, private donations remained the primary source for the acquisition of the astronomy instruments, as well as for building the observatory.

The inventories show that astronomers in Vilnius acquired many instruments from the United Kingdom and other European countries. The use of the telescope, introduced by Osvald Kryger (circa 1590–1648), helped observers in Vilnius adopt the heliocentric system quite early. The most illustrious heads of the observatory were its founder Tomas Žebrauskas (1714–58), Jokūbas Nakcijonavičius (1725–77), Martynas Počobutas (1728–1810), who in 1768 went abroad to acquire modern instruments, and in 1777 sent his colleague Andrius Streckis (1737–97) on the same mission. Počobutas's correspondence with the artisans and merchants, who would take care of the logistics, and some astronomers show the ongoing process of buying instruments. Jan Sniadecki (1756–1830, who succeeded Počobutas, revised the instruments, found many of them obsolete and renewed the observatory. Petras Slavinskis (1795–1881) bought new instruments, including the Reichenbach meridian circle, which later was used for the measurements of Struve Geodetic

Arc. Matvej Gusev (1826–66) started working with photoheliograph and astrophysics in Vilnius, and Piotr Smyslov (1827–91), who also managed to acquire important equipment, continued his work.

18th-Century Scottish University Textbooks as Instruments to Understand Metaphysics

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Students in Scottish Universities in the 18th century learned anatomy from Andreas Vesalius's famous textbooks. Among them, there was also David Hume. Indeed, he referred to his philosophizing as the work of an anatomist. If the painter aims at a realistic depiction, the anatomist must provide a careful analysis of what lays beyond the skin and textures. Similarly, the philosopher, for Hume, must investigate the principles of human reason, to understand its functions and scope. Hence, in the first Enquiry, Hume states that not all metaphysics has to be dismissed and the only way to show the absurdities of a false metaphysics is to cultivate with care a true one (EU 1.7).

I argue that Hume foregrounds a novel interpretation of metaphysics rather than rejecting metaphysics *tout court*. To understand this re-interpretation, I start from a distinction present in eighteenth-century metaphysical treatises: Ontology and Pneumatology. The former investigates the principles of human cognition, the latter employs those principles to make claims about supersensible objects. Hume's task of inquiring into the principles of the human mind is partly continuous with the task of ontology. At the same time, Hume charges pneumatology to improperly use those principles and to make unwarranted claims. I hold that Hume's reformed "ontology" is the true metaphysics that serves as the ground for the new science of man. I proceed in three steps. Firstly, I look at the metaphysics textbooks of early eighteenth-century Scotland and their distinction between Ontology and Pneumatology (e.g., Francis Hutcheson's *A Synopsis of Metaphysics*). Hume was part of an intellectual environment that called for a reform of metaphysics against the intellectual hubris of scholasticism. Secondly, I analyze Hume's first Enquiry as a reformed "ontology" and, thirdly, I focus on the Enquiry's critique of pneumatology.

Mental Illness: Linguistic Analysis from Interwar Estonia

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This paper examines the portrayal of mentally ill persons in one of the biggest Estonian newspapers during the interwar period. Specifically, it explores the topics in which they were discussed, the linguistic nuances used in the related articles, and the impression left by the articles. The significance of this investigation lies in the persistent stigmatization of mental health issues within Estonian society, despite a gradual increase in public discourse surrounding these matters. Given the media's pivotal role in shaping societal perceptions and attitudes towards diverse topics and groups, this paper aims to elucidate the historical narratives and portrayals of mental illness through analysis of 17 newspaper articles that feature the term *waimuhaige* (an older Estonian word for a mentally ill person) in their title.

The paper utilizes both quantitative and qualitative methodologies to conduct its analysis. Initially, it performs a quantitative examination of the most frequent words and word forms in the articles, as well as collocations for the word *waimuhaige*. For this purpose, tools such as Linux shell commands, vmety, and Sketch Engine are employed to facilitate a detailed linguistic analysis. Subsequently, the study shifts to a qualitative analysis, where each article is analyzed individually to identify specific topics and phrases utilized in them. This phase also assesses the articles collectively, aiming to ascertain how these qualitative insights align with or reflect upon the quantitative data previously gathered. This approach ensures a comprehensive understanding of the media portrayal of mental illness. Through analytical framework, the study not only contributes to a deeper comprehension of the historical perceptions of mental illness but also highlights the significant impact of media representations on societal attitudes during a critical period in Estonian history.

The Struve Geodetic Arc as Cultural Heritage Sites in the North of Finland

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The Struve Geodetic Arc with six of its measurement points is the only site in the UNESCO World Heritage list which in Finland is directly connected to history of science. The measurements were accomplished in Finland for the most part during the 1830s, and with Finnish officers leading the work. On the other hand, the work upwards from Tornio demanded international cooperation across the borders of Finland (Russia) and Sweden (and Norway). In the 19th century, the entire undertaking played an important role in creating international contacts between Finnish and European scientists.

Three of the six measurement sites in Finland are in the North: Enontekiö, Aavasaksa/Ylitornio, and the Alatornio Church in Tornio. In my paper, I explore how the international and the local elements of science interacted in the work of the surveyors. On the other hand, after gaining the status of a site in the World Heritage list, the “Struve chain” has gained a larger public’s attention. With my focus on Aavasaksa and Alatornio Church, I discuss how this world heritage monument has been translated into a matter of local pride and part of its cultural heritage. and marketed as a tourist attraction.

The Contribution of Kyiv’s Scientists to the History of Determining the Coordinates of Landmarks and the Creation of a Global Geodetic Network

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Many scientists took part in the various stages of the evolution of geodesy in Kyiv in the 19th and 20th centuries. Vasyl Fedorov (1838–55), the first professor of the Department of Astronomy and Geodesy and director of the Kyiv University Observatory, even before moving to Kyiv, participated in G. F. Parrot’s 1829 scientific expedition to Ararat, determined the position of 79 points in Siberia in 1833–37, conducted chronometric measurements of the longitude difference between Kyiv and Pulkovo in 1839, and established the coordinates of the Kyiv meridian in 1845. His successor, Professor Andriy Shidlovsky, took part in the measurements of the Struve Geodetic Arc in 1846. In 1877, Professor Mitrofan Handrykov, together with astronomer-observer Wilhelm Fabricius, determined the difference in longitude between Warsaw and Kyiv using the telegraph. Astronomers of the Kyiv Observatory, together with the military department, measured the exact coordinates of the observatory building and installed a geodetic benchmark on its wall in 1885. Since 1898, engineering geodesy has been taught at the Kyiv Polytechnic Institute. Professor Robert Vogel, together with Mykola Rudzky, carried out a gravimetric connection from Kyiv to Krakow in 1904. Since 1957, the coordinates of the observatory began to be determined through space programs during the operation of the Station for Visual-Optical Observations of Earth's Artificial Satellites.

The Scientific Pharmacognostic School of the Pharmacognosy Department, the National University of Pharmacy in Kharkiv, Ukraine

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The Pharmacognosy Department (the National University of Pharmacy in Kharkiv, Ukraine) originated from the Department of Drug Substances, Pharmacy and Medical Art of Imperial Kharkiv University (1805). The paper discusses the department's scientific activities in the 1920s, since the establishment of the Kharkiv Pharmaceutical Institute in 1921.

M. O. Valyashko was the first to isolate rutin from the herb *Ruta graveolens* in 1903. His main research areas included the chemistry of medicinal substances and the study of their structure using ultraviolet spectroscopy. He established absorption spectra regularities for aromatic and heterocyclic compounds. From the 1930s to 1960s, the department's activities focused on the standardization of herbal raw materials containing essential oils (the *Apiaceae* family) and their complex processing (Yu. H. Borysyuk). Since 1960, the research focus shifted to phenolic compounds in *Rubiaceae* plants (M. I. Borysov). In the 1980s, Rector V. P. Chernykh proposed a new strategic direction for research in fruit, berry, and leguminous agricultural plants, as well as their by-products. Between 1980 and 2010, plants of the *Fabaceae* family were mainly studied (V. M. Kovalev). Technologies for obtaining standard compounds of ononin (V. M. Kovalev), capsaicin (N. V. Popova), and alizarin (M. S. Zhuravlyov and T. V. Ilina) were also developed. The synthesis of analogs and derivatives of natural compounds, including as the semi-synthesis of compounds using amino sugars (O. I. Pavlii) and the directed semi-synthesis of cardiac glycosides (I. Kh. Makarevych) were developed. Plant chemosystematics and chemotaxonomy were investigated by A. M. Kovaleva. Since 2010, the department has developed new medicinal products through complex processing, modification of galena extracts, and import-substituting herbal raw material products. The implementation of 3D-printing technology for plant origin products is a pioneering direction (O. M. Koshovyi) under the MSCA4Ukraine project 1232466, supervised by Ain Raal and Jyrki Heinämäki (Institute of Pharmacy, University of Tartu, Estonia).

Scientists of the National University of Pharmacy have made significant contributions to the Ukrainian pharmacognosy science. Sixteen doctoral and 77 candidate theses have been defended. Additionally, 63 author's certificates, 171 patents, 1,050 articles, 1,060 abstracts, and 16 monographs have been published; and a number of medicinal products have been developed and introduced into medical practice.

The Material and Scientific Web of the Empire: Geodetic Markers as Scientific and Colonial Political Instruments

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With the advancement of geodesy and modern topographic surveys, Europe established an extensive network of geodetic markers across various parts of the Earth aimed at measuring its surface. The development of such a network, the political and geometrical origins of which lied in the heart of European capitals, is intricately intertwined with the history of imperial and colonial expansion. By constructing "chains" of geodetic triangles, Europeans effectively linked the colonial periphery to the metropolis. For instance, in September 1873, the connection between Algeria and France through Spain was celebrated as a symbol of imperial unity, achieved despite geographical barriers impeding scientific advancement. While the role of geographical sciences in the conquest and administration of imperial territories has been extensively discussed, the link between geodesy, its aspirations, practices, and institutions, and empire, has often been overlooked.

Throughout the nineteenth century, the measurement of large meridian geodesic arcs was conducted within both colonial and continental empires. Examples include the Struve Arc in Russia, Everest's measurements in British India, and the British arc from Cape to Cairo. Imperial contexts provided a framework of continuity in administration, language, and transportation networks over vast expanses of land, facilitating the work of geodesy. Geodetic markers, signals, and pillars served as tangible manifestations of European presence on the ground, symbolizing the expansion of scientific progress through colonial conquest. These markers can therefore be understood as instruments of both science and colonialism. The building and maintenance of markers overseas posed significant challenges, temporarily transforming geodesists into colonial agents. Examining the archive of French geodesy from 1880 to 1940, this paper aims to explore the material history of imperial geodesy by focusing on geodetic markers. Additionally, it seeks to draw comparisons with other imperial and transimperial geodetic operations, such as the British Indian and African arcs, as well as the Struve Arc.

Why Did It Take So Long to Measure Stellar Parallax?

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The failure to detect stellar parallax had been one of the main arguments in favour of the geocentric worldview. Therefore, the measurement of stellar parallax became one of the fundamental problems of astronomy since the invention of telescopes. Various astronomers occasionally reported success in measuring stellar parallax, but the results varied greatly and did not seem reliable.

In scientific literature, it is often stated that reliable measurement of stellar parallax was not possible before the invention of Fraunhofer telescopes. Two of the first three documented successful measurements were made with telescopes made by Fraunhofer or his immediate successors. But if we look at when these telescopes were completed and put into operation, we have to wonder why they were not immediately used for this purpose? Struve started operating Fraunhofer's large refractor in the new tower in Tartu at the end of 1825, but he started measuring parallax only ten years later, in 1835–36, and published the results in 1837. Bessel's Königsberg heliometer started operating in 1829, but Bessel made parallax measurements as late as in 1837–38 and published his results in 1838. Using the tools of British masters in Cape Town, Henderson made his measurements as early as in 1831–32 but did not publish the results until 1839.

In my presentation, I discuss the mental barriers that held scientists back despite the fact that they already had the necessary instruments at their disposal.

Hold Still, Latvians: The Ambitious Yet Unfulfilled Project of the Anthropometric Photo Camera

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In the 1920s and 1930s, several anthropological studies were carried out at the Institute of Anatomy of the University of Latvia. These studies largely aimed at establishing the biological identity of the Latvian nation and position Latvians within the established map of European "races." More than twenty anthropological expeditions were conducted during this era, surveying over 12,000 Latvian inhabitants.

Today, the collected data and instruments used in these studies are part of the collection of the RSU Anatomy Museum. Most of these instruments were standard tools employed internationally. However, one particular item in this collection stands out in terms of its size and ambition: the custom-made anthropometric photo camera. Crafted from wood, the device consists of a turnable chair with an adjustable headrest and a camera stand equipped with lights and various custom-made elements to ensure calibration and standardization of the process. Both the chair and the camera stand could be adjusted vertically, and the distance between them could be easily regulated. Apparently, the construction of the camera was initiated in 1939 by the assistant of the Anatomy Institute, Nikolajs Caune, who envisioned the possibility of conducting anthropometric measurements through photography, provided that the photography method could be standardized. It is uncertain to what extent Caune drew inspiration from earlier efforts to standardize anthropological photography and to what extent the device was his own innovation.

It is worth noting that the construction of the device, like many other anthropological projects, was funded by Latvian Cultural Fund, with great expectations to put it into use. However, the outbreak of the Second World War halted scientific work at the institute, and it never recovered. Consequently, the famous anthropometric photo camera was never utilized; not a single photograph was taken, and it transitioned directly from a potential working tool to a museum object, symbolizing the inseparable intertwining of science and politics.

Scientific Instruments and Dewey's Instrumentalism

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John Dewey (1916b) reputedly coined the term "instrumentalism" to denote his method. He emphasized control over conditions and the technical application of scientific discoveries (Dewey 1929b, ch. X). He showed how meaning emerges from experiment (Dewey 1929b, 81–84). He argued that we understand a phenomenon insofar as we are able to initiate, sustain, and terminate it at will (Dewey [1925] 1929a, 428). He compared scientific inquiry to manufacturing of steel articles (Dewey 1916b, 34–35). However, analytic philosophers have used the term "instrumentalism" differently. They refer to the philosophies of Duhem, Mach, and Poincaré. In this sense, "instrumentalism" is the position that theories about unobservables are not literally true but are just "instruments" that summarize observations and thereby provide economy of thought.

Henne (2023) and Lindholm (2023) have questioned Dewey's alleged "instrumentalism" in that sense. Dewey (1946, 291n) himself surmised that he should have called his method simply "technology" to avoid misunderstandings. It is true that Dewey (1916b, 240–41, 324–25) did not distinguish sharply between truth and utility. But it seems that Dewey did not deny the existence of unobservables or the possibility of literal truth about them. Because he rejected the distinction between means and ends (Dewey 1916a, 119–20, 278–79, 284; 1922, 34–37, 223–37; [1925] 1929a, 364–65, 392; 1929b, 151), he also did not deny the intrinsic value of theorizing; on the same grounds, practices can have intrinsic value too.

In this presentation, I will outline the original meaning of Dewey's "instrumentalism." It seems that he literally meant to emphasize the role of instruments (tools) and especially that of language ("the tool of tools"; Dewey [1925] 1929a, 168, 186, 247) in the acquisition of knowledge. His instrumentalism is about practice, not theory. In this way, he anticipated Ihde (e.g., 1990, ch. 5; 1998).

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From "Things Knowledge" to Practical Realism

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Twenty years ago, in 2004, Davies Baird, a chemical engineer and a philosopher, published a book titled *Thing Knowledge: A Philosophy of Scientific Instruments*. In the book, he argues for a materialist conception of knowledge, as he claims accordingly, along with theories, that the material parts of science and technology constitute knowledge. Theories, as he seems to interpret the concept, belong to the area of thinking, but knowledge is more than just thinking. The book provides the reader with several case studies of the role of instruments and material processes in knowledge construction. As a conclusion, Baird admits that while some part of knowledge is expressed in theories, other parts are independent of those, and also material instruments, substances and processes carry knowledge.

This approach to knowledge was innovative and bold when introduced; however, it involves some controversies. Even though the author is criticising the traditional epistemology for focussing just on thinking and for neglecting the instrumental part, the account of knowing things still depicts the instruments as something auxiliary to theoretical models, something that assists to get knowledge. Thus, knowledge seems to remain primarily an area of thinking and representing the external reality.

In Hasok Chang's active realism and Rein Vihalemm's practical realism, the material environment of knowledge construction has been re-evaluated as part of the "practice system" or the practical research paradigm and found inseparable from the material processes.

In the presentation, I aim to explain how the practice-based accounts avoid the trap of traditional representationalism that appears to be haunting the "thing knowledge."

Baird, Davies. 2004. *Thing Knowledge: A Philosophy of Scientific Instruments*. Berkeley: University of California Press. https://doi.org/10.1525/9780520928206.

Chang, Hasok. 2022. *Realism for Realistic People. A New Pragmatist Philosophy of Science*. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108635738.

Vihalemm, Rein. 2015. "Philosophy of Chemistry against Standard Scientific Realism and Anti-Realism." *Philosophia Scientiae* 19 (1), 99−113. https://doi.org/10.4000/philosophiascientiae.1055.

Hennadiy Dobrov's Activities in the History of Science and Technology Studies in Ukraine (On the 95th Anniversary of His Birth)

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The article discusses the activities of Hennadiy Dobrov, a Ukrainian researcher of the history of science and technology and a correspondent member of the Academy of Sciences of the Ukrainian SSR and the International Academy of the History of Sciences in Paris.

Dobrov defended his thesis on the history of coal mining engineering in 1954. In January 1963, the Unit for Natural Science and Technology History Studies was created on the basis of the History of Technology Department at the Institute for Thermal Power and the History of Mathematics Department at the Institute for Mathematics. Together with the Center for Scientific and Technological Potential at the Council for Studies of the Productive Forces of Ukraine, it was incorporated in the Center (now the Institute) for Scientific and Technological Potential and Science History Studies of the Academy of Sciences of the Ukrainian SSR, the director of which was Hennadiy Dobrov.

Dobrov worked in the history of science and technology for 18 years: as a junior researcher (1953–55) and as a senior researcher at the History of Technology Department of the Institute for Thermal Power (1963–81). Since 1954, he was a member of the editorial board of *Essays on Natural Science and Technology History*; from 1954 to 1965, he was a research manager of the Commission on Technology History; between 1963 and 1964, he worked as a senior researcher and, since January 1964, as head of the History of Technology Department; between 1966 and 1968, he was head of the department for computerized methods for processing of science history information at the Unit for Science and Technology History Studies of the Institute for History of the Academy of Science of the UkrSSR, where methodologies for the automated search of sources were developed. Dobrov is the author of more than 30 fundamental works on the history of science and technology.

On Scaffolding and Mathematical Representations

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The scaffolding metaphor is commonly used in educational psychology to convey a temporary support for the learner to complete a task which she could not achieve otherwise. It has been suggested that mathematical representations can be regarded as a scaffolding of this sort, enabling us to conduct calculations and reasonings which could not be conducted without them. This view (and the metaphor itself) has recently been criticised on the ground that "scaffolding in good order is immobile, temporary, and crude. Mathematical representations can be manipulated, are not temporary structures to aid development, and are refined" (Larvor 2020).

In our talk, we consider the arguments at hand and argue that it is possible to identify a variety of practices in which mathematical representations are used in mathematics and mathematical education, and some (at least) are adequately characterised by the scaffolding metaphor. Incidentally, we show that the metaphor has been used by mathematicians themselves prior to its occurrence in educational psychology and cognitive sciences. We also discuss some examples of scaffolding practices in the history of mathematics education and what they teach us on the role of mathematical representations.

Larvor, Brendan. 2020. "Why 'Scaffolding' is the Wrong Metaphor: The Cognitive Usefulness of Mathematical Representations." *Synthese* 197, 3743–56. https://doi.org/10.1007/s11229-018-02039-y.

PANEL DISCUSSION

Formal Systems as Cognitive Tools in the History of Math and Science

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The International Association for Science and Cultural Diversity (IASCUD) proposes a panel for the XXXI Baltic Conference on the History and Philosophy of Science. From Francis Bacon's observations about *machina intellectus*, or machines designed to aid the understanding, to more recent cognitive science inquiries into the "scaffolding" role played by formal systems of signification in knowledge acquisition (Larvor 2020), philosophers, historians, and educators have sought to better understand how symbolic notations and formal methods help individuals and communities learn new things and make new experiences possible. The project of understanding how cognitive tools help scientific understanding grow has led to a careful consideration of how artifactual practices of scientists and mathematicians make implicit features of the natural world explicit. For example, Menary (2015, 4) argues: "Practices govern how we deploy tools, writing systems, number systems, and other kinds of representational systems to complete cognitive tasks. These are not simply static vehicles that have contents; they are active components embedded in dynamical patterns of cultural practice." The goal of this panel is to consider case studies in the growth of knowledge that show how social and enculturated beings wield representational and inferential strategies to make communities of consensus possible.

Menary, Richard. 2015. "Mathematical Cognition—A Case of Enculturation." In *Open MIND: 25(T)*, edited by T. Metzinger and J. M. Windt. Frankfurt am Main: MIND Group. https://doi.org/10.7551/mitpress/10603.003.0076.

Larvor, Brendan. 2020. "Why 'Scaffolding' is the Wrong Metaphor: The Cognitive Usefulness of Mathematical Representations." *Synthese* 197, 3743–56. https://doi.org/10.1007/s11229-018-02039-y.

Cognitive Tools in the Algebra Project

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The Algebra Project (AP) was founded by Bob Moses (1935–2021) to teach algebra to adolescents. The AP defines mathematical literacy as the ability to speak the languages of mathematics fluently: "At the Algebra Project, we believe that in the 21st century every child has a civil right to secure math literacy—the ability to read, write and reason with the symbol systems of mathematics" (www.algebra.org). AP pedagogy is based on a five-step learning progression that starts from (1) a shared experience that (2) students represent in drawings before (3) comparing their experiences and drawings with each other, and from these conversations (People Talk), (4) students learn to speak more regimented discourses (Feature Talk) that make implicit mathematical features of their experiences explicit. According to Moses *et al.* (1989, 433), "The purpose of the five steps is to avert student frustration in 'the game of signs,' or the misapprehension that mathematics is the manipulation of a collection of mysterious symbols and signs." A common impediment to mathematical understanding is the expectation that the same signs will always refer to the same things when two opposing tendencies may be found throughout mathematics, both "the art of giving the same name to different things," as Poincaré noted, as well as the art of giving different names to the same things. This paper approaches AP pedagogy through the lens of the enculturation theory which suggests that dynamic group interactions with cognitive tools, including diagrams and symbols, transform how we think.

Moses, Robert, Mieko Kamii, Susan McAllister Swap, and Jeffrey Howard. 1989. "The Algebra Project: Organizing in the Spirit of Ella." *Harvard Educational Review* 59 (4), 423–44. https://doi.org/10.17763/haer.59.4.27402485mqv20582.

Leibniz and the Calculus Notation

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The dispute over the priority of creating calculus is well known. Initially, the controversy was about the timing only. Needless to say, applying acceptable notation has also become part and parcel of the story. Leibniz paid special attention to the symbols used in maths and logic, believing that they are important for human understanding, that the role of symbols is essential for a kind of automated knowledge. The attitude of Leibniz stems from his general idea that he worked into the *characteristica universalis*, which he understood as an alphabet for human thinking. Leibniz imagined a formal language that could express abstract mathematical and scientific as well as metaphysical ideas. He believed that by combining simple representations of thoughts, one can build some level of complexity through abstraction. These general considerations helped Leibniz a lot in his contributions as an originator in mathematics. For him, it was not just important to innovate maths for the mathematicians but also to make the novel developments understandable and acceptable from the applications point of view. To fulfil this task, it was vital for Leibniz to pay special attention to the notation, the symbols he introduced. Especially, his notation was connected to original contributions. Leibniz introduced the integral sign we know (∫), representing an elongated S, from its Latin word *summa*, and the operator d used for differentials, from the Latin word *differentia*. The notations introduced by Leibniz made the concepts of calculus transparent. Thus, we can say that although Leibniz was the winner over Newton in terms of the notation, he failed to achieve a priority in time due to delaying publishing his works on the new method.

The View of Medical Professionals on Transgender People in Interwar Estonia

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The early 20th century was transformative in how transgender people (people whose gender identity differs from the norms typically associated with the sex they were assigned at birth) were viewed by the medical establishment. While the interest of the medical community brought with it access to gender-affirming medical intervention, it also meant that the identities of transgender people were medicalized and pathologized. While there is a plethora of research on the interactions between the medical community and transgender people in interwar Europe, there has been almost no research into this topic in the context of interwar Estonia. The purpose of my research was to, partly, fill in this gap. To this end, I have gathered pertinent evidence from available sources such as the Estonian medical journal *Eesti Arst* and other medical texts. I have placed these findings in the wider context of how transgender people were viewed by the medical establishment in interwar Europe.

The period at hand saw the first mentions of transgender people in Estonian medical texts. While originally subordinated to the discussion surrounding homosexuality—an association that would remain throughout the period—a separate, albeit fleeting, discourse on transgender people emerged in the early 1930s. The emergence of transgender people as a separate, medically legitimized group was, as elsewhere, accompanied by the emergence of medicalization discourse, with the majority position associating deviations from gender and sexual norms with antisocial behaviour. Even those doctors who were inclined to accept transgender people, pathologized their identities. It is important to note, however, that while the research paints a clearer picture of the situation, it is an incomplete one due to the limited primary source material employed in my research, something which needs to be rectified with archival research.

Mathematical Models as Scientific Instruments? When Falsifiable Models Become Analytic Standards for Measurement

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The “unreasonable” applicability of mathematics in science remains an open debate. Why does mathematics in science allow for difficult predictions which qualitative theory cannot?

The most complete account to date, the inferential account by Bueno, Colyvan, and French, argues that structural similarities between a numerical domain and an empirical domain, plus pragmatics during modelling and interpretation of a formalism, account for the applicability of mathematics. Both this account and the base idea on which it builds (the "mapping" account by Pincock) reserve a main role for mathematics in science: it represents empirical phenomena.

In this talk, I will present a novel account that focuses on a different role of mathematical models in science: guiding measurement like analytic standards such as the meter or a measuring rod (to use Reichenbach's classical example). This is a contextual account that departs from idealized pictures of science and focuses on the nuances of actual scientific practices. Basically, when scientific evidence does not match the quantitative expectations of a mathematical model (which, in principle, is a synthetic and falsifiable entity), one can (1) falsify and refine it, or (2) use the model as an analytic standard with stipulations for measurement, and thus readjust measurement (since it was "faulty" before). Thus, depending on contextual complexities, a model can also behave as an instrument for measurement. This makes their "unreasonably applicability" rather reasonable.

Such normative and instrumental effect in measurement, although it involves epistemic circularity, is not necessarily harmful since it plays a key regulatory function of scientific evidence (although in some cases it is indeed harmful). I will discuss a case study from electrophysiology where the use of mathematical models as standards is essential and often helpful, but harmful in some contexts—and how scientists implicitly use them in this way or as falsifiable entities.

Melks' Vacuum Excochleator

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Eriks Melks (1923–2002) was one of Latvia's best-known gynaecologists during the latter half of the 20th century. In 1959, Melks began to use vacuum excochleation as a form of abortion. He presented the results of his research in his doctoral dissertation, which he defended in Riga in 1962 (published in Russian in Riga, 1966).

Vacuum excochleation was a new way of ending a pregnancy in Latvia 65 years ago. In 1955, the Soviet Union lifted a ban on abortions, allowing them up to 12 weeks of pregnancy under inpatient care if the woman felt that the pregnancy was not desirable. Contraception was scarce in the Soviet Union at the time, and so women and their doctors had to choose the gentlest method of abortion so as to harm the woman's body as little as possible. A great deal of research allowed Melks to develop and make use of a new form of ending a pregnancy—one that had great advantages in comparison to the usual form of abortion (the use of a curette). Vacuum excochleation led to 1.5 times less bleeding than was the case with abrasion of the uterus. The new method used vacuum to end a pregnancy with the help of special instruments. Vacuum excochleation was based on negative pressure—a vacuum—to evacuate the foetus from the uterus. Various metal and flexible plastic instruments were used in this process. Dr Melks' tests showed that the best option was an electric vacuum that had been manufactured by a medical equipment factory in Kharkiv since 1960.

Dr Melks's vacuum excochleator is stored at the Pauls Stradiņš Medicine History Museum in Riga. Vacuum excochleation remains a popular form of ending an unwanted pregnancy, because it causes less harm to the woman's body.

Utilizing an Old Observatory as a Unique Teaching Arena: Leveraging Sensory Elements to Turn Disadvantages into Advantages

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This paper explores the advantages and disadvantages of utilizing an almost two-century-old observatory as a teaching ground for elementary school pupils. As a key perspective, we will discuss the effects of sensory elements like smell, temperature, and acoustics.

Constructed in 1833, the Observatory in Oslo enjoyed a century of active usage before deemed out of date. After a comprehensive rehabilitation process more than twelve years ago, the building's scientific wing now hosts museum exhibitions, with school classes as its primary visitors. With the Observatory itself serving as a framework and context, they learn about science and science history.

There are several challenges in using the Observatory for science communication. The building is not originally designed to accommodate school classes, which is reflected in room sizes, temperature conditions, and high thresholds between rooms. As the building is protected as a national cultural monument, the rehabilitation and restoration had to follow strict guidelines. Significant alterations are not allowed. In winter, the scientific wing is still unheated to make stable conditions for the building and its scientific instruments. Additionally, several walls cannot be touched due to vulnerable limewash paint.

Still, these constraints have also presented us with opportunities: In our experience, particularly the unique sensory elements of the old observatory act as instruments to enhance the learning experience, including for visitors with special needs. Distinctive smells (weathered materials and old paint), temperature variations (sometimes freezing cold), and the acoustics (echoes and amplification) create an immersive environment that stimulates curiosity and a fascination of authenticity. Sensory experiences are also used as starting points for setting narratives, sparking discussions and reflections. In this paper, we investigate some of these aspects and suggest ways to turn disadvantages into advantages.

The State of Psychology in Soviet Lithuania, 1944–1969: An Analysis of the Political and Ideological Context

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The aim of this report is to present the state of psychology in Soviet Lithuania in the period between 1944 and 1969. The evolution of German experimental psychology, which emerged in interwar Lithuania, was interrupted by the first Soviet and Nazi occupations, but the most significant changes took place during the period of Soviet reoccupation. Taking into account the political and ideological context (e.g., the so-called Pavlov Sessions in Moscow in 1950, which aimed at centralising and indoctrinating the fields of biology, medicine, psychology, and physiology), the paper will address the state of psychology during the first years of the Soviet occupation. In 1947, the Department of Psychology at Vilnius University was merged with the Department of Pedagogy, and only in 1969 the departments were separated, and from that time onwards the training of psychologists began in Lithuania. Looking at the context of Soviet Lithuania, the question arises as to whether psychology existed only at the level of higher education in Lithuania at that time. Can we speak of a wider field of action of psychology, given that, for example, in 1958, the Lithuanian branch of the Psychological Society was founded in Vilnius. It is worth bearing in mind the actors in the field of psychology: who they were, who came from the interwar period, and who emerged in Soviet Lithuania. It is also important to present the content of psychology, so the paper will raise questions about the perception of psychology at that time: what were its concepts, the schools, and ideas. Finally, in the context of the Cold War, the question will be asked whether there were opportunities for Western ideas to come to Soviet Lithuania, or whether the strict Iron Curtain hindered this process. The presentation will draw on archival material and contextual literature.

From the History of Peatland Research in Lithuania*

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Wetlands play an important role in the global water cycle. Peatlands are wetland ecosystems with large deposits of organic material known as peat. They are covered by plant species that control the water balance. The draining of peatlands leads to climate change, the destruction of habitats for plants and animals, and the disappearance of rare and endangered species. Over the last three centuries, Lithuania has lost around 80 percent of its natural peatlands (Barthelmes *et al*. 2015).

Currently, the original natural state of some peatlands is only preserved in old monographs. The Lithuanian nature bibliography contains three monographs on wetlands published before the Second World War: the study by German scientist Carl Albert Weber (1902) on the Aukštumala raised bog in western Lithuania, and two studies by Lithuanian researchers on the Kamanos bog (Brundza 1936) in the northern part and the Šepeta raised bog (Brundza 1940) in the northeastern part of the country. All the three bogs mentioned above were explored in the first half of the twentieth century. Currently, the larger part of Aukštumala is exploited and a smaller part is designated as a telmatological reserve and Natura 2000 network area. Kamanos was declared a strict nature reserve in 1979. Šepeta was used for peat extraction and has been destroyed. The first two monographs on Aukštumala and Kamanos are widely available and translated into other languages, while the third monograph on Šepeta is rarely found in libraries.

We will discuss the significance of the above-mentioned monographs on bogs with regard to the history of nature and science. It would include the historical background, the history of peat extraction in Lithuania before the Second World War, the history of peatland research, some issues of Lithuanian and Estonian cooperation in this area, and other relevant studies. (The research is funded by a grant from the Research Council of Lithuania, S-LIP-22-63.)

Barthelmes, Alexandra, John Couwenberg, Mette Risager, Cosima Tegetmeyer, and Jans Joosten. 2015. *Peatlands and Climate in a Ramsar Context: A Nordic-Baltic Perspective.* Copenhagen: Nordic Council of Ministers.

Brundza, Kazys, ed. 1936. “Kamanos: geologiškai botaniška studija.” *Žemės ūkio akademijos metraštis* 10 (3–4), 1–411.

Brundza, Kazys, ed. 1940. “Šepeta.” *Žemės ūkio akademijos metraštis* 13 (4), 1–208.

The 220th Anniversaries of the Department of Geology and Mineralogy and the Museum of Geology of Vilnius University: A Brief Overview of the History

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The Department of Mineralogy and the geological museum were officially established in 1803. From the Jesuit era (1579–1773), we have collections donated to the university by the nobility. From the time of the Imperial University (1803–32), there is the large collection of Romanas Simonavičius (Roman Symonowicz, 1763–1813), head of the Mineralogy department and the founder of mineralogy in Lithuania, of about 20,000 samples of minerals and rocks, including some gems and meteorites. After the university closed in 1832, the collections were transferred to the Vilnius Medical-Surgical Academy. After the closing of the academy in 1842, most of the rich mineralogy collections were distributed among other universities in the Russian Empire. Some of the collections remained in Vilnius and became part of the Vilnius Museum of Antiquities (1855), later of the Natural History Museum, established at the Vilnius Public Library (1867).

In 1920, the Department of Geology was established at Stephen Bátory University in Vilnius. In 1926, the Department of Mineralogy begins to operate, holding the collections of the former Department of Geophysics, and the former collections of the Vilnius City Public Library. In 1928, a Nature Museum with a geology-mineralogy department was established at the Faculty of Mathematics and Nature. In 1929, preparations were made for the founding of the Museum of Mineralogy at the University of Kaunas, which was to include a collection of meteorites that fell in Lithuania. In 1939, efforts were made to establish the Museum of Geology at Kaunas Vytautas the Great University.

In autumn 1940, the geological departments and offices were transferred from Kaunas to Vilnius. On March 17, 1943, the Germans closed Vilnius University and about 75 percent of the museum’s collections were lost. In the postwar years, the Museum of Geology and Mineralogy was restored. It was traditionally led by the heads of the department: Professor M. Kaveckis until 1969, Dr S. Žeiba in 1960–75, and Professor J. Paškevičius in 1975–76. In 1976, the Museum of Geology and Mineralogy became a branch of the Museum of Advanced Scientific Thought of Vilnius University, headed by A. Brazauskas (1976–77) and later E. Rudnickaitė. In 1986, a part of the old collection of Vilnius University was returned from Odessa University. In 1992, the Museum of Geology and Mineralogy was transferred under to the Department of Geology and Mineralogy of the Faculty of Natural Sciences. On April 1, 2017, it became the Museum of Geology of Vilnius University of the Department of Geology and Mineralogy, the Faculty of Chemistry and Geosciences of the Institute of Geosciences.

Diagnosis and Treatment of Nervous System Diseases in Vilnius University Therapy, Surgery and Obstetrics Clinics at the Beginning of the 20th Century

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Practical skills were and are important in production professions such as metal and glass processing, manufacture of watches and tools, shipbuilding, and others. A physician must also acquire certain practical skills to be able to properly diagnose the disease and treat the patient. In this paper, I will review the origins of medical student training ("at the bedside of the sick"), describe the birth of the Vilnius university clinics, present the statistical data of the treated patients, and analyse the diagnoses and treatment methods of nervous system diseases at the beginning of the 19th century in Vilnius. Anthropometric, morphometric, somatic, and neurological examinations were performed in Vilnius clinics. Vilnius physicians and professors of clinical medicine, as well as medical students evaluated pupillary light reflex, patients' response to painful stimuli, their mental condition, paroxysmal movements, limb position, weakness of limb movements, and some sensory modalities—touch, vision, audition, smell, taste, as well as dysfunction of pelvic organs—among other signs and symptoms. In Vilnius, as in other European clinics, the causes of the diseases were looked for in internal organs (the influence of the solidism theory), but autopsy findings usually revealed the brain and spinal cord congestion with blood, confirming the presence of humoral imbalance in the nervous system (according to humoralism theory). In the first half of the 19th century, the level of diagnostics and treatment of nervous system diseases in Vilnius corresponded to the level of Western Europe.

Revisiting All the Original Points of the Struve Arc in Finland in 1886 and 2023

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At least one point on the Struve Arc was protected officially in ten countries as a UNESCO Cultural Heritage site in 2001. This international cooperation occurred at the last moment, as so many sites had already been destroyed in the 1900s, some even in the 1800s.

In Finland, the very first evaluation took place as early as in 1886–88, when geodesist Alfred Petrelius traveled through Finland visiting the original sites. Already at that time, 17 percent of the marks on the solid rock and stones had disappeared for many reasons. The report titled *Expeditionerna till triangelpunkternas uppsökande åren 1886 och 1888* is available in Swedish and opens with a meeting with Struve in Pulkovo Observatory. Thus, in 2020–23, a group of Finnish researchers visited all the original points from Baltic Sea archipelago to the high hills of northern Lapland to evaluate the current situation. Naturally, the six UNESCO sites were included. During the evaluation of Petrelius' era, the most common reason for the purposeful destruction of the marks was the local population's distrust and suspicion towards officials. Also, the lead metal balls used for the marks were often stolen because they were valuable for riffle bullets. In the 2020s, the main reason for the failure to find the original marks in Finland was the GPS mobile phone towers, erected in the 1990s on the highest points of Finland. Astonishingly, a number of marks (67 percent) have remained. The main reason is, of course, that the holes were drilled into solid rock, such as granite. These points are sometimes located in very remote forests but are also easily accessible next to main roads. One of the marks that Petrelius reported as having disappeared has now been found!

The presentation includes selected photos from all the locations, along with maps and environmental descriptions. The slides tell of changes in nature, geography, biology, science, economics, culture, history, and society in Finland.

“It Would Be Tedious to Talk about Dorpat and the Celebrations There”: Alexander von Humboldt’s Visit(s) to Tartu and the Baltic Region on his Expedition to Russia, Siberia, and Central Asia in 1829

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The first volume of the diaries of Alexander von Humboldt’s 1829 journey to Russia, Siberia, and Central Asia has recently been published as a complete digital edition for the first time and is freely accessible online. Shortly after the start and before the end of his journey, Humboldt also visited Tartu (Dorpat). On both occasions, he was received warmly and with great respect by scientific colleagues and the local dignitaries. Although Humboldt complained about the lengthy official welcoming ceremonies, he was delighted with the encounters and exchanges with local scientists such as Kruse, Engelhardt, and Struve. While the now accessible diaries of Humboldt and his travelling companion Christian Gottfried Ehrenberg, as well as the printed travelogue by Gustav Rose, contain only a few notes about the two visits to Dorpat, they provide a considerable amount of information concerning Humboldt’s entire journey through the Baltic region on his way to St Petersburg. They tell us which instruments Humboldt took with him on his expedition and how he used them. They show how Humboldt took measurements and checked the correct functioning of his instruments right from the start of his journey. We also learn how measuring methods had to be adapted to the special conditions of the journey. The presentation (which will hopefully not be too tedious) will conclude with a brief introduction to the new index of Humboldt’s instruments in the *edition humboldt digital* (https://edition-humboldt.de).

The Natural Science Circle of Nõmme Gymnasium in the 1940s and Early 1950s

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Becoming a scientist, especially a top-level scientist, is often determined by many different factors—deep personal interest, long-term commitment, a favorable environment for development, often also someone’s advice and guidance, etc. Institutionalized forms of cooperation, such as various professional circles and/or student publications can act as kind of “instruments” in directing, maintaining, and strengthening personal research interest of “young scientists.”

The presentation focuses on the activities of the Circle of the Friends of Nature (later the Natural Science Circle) of Tallinn 10th Secondary School in the 1940s and the beginning of 1950s. The school, which used to be and is still known as Nõmme Gymnasium, produced a significant number of outstanding natural scientists in the course of a few years towards the end of the 1940s, including those who later became members of the Estonian Academy of

Sciences (e.g., Erast Parmasto, Hans-Voldemar Trass, Endel Lippmaa, and Loit Reintam). Reasons for this extraordinary phenomenon are still not fully understood.

However, one of the contributing factors was certainly the activity of the Natural Science Circle. Since 1943, some nature enthusiasts operated as a “semi-underground” group at the school. Their activities were encouraged by teachers and eventually the group gained an official status at the beginning of the new Soviet occupation in 1944. The proceedings of the circle was the publication in which many secondary school students who later became well-known natural scientists published their works for the first time (e.g., Hans Trass, Erast Parmasto, Harry Ling, and others). Unfortunately, it has not been possible to find any issues of this important publication up until now. However, from the memories of Hans Trass, Erast Parmasto, and others, as well as the occasional archiving of related documentary material, it is possible to get a fairly good overview of the activities of the Natural Science Circle of Nõmme Gymnasium and how these contributed to the development of future young scientists.

German and Soviet Science Policies and Science in Estonia in the 1920s–1960s

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As a result of the First World War, several new nation-states emerged on the map of Europe. One of them was the Republic of Estonia. As Estonians had never had their own state before, the establishment of the parliamentary republic, its institutions and national identity was a big challenge for the country’s small elite. The primary ambition was to do things differently from previous (Baltic) German and Russian rulers.

In 1919, the University of Tartu was reopened as an Estonian university, tasked with developing both Estonian science and Estonian scientific terminology. As the country oriented to agriculture was poor, all fields from theology to agricultural and technical sciences had to be developed at the University of Tartu, which also fulfilled the functions of the Academy of Sciences at the time. In such a university, it was difficult to comply with the development interests of all the different fields. The economic crises of the early 1930s emphasized the need for a technical university to enhance Estonia’s national wealth. The Estonian-German agreement, signed in 1935, on supplying the German navy with Estonian shale oil further emphasized this need and, in particular, the need for oil shale research. Consequently, in 1936, under government pressure, the Tallinn Institute of Technology was established on the basis of the Department of Technical Sciences and Chemistry of the University of Tartu. From that point on, the task of the University of Tartu was to focus on the development of the national sciences.

The first Soviet occupation (1940–41) and the following German occupation (1941–44) were too short-lived to change the established research organization and research traditions in Estonia. At the same time, Estonian scientists were compelled to cooperate with both sides of the occupying forces, leading to the difficult choice on the eve of the restoration of Soviet occupation in 1944 either to stay in homeland or flee into exile.

Before the Second World War, the Soviet higher education and research policy was shaped by the union republics themselves, resulting in a highly diverse level of research and education. During the war, the infrastructure of higher education institutions in the western part of the USSR, including Estonia, was severely damaged. In 1946, the Ministry of Higher

Education of the USSR was established, subordinating most of the higher education institutions of the federal state to the new ministry. The aim was to raise the level of teaching and research, but also the level of ideological work in the context of the Cold War. Political campaigns in Soviet Union against different fields of science (e.g., Michurinist biology) also affected the Estonian universities and the institutes of the Academy of Sciences, founded in 1947. As a result of the campaigns, Estonian scientists were forced to demonstrate loyalty to the Soviet government.

Khrushchev's rise to power, the warming of relations with the capitalist world and the improvement of the economic situation, followed by a reform of higher education and research in the Soviet Union and the strengthening of scientific competition, had a favorable effect on the development of Estonian science, especially the natural sciences. These days, Estonia is renowned for its very high level in the latter field and especially information technology.

Interacting with Authentic Objects to Learn about the Nature of Science

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Since 1833, the observatory in Oslo was in active use for 100 years. A thorough rehabilitation process was completed in 2011, resulting in a new use of the building: the scientific wing now hosts museum exhibitions. The primary users of the building and its exhibitions are school classes.

Currently, we are working interdisciplinarily between two departments of the University of Oslo, the Museum of University History and the Norwegian Centre for Science Education, to design a new exhibition to promote dialogue and reflection on how knowledge is generated, also referred to as nature of science, through analogue, tactile interactions with authentic objects and replicas that can be handled by the pupils.

Allowing pupils to interact hands-on with both authentic objects and replicas is an important aspect of the exhibition, helping them to relate to the old scientific instruments, and giving a multisensory narrative about how research was carried out at the observatory in the 19th century. We will present replicas of a magnetometer designed for fieldwork, another designed for laboratory work, notebooks, and an original book presenting empirical data as research.

In our presentation, we will focus on how we plan to use the authentic objects in an interactive, hands-on manner to engage visitors in conversations about how knowledge was historically generated in earth magnetism research. More specifically, we will illustrate how data and observations are transformed into explanations: the replica of the magnetometer will be used to illustrate data collection and the original book presenting empirical data and field notes will show how these data are used as evidence to propose explanations.

How the Development of Exact Time Measurement in the 20th Century Impacted the Time Service of the Astronomical Observatory of the University of Latvia and the Citizens' Ability to Know the Correct Time

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The 20th century saw rapid technical advancements in the field of accurate clocks. Mechanical clocks were replaced by quartz clocks, then by atomic clocks, resulting in an extraordinary increase in the accuracy of clocks by a billion of times. The time service of the Astronomical Observatory of the University of Latvia, which started its work in the 1920s, kept up with the development of technology, using mechanical clocks, quartz clocks and adopting frequency standards of the time. In the first half of the 20th century, determining the exact time using observations of stars was a task entrusted to astronomers. Accurate timekeeping later became the responsibility of physicists. Over the course of the 20th century, the citizens' ability to know the correct time also improved significantly. Wrist and stationary clocks became smaller and more precise, time signals for their adjustment were transmitted on radio, television, and by the end of the century the clock was also available on mobile phones. From being exclusive and hard-to-find, correct time became an easy-to-use everyday tool.

Inductive Inference and Scientific Procedure

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Contemporary philosophers of science, and epistemologists more broadly, have primarily considered the justificatory role of inductive inference in obtaining scientific knowledge. However, this role for induction, and ampliative inference more generally, is not thoroughly understood, and remains a subject of controversy. Scientific practice, as detailed from Bacon's observations, and exhibited in contemporary instructional methods and modern research papers, suggests that the role of induction in producing scientific knowledge is not fully captured through the lens of justifying particular hypotheses. Rather, inductive reasoning, broadly construed, has a generative function as well, which leads to new hypotheses and suggests how data may be produced to test them. I begin by briefly considering how induction plays a justificatory role in the analysis of data, taking note of the formal methods used, and how they lead to a store of experimentally established facts and hypotheses. I then reflect upon what this leaves out in characterizing the acquisition of scientific knowledge. This reflection leads to an examination of the ways in which inductive inference can be viewed as proceeding from the background store of experimental knowledge to produce new hypotheses to be tested. In observing the distinct ways in which inductive reasoning functions in producing scientific knowledge, I draw explicitly from scientific practice, particularly as exhibited in the reasoning that may be discerned in journal articles, which play a distinctive and multifaceted cultural role in the advancement of science, both challenging and reinforcing the classical distinction between the contexts of discovery and justification.

Scientific Instruments and the Neglect of Teaching in History of Science

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While historians of science are mainly interested in the history of research, many, if not most of the historical scientific instruments in our collections emerged from a teaching context. I argue that we need to relocate education from the periphery of the history of science to its centre. I claim that it is essential to study science education in its entirety and complexity if we want to understand the generation, reproduction, circulation, and transformation of scientific and technological knowledge, practices, practitioners, and objects inside and outside of scientific institutions and communities. Deborah Warner has suggested that the most common use of the term philosophical apparatus in the eighteenth century was in pedagogy. Since then, the relationship between research and teaching, and research and teaching instruments have changed considerably. For the last decades, the historical study of scientific instruments and collections has received a boost in Europe through the efforts of many of those involved to preserve the material heritage of universities, which had become endangered by institutional restructuring. Changes in research and teaching practices made these objects obsolete for current scientific activities and transformed them into historical objects. The material cultures and teaching practices related to these instruments, and their relation to research and other scientific practices, need to be studied. Drawing on examples, I will elaborate on this in my presentation.

Beyond Surgery: The Ideological Underpinnings of the First FTM Gender-Affirming Surgery in the USSR

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In 1972, the Latvian surgeon Viktors Kalnbērzs (1928–2021) successfully performed the first full sex reassignment or gender-affirming surgery from female to male (FTM) in the USSR, including vaginectomy and phalloplasty. The information regarding the world's first FTM reassignment surgery is contentious: while some sources claim it occurred in the late 1950s and early 1960s in the Netherlands, others assert that these surgeries were incomplete, lacking vaginectomy. Regardless of the truth behind the first full FTM gender-affirming surgery globally, Kalnbērzs's surgery marked not only a significant medical breakthrough in the USSR but revealed a specific thinking behind the ideology of the "proper" Soviet citizen.

Letters from Kalnbērzs's prospective patients and records from medical committees affirming the list of FTM surgeries, housed at the Pauls Stradiņš Medicine History Museum, offer insight into the reasons why this controversial surgery was permitted. This paper traces the arguments that paved the way for the first FTM gender-affirming surgery in the USSR, with a specific focus on the sociocultural, including ideological, thought processes of medical committees that acknowledged this groundbreaking procedure, seemingly ahead of its time within the USSR ideology. I argue that the reasoning behind approving the FTM surgery was rooted in the perception of homosexuality as a disease jeopardizing the envisioned societal utopia that underpinned the ideology of the imagined Communist state. In this context, being homosexual was considered socially more detrimental than being a heterosexual transperson.

Memoirs as Primary Sources and a Powerful Tool in Rediscovering the History of Medicine

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Like any other historian, a historian working in the field of the history of medicine must be aware about the tools, methods, and sources of research. Secondary sources are important when teaching students, in case a broader picture of a subject/phenomenon is needed. However, primary sources are of the greatest value for the real researcher.

Although memoirs as a primary source are considered quite inaccurate when it comes to pure fractography, chronological order of events, etc., they are an irreplaceable tool in recreating the atmosphere of a given situation. A memoir written by a medical doctor provides numerous details which doctors are prone to notice namely because of their profession. They tend to describe the patient's appearance, physical features, temperament, habits, and many more related details, since each of them might be important in identifying the cause of a disease. Similarly, doctors tend to be observant when it comes to different events, people they meet, or places they visit. Moreover, they naturally have opportunities for a broader scope of comparison. Because of their high position in the society, they are welcome at upper-class events, but their duties also include visiting the poor. The last but not the least thing to emphasise is the sense of humour as a sign of high intelligentsia, creativity, and healthy criticism towards others and self.

The Provision of Models and Instruments for the Teaching Process of the Riga Polytechnikum in the Second Half of the 19th Century

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The Riga Polytechnicum began its work in 1862 and its first task was to provide its students with pedagogical and scientific instruments to enable them to better understand the theoretical courses and to provide the professors with tools to improve their research and educational skills. They started with physical and chemical apparatuses and models in gypsum, wires, and wood. After the first year of acquisition, they already had a physical cabinet and, as a gift from Mr. Thilo, one of the members of the board of administration, a chemical laboratory. To enlarge their collection, the director of the Riga Polytechnicum made a round-trip through Germany and Switzerland, collecting gifts from industries there to enlarge their collection for their laboratories. In the following years, the institution enriched their collections for architecture and modeling. The gifts came from governments in the Baltic region, and from Berlin, Dresden, Prague, Vienna, St Petersburg, and elsewhere. All these collections served the pedagogic personnel and the students, helping to improve their skills in scientific research and inventions. However, not all the equipment was acquired from foreign institutions alone, some of it was devised by local scientists themselves to help students to better understand the subject matters. We know that some apparatuses were constructed by the later Nobel Laureate Professor Wilhelm Ostwald himself. From the reports of the administrative council of the Riga Polytechnicum we know exactly how large the collection of these models and apparatuses was. After two world-wars and some dislocations as well as nothing is left over from this period after the foundation of the Polytechnicum. But the pedagogic process still needs models to visualize technological processes and so the collections are still permanently updated.