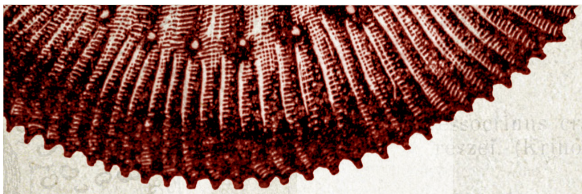


BOOK OF ABSTRACTS

POLISH GEOLOGICAL INSTITUTE
NATIONAL RESEARCH INSTITUTE

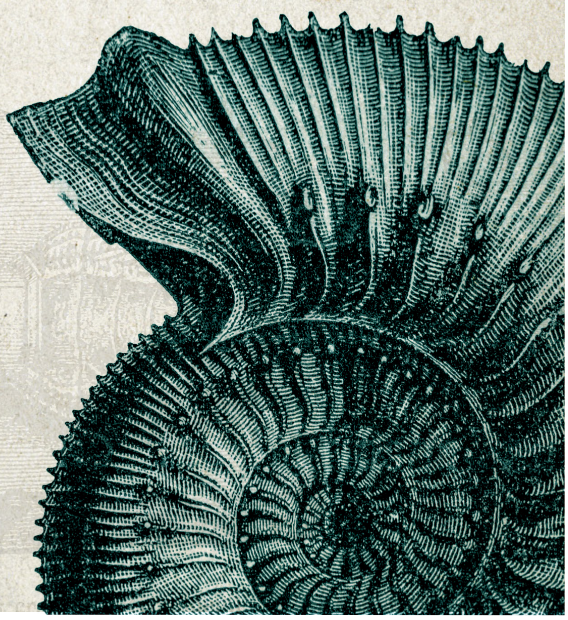
INTERNATIONAL COMMISSION
ON THE HISTORY OF GEOLOGICAL SCIENCES

POLISH GEOLOGICAL SOCIETY

POLISH ACADEMY
OF ARTS AND SCIENCE

46TH INTERNATIONAL COMMISSION ON THE HISTORY OF GEOLOGICAL SCIENCES (INHIGEO) SYMPOSIUM

POLAND
19-22 JULY 2021



Patronage: Ministry of Climate and Environment

Funded by National Fund for Environmental Protection and Water Management

BOOK OF ABSTRACTS

Editorial work:
Stanisław Wołkowicz

Layout and typesetting:
Anna Andraszek, Monika Cyrklewicz, Paweł Zawada
Cover: Monika Cyrklewicz

ISBN 978-83-66509-93-1

INTRODUCTION

This year's INHIGEO conference has a special character due to the pandemic circumstances under which it takes place. Geology, a science that accompanies mankind, whether or not we are aware of it, has existed at least since the time of the oldest underground mines in Krzemionki near Ostrowiec Świętokrzyski in Central Poland. For nearly 6,000 years it has seen the ups and downs of civilization. From the point of view of geological time, the present conditions will probably be recorded as an insignificant episode, which we will only remember thanks to, among other things, these words.

Just looking at the presentation titles for this year's paper sessions, one can see great respect and admiration for our predecessors, who created and shaped our current circumstances. The authors present during this conference, represent almost all time zones on Earth, and each of them shows the history of individuals, research groups, nations that is characteristic for their region. They show that people have been fascinated by the history of the Earth sciences long before us, seeing these insightful ancient document analyses as a source of inspiration for current research. For Poland, the testimonies of the past are all the more valuable because, throughout the turbulent history of our nation, our material goods were repeatedly destroyed by invaders, making them scarce.

An excellent example of the great value of work on history is the fact that thanks to the compilation of even older documents, it was possible to preserve complete documentation on the legal standing of mining in old Poland. The extremely valuable two-volume study by Hieronim Łabęcki from 1841 preserved these records in the form of copies, having survived in its original form for nearly 200 years, including armed uprisings, the destruction of Polish identity by invaders and two World Wars, although it suffered significant losses and is therefore incomplete. This, as well as any other study describing past events and their heroes, enriches our understanding of all that is happening today. All the more valuable in such a context are the memories of our colleagues who have passed away. In time, these written records of their lives and activities will speak for them, when we too will be long gone.

A part of the history of Polish geology is the history of our geological survey, which for the past 102 years has been honorably performed by the Polish Geological Institute – National Research Institute. The history of the Institute was initially connected with Poland regaining its independence, meaning the struggle against German aggression in the years 1939–1945, its reconstruction and functioning in the times of dependence in a socialist reality and finally, over 30 years of activity in the conditions of a free and independent country. It was shaped by brave and wise people, who have left their imprint on the economic success of our country. The discovery of copper, sulphur, coal, K-Mg salts and rare elements [W, Mo] deposits made by the Institute's staff, as well as their daily documentation and monitoring work, are an indispensable element in the functioning of the economy.

As we conduct our research now, we must be aware that we are also making history, which 50, 100, and more years from now, will be of interest to our successors. Let us leave behind the best possible source materials, knowing that a conference paper that goes unnoticed today tomorrow may become a starting point for groundbreaking research.

Piotr Dziadzio

Undersecretary of State, Chief National Geologist,
Government Plenipotentiary for the State's Raw Materials Policy

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In 2021, the *Società Geologica Italiana* (SGI) celebrates its 140th anniversary. After the first President, Giuseppe Meneghini, was appointed on September 29, 1881 during the 2nd International Geological Congress in Bologna, 77 other scientists have led the institution for almost a century and a half. The History of Geosciences Section of the Society has been appointed to tell its tale through the biographical profiles of its Presidents. One of the goals of this challenging task is to enhance the influence of geology on Italian culture, simultaneously growing Italian national identity. A complicated relationship, built along a sequence of natural disasters that frequently occurred in Italy. Promoting the development of geological knowledge of Italian territory is still lacking, as testified by the incomplete national geological map. The compilation of biographies is in progress, but most of them are available on the Society's website (https://www.socgeol.it/383/presidenti.html); the final goal of the project is to gather all the biographies in one special volume. The biography authors are members of the History of Geosciences Section, who progressively joined the "Mente et Malleo Group", driven by the admiration or affinity with a specific Society President. Somehow, empathy grew between the biographers and their "seventy-eight Society Presidents in search of an author", giving further value to the cultural undertaking. The study of past Presidents' scientific and technical careers also takes into account their private lives, focusing solely on the aspects relevant to better characterize them. The first source for information was the *Società Geologica Italiana* publications that, since its establishment, honored the memory of members by hosting obituaries and biographies written by colleagues and coworkers. Certain Society Presidents required an exploration of "non-geological" national and international archives and publications, because of their multidisciplinary careers. Another fundamental reference used is the *Dizionario Biografico degli Italiani*, published by the Istituto dell'Enciclopedia Italiana founded by Giovanni Treccani. SGI members participated to the encyclopedic collective work since the beginning, creating an osmotic flow between the two institutions. Among all geoscientists, we must cite Bruno Accordi, forefather of a scientific approach to modern Italian history of geology; conversely, Nicoletta Morello leaded the epistemological approach in the last decades of the XX century. On these assumptions, SGI recently instituted the Prize "Quintino Sella for the History of Geosciences" in honor of Nicoletta Morello and Bruno Accordi, intended to recognize and encourage the activity of the young researchers in the field of the History of Geosciences. The first edition of the prize was awarded in 2021. Reading the biographies, a strong passion for geological sciences comes up for all the personas. Their strong devotion to teaching has inspired generations of pupils, giving birth to local geological schools all over Italy, whose tradition is perpetuated to this day. Moreover, the Italian geological community is in debt to its ancestors for their commitment to preserve a cultural heritage for future generations.

Treasure trove and divine artwork: Early modern mining as financial promise and aesthetic experience

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Since the sixteenth century literature on mining and metallurgy has idealized the underground as a well-ordered treasure trove, furnished by divine providence. Vannoccio Biringuccio described the mountains as a "repository of all treasures" (*Pirotechnia* 1540). For the merchant and mining investor Andreas Ryff, the ores with their beautiful glazes and colours were arranged by divine power in the hard rock layers of the barren mountain regions. He believed that no painter was able to reproduce this natural aesthetic to a greater degree of perfection (Ryff, 1594). These examples envision the importance and the effects of mining as a site of financial promise and aesthetic experience. However, the relevance of imaginary and aesthetic rationalities is still hardly taken into account in the early mining industry, due to the analytic horizon of economic development and technological innovation. This paper explores the aesthetic, sensual, spiritual and affective perceptions of mining and their inextricable entanglement with economic and technological rationalities. This approach affords a broader perspective that expands the history of mining beyond the narrow sense of a history of material extraction and production. While analysing a broad range of sources (print, manuscript, images, objects) from the context of sixteenth and seventeenth century European mining regions, I show that metals in the form of raw materials, crafted artworks and desired collectibles should be considered simultaneously as economic resources, scientific objects/substances, raw materials for craftsmanship and powerful symbols, as well as social phantasms.

Charles S. Peirce and the slaty cleavage controversy

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In July of 1897 America's most eminent geologist, Thomas Chrower Chamberlin (1843–1928), editor of the *Journal of Geology*, invited Charles Peirce to submit for publication his report to the U.S. Geological Survey on the slaty cleavage problem. Had his report been published it is likely that Charles Sanders Peirce would be well known among geologists, in that his report may could well have resolved an important geological controversy that continued well into the mid-twentieth century (Siddans, 1972; Wood, 1874).

Slate is a fine-grained rock, altered mainly by pressure from what were originally sedimentary accumulations of clay or volcanic ash. The alteration transforms the original sediments into a low-grade metamorphic rock in which there are distinct layers that can be broken, or cleaved, along sheet-like planes. The distinctive cleavage of slates develops in response to the prolonged action of compressive forces, which are also responsible for the buckling of the rocks into folds. The relationship of the forces to the sheet-like pattern of cleavage was of great interest to early geologists, not in the least because of the utility of slate to serve as the raw material for roofing shingles, floor tiles, and writing tablets. Among the many geologists who made important contributions to explaining this rock was the young Charles Darwin (1809–1882), who distinguished cleavage, which is the tendency of some rocks to break into layers to plates, from foliation, in which layers of rocks have a different mineralogical character. Darwin considered foliated rocks to be in a more advanced state of rock metamorphism than rocks displaying slaty cleavage (Darwin, 1846, p. 141).

By the late 19th century geologists had developed a rather complete understanding of slaty cleavage that was summarized in a series of papers by Charles Richard Van Hise (1857–1918). An abundance of geological observations, including the deformation of fossils, microscopic textures, and the relationship of cleavage orientation to folding of the rocks, all pointed toward the same conclusion: that slaty cleavage develops along planes perpendicular to the external pressures exerted upon the rocks (Van Hise, 1896, 1896–1897). It results from a flattening process, in which clay-rich rocks get compressed, leading to flowage, associated rotation of irregular-shaped grains, and the oriented crystallization of new minerals, all along lines perpendicular to the compressive force directions, which in turn leads to cleaving along planes oriented in the same directions.

On January 14, 1897, Charles Peirce received a request from C.D. Walcott, the Director of the United States Geological Survey, to analyze the slaty cleavage question, a charge that had been arranged by the survey Geologist in Charge, George Ferdinand Becker (1847–1919). A long-time friend of Peirce, Becker was attempting both to achieve some financial compensation for the latter, and to gain support for his own theory that ran contrary to the geological interpretation of Van Hise and others. In a January 5, 1897, letter to Walcott, Becker summarized the controversy as follows:

"The origin of schistosity and slaty cleavage is a subject upon which there is a wide difference of opinion between Prof. Van Hise and myself. In brief, the professor, in common with other authorities, ascribes the origin of the cleavage to the action of forces perpendicular to the planes of cleavage, while according to my theory forces acting on (viscous) rocks produce cleavage at a large angle to the direction of pressure… I request that you refer the papers of Van Hise and myself to some able physicist familiar with terrestrial questions for a judgment."

In an added note, sent on the same day, Becker recommended that the reviewer be Peirce, who he described as, "…an astronomer, geodesist and mathematical physicist of whose knowledge in terrestrial questions Mr. Clarence King [the former director of the Survey] has highest opinion." Becker knew that Peirce was familiar with a mathematical theory that he had earlier worked on for the strain ellipsoid (Becker, 1893) because he had corresponded about it with his friend. Becker's theory was well in advance of its time, and it subsequently became a fundamental physical concept in rock mechanics. However, in a simplified version of his theory for non-mathematical geologists, Becker (1896) showed that it predicted the shearing of rocks in a direction sub-parallel to the direction of the external pressures exerted upon them. Assuming that slaty cleavage was a fracturing phenomenon, rather than a flattening one, the theory predicted a cleavage orientation quite different the one that was being inferred by the geologists. Moreover, the rigor and elegance of Becker's mathematical treatment convinced many scientists that the geological hypothesis championed by Van Hise must be incorrect, and that slaty cleavage was best explained by Becker's mathematical treatment.

Peirce's report on slaty cleavage begins with a discussion of terminology. In retrospect the emphasis on the need for precise terminology was highly appropriate given that subsequent developments in the field produced serious confusion in regard to terminology and definitions that impeded progress on resolving the genetic issues (Siddans, 1972). Peirce's report continues with a discussion of Becker's mathematical approach to the problem, acknowledging the general excellence of Becker's elegant and rigorous treatment. Nevertheless, Peirce ultimately concludes that the mathematics does not invalidate the geological arguments advanced by Van Hise. He calls for further work on the geological hypothesis in terms of its "miscellaneous consequences".

Peirce concludes his report by making some proposals as to what might form a more satisfactory theory for the origin of slaty cleavage. In order to apply his mathematical analysis Becker had assumed a continuous quality to the rock matter that was undergoing deformation. Peirce notes that a discontinuous character should be the more appropriate presumption. Unfortunately, Peirce uses the term "molecular" to refer to this approach, and that term has subsequently come to have a very different meaning than what was used by Peirce in the context of slaty cleavage. Peirce even hoped to advance the understanding of slaty cleavage by new experiments of his own, but, as with many ambitious plans made by Peirce during this time period (Brent, 1998), his planned experiments never came about.

Despite Piece's lack of endorsement for his theory, Becker continued to have great respect for his friend. In an obituary note for the Harvard Alumni Bulletin of May 27, 1915, Becker referred to Peirce's "eccentricities" which "...deprived him of the popularity, prosperity, and honors to which his great achievements would have entitled him." Recognition of the geological nature of slaty cleavage was one of those achievements.

Antanas Giedraitis (1848–1909) – the pioneer of professional geological cartography in Lithuania

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Geologist Antanas Giedraitis (Antoni Giedroyć, A. Gedroïz, A. Гедройц) comes from a famous family of dukes. Born on February 21, 1848 in Karvys (Korwie) near the township of Maišiagala (Vilnius district). In the history of science in Lithuania and neighbouring countries, he was the first who compiled a geological map in accordance with international standards, understood Quaternary deposits and took a courageous stance for that time in maintaining that the region was covered by two glaciations. In 1867, he graduated from the Vilnius 1st Gymnasium. From 1872 to 1876, he studied at the Freiberg Mining Academy (Bergakademie Freiberg) in Germany, where he attended the lectures in 25 courses. In 1877, he graduated from the University of Tartu (Dorpat) in Estonia, which also accounted for his studies at Freiberg. After passing additional examinations and preparing the final work "Zur geognostischen kenntniss nordwestlichen provinzen", A. Giedraitis was awarded the degree of Candidate of mineralogy. Interestingly, his father Edmund graduated from this University in 1834. After receiving an order from the St. Petersburg Mineralogical Society, in 1877–1878 A. Giedraitis explored the western part of the Russian Empire (Vilnius, Kaunas, Grodno provinces and northern Poland). Before completing this work, he was invited to join an expedition by the (Russian) Ministry of Transport Roads, which was tasked with exploring the old furrows of Amu Darya River and the old riverbeds of the Uzbois in Turkmenistan. This was a significant trip that led to subsequent cooperation with the Russian Geological Committee (hereinafter the GeolCom). As an expert in geology in the western parts of the Russian Empire, in 1883 he was invited to perform geological research and geological mapping on a 10-verst scale (1 : 420,000). A. Giedraitis completed that work in 1887, but the full summary with the map was not published until 1895. The material of this map was used to create a geological map of the European part of Russia in 1893. A. Giedraitis' map was based on conventional legend, a ratified stratigraphic chart and a sufficient number of observations required for such mapping. Soon the GeolCom delegated three geologists: V. Obruchev, A. Gerasimov and A. Giedraitis, to perform research on the construction of the Transsiberian railway in the Transbaikal Territory (Zabaykalsky Kray). The material from these investigations (1895–1898) was presented to the GeolCom in annual reports. Some of the collected mineral samples were delivered to the Chita Local History Museum. This work of A. Giedraitis was summarized only 10 years later (1909). In 1900–1902, A. Giedraitis worked at the Yekaterinoslav Mining Academy (now Dnepropetrovsk, Ukraine). A. Giedraitis' professional achievements are well known, evidenced by detailed research reports and scientific publications in German, Polish and Russian languages. Unfortunately, little is known about his possible connections with 1863-1864 rebels (among them his cousin Vitold Giedroyć, sister's Mary's husband K. Bolcewich, Karvys priest J. Vaitkewich). Little is known about the fate of his children, including his son Antanas (1892–1966), who was exiled along with his family to the USSR (Kazakhstan) in 1940–1942, later reaching Great Britain via Iran. This study on the life and geological research of A. Giedraitis was based on new data from the archives of the TU *Bergakademie* Freiberg, the National Archives of Estonia, the Lithuanian State Historical Archives, as well as digitial heritage sources from Russia and Ukraine.

Grigory Helmersen (1803–1885) – creator and first director of the Geological Survey of Russia

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Grigory (Gregor) von Helmersen was born in 1803 in Duckershof (near Tartu, now Estonia). In 1825, he graduated from the University of Dorpat.

Helmersen made the first scientific expedition to Urals Mountains for study of gold deposits in 1826. Since September 1829 he charged to support the expedition of Alexander Humboldt across South Urals Mountains for half a year.

In 1830–1832, he listened in Berlin lectures on mineralogy by Gustav Rose and on chemistry by Heinrich Rose. He studied paleontology in the Bonn University and studied mining in the Freiberg Mining Academy. He visited some mines of old ore regions of Germany, passed across Austria and Italy.

Helmersen conducted field geological researches of Russia almost 50 years. He researched gold deposits on the Urals, Altai and in Siberia, investigated Valdai Hills within Novgorod and Tver provinces. He was the first geologist who conducted study Moscow and Donetsk coal basins.

In 1841, he compiled and published the first *Geological Map of European Russia*. Helmersen received the Demidov Prize of the Academy of Sciences for this map. Roderick I. Murchison used this map at a writing of his work *Geology of Russia* (1845).

In 1845, Helmersen participated in establishment of the Russian Geographical Society and in the organization of the Society's first expedition to North Urals Mountains in 1847. He investigated of Upper Silurian sediments of the island of Gotland (Sweden), geology of classical cross sections near Christiania in Norway.

In 1856–1859, Helmersen traveled to four expeditions to Karelia and Finland. He made the first description of *oz* (*os* or *esker)* (with drawing up of a map) and he made a real contribution to creation of the glacial theory.

In 1859, he got an assignment to generalize and systematize available materials for compiling a better geologic map of Russia. Helmersen has scrupulously familiarized with all geological publications and new regional maps, has consulted a number of geologists, has added results of his studies and *General Map of Geological Formations of the European Russia and the Ural Range* was compiled in 1863 and published in 1865.

At preparation of this map, Helmersen was able to critically analyze the data and the quality of geological research in Russia. He analyzed the level of geological study of the country and first among Russian geologists realized necessity of state monopolization of geological exploration works. He considered that the national economy is in direct dependence on geological mapping, which should be concentrated in a state geological survey. In 1862, he offered to create a state geological survey of Russia for the first time in paper *The current status of geology in Russia*. But his proposition was realized only 20 years later, in 1882. Helmersen was the first director of Geological Committee (Geological Survey) of Russia. He is author of more than 200 works on the geology and mineral resources of Russia.

He trained at the Corps of Mining Engineers and taught for many years at the Mining Institute in St. Petersburg with the rank of professor. In 1865–1872, he was the director of Mining Institute.

He was the first mountain engineer in Russia who became an adjunct of the St.-Petersburg Academy of Sciences in 1844, in 1850 he became an academician.

From pencil to pixel: 186 years of BGS history

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The British Geological Survey (BGS) is often described as the world's first national geological survey, having been initiated in 1832 and formally established in 1835. In fact, there were earlier relatively short-lived government-funded geological surveys in France (1825–35), in the eastern United States (from 1824) and in Ireland where an official geological survey was attempted from 1826 but was twice abandoned before being formally reinstated in 1845. The BGS is, however, the world's oldest continuously functioning national geoscience (geological survey) organisation. The Survey was established by H.T. De la Beche, initially under the control of the Board of Ordnance, and has continued to operate under a succession of Government departments up to the present day.

The original remit of the Geological Survey was to provide an understanding of the geology of Britain which would be "of great practical utility to the Agriculturalist, the Miner, and those concerned in projecting and improving the Roads, Canals, and such other public works, undertaken for the benefit and improvement of the Country". In the 19th and early 20th centuries the Survey's principal focus was on geological mapping, supported by stratigraphical palaeontology and, from the late 1860s, petrography. Other topics covered included mineral assessment (coal, oil shale and ironstone), research into metalliferous mining and mineral processing, compilation of mineral production and trade statistics and, from at least the 1870s, underground water supply. The two world wars of 1914–1918 and 1939–1945 saw a particular focus on mineral reconnaissance and water supply. Records of wells and borings were being collected from the 1860s, but their acquisition only became systemised with the Mining Industry Act 1926 and Water Act 1945. The application of geophysics to mineral exploration was initiated in 1926.

In 1965 the British Survey was combined with the Directorate of Overseas Geological Surveys (OGS), which traces its origins to the Mineral Resources Department of the imperial institute, set up in 1894. There was a great expansion in overseas activity from this period onward, focused on large-scale regional mapping and mineral assessment projects across Central and South America, Africa, Asia and the Pacific. A number of new disciplines and ventures were added to the organisation's remit (some inherited from OGS), including photogeology, seismology, geomagnetism, engineering geology, regional geochemistry, marine geology (initially hydrocarbon-based), and geothermal assessment.

With the advent of digital technology the drive from traditional pen and ink survey methods to the production of digital maps and mapping began in the 1980s. In 1997 this culminated in the unification and standardisation of digital mapping methodologies and data structures and the release of the first digital geology map of the UK in 1997. Full scale end-to-end digital systems were not implemented until late 2000s and today high-resolution satellite technologies with mm-scale precision, 3D modelling and virtual fly-around generate large volumes of data that have allowed national surveys to cooperate on global data integration. While the present BGS mission still preserves elements of the original remit providing impartial and independent geoscience advice and data for the UK it also leads on thematic programmes that address the major global challenges of decarbonisation, environmental change and hazard and risk.

History of the Geological Survey of Israel

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The Geological Survey of Israel (GSI) is a research institute entrusted with the study of the natural resources and natural infrastructure of Israel. It serves as a center of applied scientific knowledge focused on national needs in earth sciences. The institute maintains a close network of professional ties and cooperates with other government research institutions, industrial companies and universities in Israel and abroad. The GSI activity is carried out as part of thematic, short-term and long-term projects, in accordance with an annually updated work plan, in response to the changing state and public needs. The GSI is mostly funded by the government, but research is also supported by competitive grants from local and international science funding organizations. Other sources of support come from agreements between Israel and other governments and from national projects, which in recent years included national preparedness for earthquakes and monitoring and studying the consequences ensuing from the Dead Sea level drop. In 2020, the core of the survey's staff are 43 scientists with PhD degrees in geology and natural sciences, 50 auxiliary and administrative staff members and 25 graduate students for high degrees. The GSI provides expert services and independent advice to the public in all spheres of geoscience, industry and universities in Israel and abroad. Based on its scientific achievements, the GSI is presently a well-recognized research institute in Earth Sciences.

From stones to maps since 1746: The French geological survey and its forerunners

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BRGM – *Bureau de Recherches Géologiques et Minières* is the French geological survey since 1959. BRGM is the France's leading public institution for Earth Science applications for the management of surface and sub-surface resources and risks. Today, it draws on its historical geological expertise to address the 21st century challenges (developing the circular economy, land and mineral use, traceability, groundwater resources, reclaiming industrial wasteland, and management of natural risks). BRGM recently celebrated its 60th anniversary while it results from the merger of different geological and mining services of mainland and former colonies, and from the forerunners' work in the field of mineral resources and geological mapping of French territories. All starts in 1746: J.-E. Guettard published the first outline of a mineralogical map of the Paris-London basin and its mineral resources. This pioneering work was followed by memoirs dealing with the Paris basin and accompanied by sketches of geological maps published by G. Cuvier and A. Brongniart (1811), and by J.-B. d'Omalius d'Halloy (1816). In 1822, the first modern geological map of France is published by J.-B. d'Omalius d'Halloy, followed in 1841 by a geological map of France at 1:500,000 scale, drawn up by A. Dufrénoy and L. Élie de Beaumont. Concomitantly in 1835, V. Legrand promoted a national plan for geological mapping of departements started in the 1820s. In 1867, 62 sheets at 1:80,000-scale were exposed at the Universal Exhibition in Paris and paved the way to the establishment, in 1868 by Napoléon III of the Geological mapping service.

However, this institution is only in charge of the geological mapping and is not a geological survey in the sense of other industrialised countries during 19th century. Indeed, mineral exploration and other domains related to economic development are performed by Mining administration even if skills are missing for accurately addressing economic and society challenges. Changes are undertaken to reinforce the Geological map service by attaching the Underground topographies service in 1877, by entrusting the water supply from 1900 and by surveying geological academic drillings from 1918. Nevertheless, there is still not an identified geological survey and issues remain as the conservation and public dissemination of geological data. During the 1930s, E. Friedel and P. Pruvost advocated to the authorities in the creation of an institution, which can conserve geological data. In 1941, the *Bureau de Recherches Géologiques et Géophysiques* (BRGG) is created and then replaced by the *Bureau de Recherches Géologiques, Géophysiques et Minières* (BRGGM) in 1943 for the mainland. Following the example of the *Bureau Minier du Maroc* in Morocco founded in 1928, three mining offices are created in 1948 and 1949: the *Bureau Minier de la France d'Outre-Mer* (BUMIFOM) covering West Africa, Equatorial Africa, Madagascar, and New Caledonia; the *Bureau de Recherches Minières d'Algérie* (BRMA) in Algeria, and the *Bureau Minier Guyanais* (BMG) in French Guyana. In parallel to the mining offices, Directorates of Mines and Geology carry out the geological mapping and general surveys of French territories in Africa and in Indochina.

In 1959, the international context led to the creation of BRGM by merger of BRGGM, BUMIFOM, BRMA and BMG. The 1960s encompassed the final absorption of the activity and staff of the Geological mapping service of French Guyana and of mainland, the Directorates of Mines and Geology in Africa.

INGEMMET: 168 years of mining and metallurgical geological history and research in Peru

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The historical evolution of the *Instituto Geológico Minero y Metalúrgico* (INGEMMET) is presented from the republican public institutionalization records that were based on the research product of scientific exploration by Renaissance cosmographers and the studies of natural resources by European mining entities, despite the independence wars. In part of that stage, although they generated a delay in mining activity, they were a very important economic factor for its recovery, which allowed the organization of institutions in order to manage such precious resources.

In this context, in 1821 under the regulations of Don José de San Martín, the General Directorate of Mining, Agriculture, Public Instruction and Museum was created, where the young Peruvian scientist Mariano Eduardo de Rivero y Ustáriz (1798–1857) stands out, who was also appointed in 1825 as general director of Mining. Because of his qualities, he was also charged with founding and promoting a School of Mines in Lima and working on the planning and creation of the country's first National Museum of Natural History, Antiquities and History.

As a result, the history of INGEMMET begins in 1852, when the *Comisión Central de Ingenieros Civiles* (CCIC) is created, which undergoes a reorganization in 1857 and the Cuerpo de Ingenieros y Arquitectos del Estado is created in order to study the national territory and also to know its mineral wealth and form geological and mineralogical collections. In this context, the contributions of foreign scientists such as Antonio Raimondi arise, who in almost twenty years of travel (1851–1869) left a very important documentary legacy in his work *Peru: travel itineraries*, as well as the contribution of William Gabb and Gustav Steinmann, with his work *Geology of Peru*, who synthesizes the Paleontology, Stratigraphy and Tectonics of Peru.

In 1896, the *Ministerio de Fomento* was created. It comprised the *Sección de Minas y Yacimientos* as one of its main dependencies, by establishing the registration of mining properties. Then, in 1902, the creation of the *Cuerpo de Ingenieros de Minas* (CIM) was decreed with its director José Balta Paz, whose regulations established a Directive Office for the analysis and classifications of minerals, rocks and fossils, which the commissions gathered on their travels. Likewise, it is assigned a special library and map library, a Petrography, Photography, Topography and a Drawing office and museums of Mineralogy, Geology and Paleontology.

During that time, mining activities were promoted and the *Instituto Geológico del Perú* (IGP) was founded in 1944 as a national geological institution, managed by Jorge Broggi. In 1950, the *Cuerpo de Ingenieros de Minas* and the *Instituto Geológico del Perú*, which preserve their respective autonomies, were reintegrated under the name of the *Instituto Nacional de Investigación y Fomento Minero* (INIFM). This new institute created a Division of Geological Studies and a Division of Geological Maps: the first, in charge of scientific-technical geological studies and the prospecting of mineral deposits, and the second with its own tasks of lifting the National Geological Chart.

Against this background, during the government of President Manuel Prado, the Comisión Carta Geológica Nacional (CCGN) was created in 1960 and systematic geological mapping work of the national territory began at scale 1:100,000. In 1966, the *Servicio de Geología y Minería* (SGM) was created through the merger of the two institutions aforementioned. After being constituted, the field work is accentuated and, therefore, the information towards the elaboration of *the First Geological Map of Peru* at 1:1 000,000 scale. In 1973 the *Instituto Científico y Tecnológico Minero* (INCITEMI) was created, whose functions were to promote, coordinate, guide and carry out research and scientific and technological work applied to the activities of the mining industry. On the *Servicio de Geología y Minería* side, changes occurred and in 1975 it was renamed the *Instituto de Geología y Minería* (INGEOMIN).

In 1979, INCITEMI and INGEOMIN merged under the name of the *Instituto Geológico Minero y Metalúrgico* (INGEMMET) having as its main function, the geological cartography of Peru and applied geology research, in their Regional Geology, Mineral and Energy Resources and Environmental Geology and Geological Hazard with extensive scientific technical support in the direction of Laboratories. In 2007, INGEMMET merged with the *Instituto Nacional de Concesiones Mineras y Catastro* (INACC), and assumed a new role of conducting the Ordinary Mining Procedure commensurate with the General Mining Law.

From gentleman to professional geologist: Henry de la Beche and the origins of the British Geological Survey

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The geological interest of Henry Thomas De la Beche (1796–1855) emerged within a gentlemen society of the early nineteenth century. Born into a wealthy family whose Jamaican sugar plantation supported their lifestyle, De la Beche examined landscapes through his travels, translated geological papers for his colleagues, and became Fellow of both the Geological Society of London and the Royal Society. With increasing abolitionist activity (and eventually Britain's 1833 Slavery Abolition Act), De la Beche found himself, while mapping in Devonshire, without a regular income source. In 1832, he opportunistically proposed to the Board of Ordnance that he be *paid* to finish his mapping, geologically coloring eight sheets of *The Ordnance Map of England*. He asserted that these maps would be valuable for exploration of natural resources and public works, and he astutely provided a cost analysis. The proposal was accepted contingent upon De la Beche using an approved color index and publishing supporting materials (*e.g.*, color index, cross sections) at his own cost. Upon finishing the project in 1835, De la Beche next proposed to extend geological mapping to other parts of the country. His colleagues, primarily Charles Lyell, William Buckland, and Adam Sedgwick, supported the proposal by extolling De la Beche's skills and the economic advantages of geological maps. Thus, De la Beche emerged victorious as the first director of the new Ordnance Geological Survey, the first British professional, non-academic geologist.

De la Beche's persistence through challenges and his discernment of governmental politics helped him expand the survey from a sole director. By documenting his methods and detailing them in instructions to his survey directors, De la Beche ensured consistency within superior maps so "the public may obtain those results which it has a right to expect from this branch of public service." His methods were exported into other surveys and influenced other countries. De la Beche also emerged as an advocate for the people and was instrumental in the establishment of the Museum of Economic Geology, the School of Mines, and the Mining Records Office. The survey's oversight and structure changed throughout the next century and a half, eventually becoming the British Geological Survey in 1984.

De la Beche's leadership, insight, and political knowhow greatly influenced the character and trajectory of Britain's geological survey. If not for his disposition and life circumstances, the origin and course of the survey would likely have had a different outcome altogether. However, modern reexamination of racism has resulted in more subdued recognition of De la Beche as a geological role model. Although he empathized with enslaved peoples, he failed to advocate toward emancipation; he wished "their condition to be gradually bettered, and not suddenly". In 2020, Imperial College Union's departmental society for geology announced it would change its name from the De la Beche Society. And De la Beche is no longer – literally or figuratively– on a pedestal at the British Geological Survey. The Keyworth theatre removed his name and his bust is not prominently displayed. Regardless, the British Geological Survey's founding director, with detailed observational and mapping skills, political savvy, and foresight toward expansion, established the firm base upon which the institute was built.

Resurrecting extinct worlds: Sense, art and image in nineteenth-century palaeontological reconstructions

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While he assigned the goal of the resurrection of lost worlds to the science he created, Georges Cuvier claimed that the palaeontologist has an almost magical power to resurrect extinct species from the past; to reconstruct an entire animal from just one of its claws or teeth.

But to adhere to this myth, is to forget that reconstructing extinct worlds is in no way an immediate operation. Beyond simplistic or rhetorical claims, it is necessary to reflect on the modalities and difficulties of this singular scientific operation, specific to palaeontological activity.

Understanding this operation requires questioning the palaeontologist's particular perception of fossil remains, the slow, patient work of proof in disciplines that have only a few clues-bones, stones, traces, fragments of DNA – to reconstruct the immensity of the prehistoric past.

Moreover, as I will argue, these procedures are not established once and for all: for more than two centuries successive reconstructions of extinct animals reflect deep controversies on the coherence of the living organism, on the articulation of morphology and evolution, on how to constitute phylogenies, and on how it is possible to represent extinct worlds. Innumerable reconstructions by illustrators, painters, or novelists, bear witness to the fact that fiction occupies a large part of palaeontological representations, both in the past and present.

To support this argument, I will draw examples from nineteenth-century reconstructions of dinosaurs, mammoths and humans.

Union at the Hammer's End. A history of the European integration of geological surveys (1991–2005)

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EuroGeoSurveys (EGS) is an umbrella organisation bringing together geological survey organisations of European Union member states. It represents the interests of the latter in EU forums, also providing expertise and support to European policies. EGS finds its roots in a small group of geological service directors who met informally once a year since 1971: The Western European Geological Surveys (WEGS). It began as a "pipe-smoking club" which did not aim at representation or professionalization and had no formal links with the European institutions for at least 20 years. My contribution will seek to explain why and how, in the first half of the 1990s, the WEGS underwent an institutional evolution to eventually become EGS. This "passage to Europe" of geological surveys gradually took shape between 1991 and 2005. In 1991, WEGS agreed on a common action programme (Lumsden, 1992). A year later, WEGS was expanded to include directors of the former Eastern Bloc countries, taking the name of The Forum of European Geological Surveys (FOREGS). The years 1993 and 1994 saw a group of directors of geological surveys of the member states of the European Community work on the creation of a representative office to the European institutions. EGS was founded in 1994 and set up a General Secretariat in Brussels in 1996. After cohabiting for a decade FOREGS is finally merged into EGS in 2005. Through a historical and sociological study, this contribution attempts to understand how this European deployment came about and can be explained.

At the beginning of the 1990s, WEGS saw the arrival of a new generation of geological survey directors. Most of them had to defend the institution in the face of national budget cuts. Many of these directors intended to modernise their respective geological survey, learned to communicate their interests to governments and to look for new funding opportunities. WEGS directors are also inspired by "geological internationalism", which is understood when considering geology itself, as well as by their membership in international learned societies. Borders thus have no more significance in geological work than in the political division of the European continent. These predispositions are revealed in the context of the 1990s, marked by the fall of the Berlin Wall and by the development of European research policy. Some of the directors of the WEGS, later FOREGS, saw the European construction of funding opportunities for research and political recognition, at a time when these two resources are cruelly lacking in national policies. It is within this framework that EGS was born, designed to be a vehicle for representing geological surveys in European institutions. The integration of EGS into European development led to greater autonomy from the geological surveys' directors in comparison to the WEGS-era. The EGS secretariat became the main communications channel with the European institutions, developing expertise on the understanding of European mechanisms, as well as a unique ability to translate geology into an 'Euro-compatible' language. Moreover, the arrival of new countries in the EU and therefore in the EGS, as well as the shift from unanimity to majority voting internally, upset the balance of governance that had prevailed. The absorption of FOREGS by EGS in 2005 reflects the completion of the institutionalization and a professionalization in relations between European geological surveys themselves and the EU.

Geological pedagogical collections – a little-known document in the archives of Julius Verreaux (1807–1873) in the collections of the manuscripts of the Main Library of the National Museum of Natural History (MNHN) in Paris

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Established in 1803, the „Maison Verreaux" was the largest 19th century natural specimen trade company. This Parisian department store played a particularly important role in the development of natural sciences during what historians call „the golden age of natural collections". MNHN maintains the archives of Jules Verreaux. Especially interesting, from a pedagogy of natural science point of view, are the documents concerning the preparation and sale of natural science collections as teaching aids for schools, and the advertisements promoting them are very good material for the analysis of the pedagogical role of natural science collections.
The reform of the French schooling system (27 February 1869) has made the teaching of natural sciences a particularly important role. By reforming of secondary education, a natural specimen market had developed in France. While previously such items were purchased by museums and universities, during the reign of Napoleon III, secondary schools also became buyers. The authors analyzed documents from the Verreaux Archives advertising pedagogical geological collections. A typical collection intended for gymnasiums was presented, pedagogical geological collection, as well as the cost of its purchase, and especially pedagogical geological collections. The role of Jakub Malinowski (1808–1897), educator, writer, participant in the November Uprising, and the author of the idea of establishing mineralogical shops in schools, was also mentioned.

Transatlantic transfer of paleozoic stratigraphic knowledge by G.W. Featherstonhaugh, "The First U.S. Government Geologist"

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Born in London in 1780, George William Featherstonhaugh (aka 'Featherston'), emigrated to the United States in 1806. There he met and married Sarah (or 'Sally') Duane, the daughter of a former mayor of New York City, with landholdings near Schenectady, New York. By exchanging some of her property with a neighbor, the newlyweds acquired a sizable tract of land near Troy, New York, which they named Featherston Park. There they built a house, raised a family and engaged in 'scientific farming' for about 20 years. In the late 1820s Featherston became interested in the potential of railroads, and in 1826 he secured a charter for the first railroad in New York. The Featherstonhaughs then traveled to Britain for two years to visit his family and so that he could investigate railroad technology. During their stay, Featherston developed a keen interest in geology, joined the Geological Society of London, and made the acquaintance of many of the leading British geologists including William Smith, William Buckland, Roderick Murchison, Richard Owen and Adam Sedgwick. Shortly after their return to New York in 1828, Featherston suffered grievous losses; Sally died and a year later the family house burned to the ground. The despair surrounding these events caused Featherston to move to Philadelphia where he established the short-lived *Monthly Journal of Geology and Natural Science* in 1831, and contributed to the founding of the Geological Society of Pennsylvania. Upon the demise of the journal, Featherston sought a new occupation and after extensive lobbying of Congress, and President Jackson and his Cabinet, he became "The First United States Geologist" on 28 June 1834, a post he held from 1834 to 1837. During his tenure he made three campaigns as far west as Arkansas, Missouri, Wisconsin and Minnesota (1834, 1835 and 1837), which resulted in two official reports to Congress. His reports were among the earliest accounts of the geology of regions he had visited and they contained the most up-to-date stratigraphic terminology then available, including early recognition of the Cambrian and Silurian Systems. His efforts informed interested readers, both at home and abroad, about the geology of large parts of the United States, including mineral prospects in Illinois, Missouri and Wisconsin. His contributions to the development of geology in the U.S. resulted, in part, from knowledge he obtained by networking with geologists in Britain.

Geological Survey of Canada: Origins and early history

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The Geological Survey of Canada (GSC) was established in 1842 when Canada was a British colony less than one-tenth its current area. Its creation was the culmination of more than a decade of advocacy by civil society. The colonial economy was based on agriculture and timber: mining was insignificant. Early geological work conducted by British military personnel, largely in their spare time, had raised awareness of mineral potential. In 1824, J.J. Bigsby, the earliest of these, observed that only government could afford geological work on the scale required to unlock the potential. Civil organizations promoted public awareness of geology and a sustained lobbying effort by the Natural History Society of Montreal ultimately resulted in the legislature voting funds for a geological survey in September 1841. The Governor-General died barely a week later, placing a plan to contract the work to two American academics in limbo for three months. In the meantime, expatriate Canadian William Logan, who had developed his geological skills in the Welsh coal fields, was visiting Canada while the survey question was before government and decided to apply for the job. His candidacy attracted wide support in Canada and England, and he was appointed Provincial Geologist in April 1842. Some thought the task would be completed in two years, but Logan knew better and skilfully navigated the political waters to sustain the effort. The GSC mandate, as Logan defined it, was to ascertain the mineral resources of Canada, and the approach he articulated is still relevant today. Asked by legislators whether the primary goal was scientific or economic, Logan suggested this was a false dichotomy saying, "economics lead to science and science to economics". Defining the country's geological framework was the essential role. This would indicate areas of greater or lesser resource potential, thereby facilitating discovery by private enterprise. To this end, GSC findings have from the outset been made freely available as a public good. Displays at the great expositions in London in 1851 and Paris in 1855, intended to attract investment, earned international acclaim for both Canada and its Provincial Geologist. The GSC was mandated in 1856 to establish a public Geological Museum, which evolved to include other branches of natural history and anthropology and was ultimately spun-off in 1927 as the National Museum of Canada. Publication of the massive volume on the *Geology of Canada* in 1863, along with a portfolio of maps appearing over the subsequent six years, was Logan's crowning achievement. His *Geological Map of Canada* depicted not only Canada as then constituted but also neighbouring British colonies and the northern United States. It was important scientifically to illustrate correlation across political boundaries, but also anticipated the expansion of Canada through confederation with Nova Scotia, New Brunswick, and Prince Edward Island in 1867. Logan retired in 1869, having completed the commission he undertook in 1842. However, the organization he created was about to see its mandate expand to embrace half of North America.

Living/inanimate – the collections of shells, corals, and fossils of the Russian Kunstkamera's Mineral Cabinet

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Kunstkamera is the oldest Russian's museum. Its history begun in 1714 and the mineral cabinet was at its base. History of science pays great attention to paradigm shifts, and how a universal science had become divided into two independent sciences.

Paradigm shifts are incredibly interesting, for example, the reinterpretation of the classification status of such biological objects as shells, corals, and fossils (to clear up whether or not they are alive). From the early 17th to the 19th century, these objects were attributed to minerals, ergo attributed to the natural products of geological processes. The main aim of the report is to show how scientific research allowed the scientists to attribute these objects as biocosal substances (the result of the joint activities of living organisms and geological processes). The author presents the results of an analysis of the archival materials from the Russian National Library and the Saint-Petersburg Branch of the Archive of the Academy of Sciences.

The mineral cabinet in Kunstkamera was opened in 1716 and its collection included a lot of fossils, shells, and corals. The idea that fossils, shells, and corals weren't just inorganic minerals arose as early as the 17th century, but the scientists of the Russian Academy of Sciences raised this issue only at the beginning of the 19th century, when the Director of the Academy of Sciences (before 1832, Kunstkamera was the only Russian museum and was under the Academy's jurisdiction) decided to allocate the fossils, shells, and corals to a specific part of a single mineralogical collection. Only in 1832, the principle of the formation and composition of the collection had been revised and the collection of shells and corals were transferred to the Zoological museum. In 1912 the fossil collection was transferred to the newly formed Paleontological museum, based on the Mineral museum of the Peter the Great of the Academy of Sciences in Saint-Petersburg.

In this context, there were three historical stage in the presentation options the collection of the fossils, shells, and corals (depending whether they were classified as living or inanimate): 1. Objects were included in the mineral collection; 2. Objects were included in the mineral collection, but as an independent part; 3. Objects were displayed as independent collections in the museum. This research paper describes an exceedingly small part of the global process of the development of a science: from a simple question, if an object is living or inanimate, to the global understanding the complex structures of the Earth's biosphere

The science, the society, the savants, and the scientist: Nérée Boubée at the *Société Géologique de France* (1830–1860)

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The relevance of the *Société Géologique de France* (SGF) in the geoscientific scene is undoubtedly recognized. The SGF was founded on March 17, 1830, in a meeting that counted about 40 persons "interested in geology". The minutes of the SGF meetings were regularly published in the *Bulletin*. They show that the subjects presented and discussed covered a wide range of topics, involving the *savants*, powerful scientists and engineers, experts, and amateurs. The present paper aims to portray some aspects of the SGF ordinary functioning as seen through the eyes and experience of a first-time member during the years he was active in the society's life – approximately from 1830 to 1860. The constant and intense participation of Nérée Boubée (1806–1862) reveals a lot about both the SGF and himself. We will follow in his footsteps, occasionally counterbalancing the printed polite and detailed minutes of the regular meetings issued in the SGF's *Bulletin* with the news Boubée published in his journal *L'Écho du Monde Savant*. Although he did not integrate the élite of French science and should be placed in the second row of active nineteenth century naturalists, we believe that Boubée's actions and accounts are worth considering, because a history of science limited to the study of the big names would only be an artificial and partial narrative. Our basic assumption is that the SGF, as any other (geo)scientific society, was an "arena of geological debate in the early Nineteenth century", in the definition of Martin Rudwick. The value of learned societies has long been acknowledged in the historiography of sciences. Through these institutions it was easier for scientists (*lato sensu*) to group together in an organized manner, and publicly profess the weight of their work. Learned societies were quite relevant in promoting the internationalization of science, whether it was via the election of foreign members, an exchange of publications, or by organizing joint meetings. All these aspects were strongly present within the actions of the SGF, and Nérée Boubée did get involved with them. Besides his involvement in the first moments of the *Société Géologique de France*, Boubée belonged to several scientific associations. He presented himself as "Professeur de Géologie à Paris," working as an independent teacher. Boubée was also a "merchant of fossils and natural specimens". During his participation in the SGF, Boubée spoke from two viewpoints: that of a teacher concerned with geological education for laypeople, that he called "popular education"; and that of an expert in the Parisian and the Midi regions, particularly the Pyrenees.

The evolution of The Nigerian Geological Survey Agency (NGSA)

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The beginning of official Geological Surveys in Nigeria dates back to 1903 and 1904, when the Mineral Surveys of Southern and Northern Protectorates were inaugurated. Their primary function then was to carry out reconnaissance surveys of the mineral resources of the two protectorates under the supervision of the Director of Imperial Institute, Professor W.R. Dunstan. Over the years, the Mineral Surveys metamorphosed into a single autonomous body, which in 1919 became the Geological Survey of Nigeria, as a result of the merger of the two Mineral Surveys. It was headed by John D. Falconer between the years of 1919–1927, and continued to function until 1971, when the first indigenous director, Director C.N. Okezie was appointed.

The Nigerian Geological Survey Agency (NGSA), a parastatal agency under the Ministry of Mines and Steel Development, was established by an Act of the National Assembly via a bill of May 2006 on the recommendations of Solid Minerals Policy (1998). The establishment of NGSA as an extra-ministerial agency was carried out to grant autonomy to the Agency in line with best international practices. Its role is to provide geoscientific data for the benefit of the country.

Since its establishment, the NGSA has had three Director Generals. The first was Professor Siyan Malomo (2003–2013), followed by Mr. Alex Nwegbu (2013–2018) and the current Director-General is Dr. Abdulrazaq Garba (from 2019). Over the years, the Nigerian Geological Survey Agency has stepped-up its geological mapping, geotechnical investigations, exploration and mineral assessment in Greenfield and Brownfield settings, using a unified sampling and data capturing system. This has generated integrated geosciences data in geologic map productions, foundations and engineering, metallic and industrial minerals assessment. Integrated geoscientific data has led to the production of digital geologic and mineral maps for every part of the country. Geological and geochemical maps covering a predominant part of the country in the 1:100,00 scale and accompanying bulletins have also been made.

The NGSA has published several scientific reports on geohazard monitoring and marine geosciences in some parts of the country. NGSA's improved quality and accessible geoscientific data has provided support for the start-up of a number of emerging mining companies in Nigeria. The benefits of such start-ups to the nation's economy include foreign exchange, employment generation, poverty reduction, wealth creation, infrastructural development and an increase in the availability of raw materials for local industries.

The most important recent achievement of the NGSA is its role in the ongoing National Integrated Mineral Exploration Project (NIMEP), the first of its kind in the country. The project seeks to prospect for metals, lead-zinc, silver, copper, and barite and iron ore in Nigeria. It is aimed at improving the attractiveness and competitiveness for investment in the Nigerian mining sector. Another key achievement is the geochronological studies of local rocks and minerals. The purpose of the study is to generate holistic information about the ages of the Nigerian rocks and mineral for a better understanding of their relationships and also to produce Geochronological Maps.

The NGSA has so far published over 55 bulletins, 28 occasional papers and several geochemical, geological, geotechnical, geophysical, hydrogeological maps on different scales.

The life and geological achievements of professor Józef Zwierzycki in Indonesia and Poland, 1914–1961

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Józef Zwierzycki was born in 1888 in Krobia, a small town in Wielkopolska, which was under Prussian domination. From 1909 until 1914, he studied mining engineering at the Mining Academy, and geology with palaeontology at the Friedrich Wilhem University, both located in Berlin. He graduated and obtained a doctorate degree in geology, with a thesis on cephalopods from the Tendaguru Expedition to Tanganyika (East Africa).
He left Europe on the eve of the World War I, beginning his 24-year professional geological career as a "Government geologist"in the service of the *Dienst van het Mijnwezen* (Bureau of Mines/ Geological Survey) of the Dutch East Indies (now Indonesia).
Zwierzycki is known mainly for his significant contributions to the geological mapping of large, poorly known areas of Indonesia, mainly in Sumatra and in northern New Guinea. He is also the author of 6 regional geological compilation map sheets of still used today in Indonesia. He published 44 papers and reports on a broad range of other geological topics including tectonics, stratigraphy, volcanism, mineral deposits (e.g. gold-silver in Sumatra), petroleum geology (*e.g.*, oil and gas fields of Sumatra, Java and oil prospects in northern Dutch New Guinea), paleontology (*e.g.*, Pleistocene mammals, reptiles and hominids of Java) and archeology (*e.g.*, stone tools in caves of Sumatra). In 1927 he was promoted to the position as Head of the Sumatra Geological Mapping project and later to Head of the Java Mapping Project. In 1935 Zwierzycki became a Director of the entire Dutch Geological Survey in the Dutch East Indies. In March 1938 he reached retirement at the age of 50, returning with his family to Poland. In Warsaw Józef Zwierzycki had been offered the position as Head Director of the Petroleum and Salt Division of the Polish Geological Institute. After the outbreak of World War II, he became the Director of the Institute, responsible for securing its property, archives and collections. In 1941 Józef Zwierzycki was arrested and sent to Auschwitz. One year later he was released and transported to Berlin, where, as a prisoner, he worked to satisfy German geological demands. In the summer of 1944, while being escorted by the Germans to the Carpathians, he boldly escaped and hid in Kraków. With a help from his brother-in-law, Kazimierz Maślankiewicz, he was fortunate to hold out in a hiding place until the liberation of Kraków from German occupation.
In May 1945, Józef Zwierzycki came to Wrocław (formerly Breslau) with a group of professors, mainly of Lvov University and Polytechnics to organize higher education in the region. They secured the remnants of buildings and high school scientific collections , left by the Germans. In the same year, he obtained a "habilitation" degree and in 1948 received the title of "ordinary professor". Józef Zwierzycki was an outstanding academic teacher with very wide geological knowledge and enormous professional experience, so he gave lectures on several subjects.
The research interests of Professor Zwierzycki were, at that time, mainly focused on mineral deposits in SW Poland. He prepared a scientific base for prospection of copper deposits, and is considered to be one of the people responsible for discovering these deposits in Lower Silesia. He also published some important papers on volcanoes of Malay Archipelago, tin deposits, and paleontological sites with hominid remains based on geological data from Indonesia. Józef Zwierzycki died in 1961 at the age of 73. In 1966, he was honored with the „1st group prize in geology, mining and power engineering" for his contribution to the discovery of the cooper deposits in Lower Silesia.

Two centuries of Eduard Eichwald's idea of the evolution of life

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Carol Eduard von Eichwald earned his international scientific fame in geology and paleontology for his discoveries of Jurassic system deposits and his early pre-evolutionist investigations of the chronology of organic life. He organized the first Vilnius University natural sciences expedition around Lithuania, Volhynia and Podolia, and discovered deposits of the Jurassic system at Papilė, a town near the Venta River in Lithuania. The results of the expedition were published in 1830. Eichwald's idea of evolutionism was clearly presented in the so-called "Eichwald's tree of life" (1829).
Carol Eduard von Eichwald (1795–1876) was born in Mitau (now Jelgava, Latvia) into a noble family. After graduating from Mitau gymnasium, he studied medicine in Berlin and natural history in Paris, and then toured Europe making the acquaintance of leading naturalists. Eichwald earned his doctorate philosophy at the Vilnius University in 1819, with a dissertation on a sea-dwelling fish – *Selachis Aristotelis*. In order to teach at Dorpat (Tartu) University, he had to get his habilitation. He did so in 1821 by writing a dissertation *De regnis animalis limitubus atque evolutionis grabidus* about the animal kingdom's boundaries and its evolutionary stages. Eichwald first worked as a physician in Aispute (Latvia, 1819–1821); lectured at the University of Dorpat (Tartu, 1821–1823); at the University of Kazan (1823–1829); at Vilnius University and the Vilnius Medical-Surgical Academy (1829–1837); and finally at the St. Petersburg Medical-Surgical Academy (1838–1851). During his stay in Vilnius, he organized expeditions to Lithuania, Belarus, and Ukraine to collect flora, fauna and fossils, and published several indexes of the natural resources of those countries. His most important work is the *Zoologia specialis quam expositus animalibus...* (Vilnius, 1829–1831). There he describes the animal kingdom in an ascending order of complexity, from lowest (Heterozoa) to highest (Mammalia). He represents this biodiversity as a "tree of life", with a human at its top. This figure demonstrated some pre-evolutionary ideas in biology that appeared 30-years prior to Darwin. This paper will present several episodes from the scientific life of Eichwald: as curator of the Museum of Zootomy at the Imperial Vilnius Medical-Surgical Academy and as author of a catalogue of that museum (Vilnius, 1835).

The collections of the Archive of the History of Geology at the University of Vienna. Organizing and digitizing geological heritage

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The collections of the Geological Institute go back to the initiative of the former head of the Geological Institute Alexander Tollmann (1928–2007). He collected documents from the 1970s at the former institute and transferred them into a separate repository during the relocation of the Institute in 1997, to its present location at the Geozentrum in the 19th district of Vienna, Althanstrasse 14. He arranged and labeled a number of documents.

Many Institute documents were collected and preserved in various files during A. Tollmann's management period, also including his personal records. Thus, there are documents about new acquisitions by the Institute, as well as travel guidebooks. Partial, but also entire legacies of various geoscientists, were collected in colorful boxes.

An interesting part of Eduard Suess's (1831–1914) estate, the first professor of the Geological Institute, contains a lot of handwritten records. A. Tollmann sorted and described a small number and put them into files.

Likewise, part sorted or unsorted estates of well-known geoscientists were obtained, such as Martha Cornelius-Furlani (1886–1974) and her husband Peter Cornelius (1888–1950). An extensive estate by Walter Medwenitsch (1927–1992) was found in colorful boxes in an extremely chaotic state. As a side note: there is a beautiful collection of beer mats and even collectors magazines. This gives an indication of Medwenitsch's preference for beer, as these collections were kept neatly arranged and labeled by the owner.

A geological map of the Eastern Alps painted by Leopold Kober (1883–1970) had been restored. Kober named it *Tektonogramm* and dated 1937.

A large collection of slides with geological content from the estate of A. Tollmann has also been preserved. Similarly, many slides by Walter Medwenitsch exist in a disorderly state. Within the estates of Tollmann and Medwenitsch there are series of photos of geoscientists. These are to be digitized over time.

There is also a numerous collection of hammers, hammers of contemporary and past geologists and mineralogists given to the Geological Archive. This large collection of hammers dating back to the time of Eduard Suess has already been restored.

A collection of about 3,000 pieces of black and white glass photo plates, in excellent condition, await their time for digitization.

At the request of the current head of the institute, Bernhard Grasemann, the author took up the task of organizing, systematizing, digitizing and provided access to this extensive collection, kept in "modern" archive boxes, to interested audiences, professors and students alike.

Fig. 1. 33 boxes on the History of the Geological Institute at the Archive of the History of Geology, University of Vienna

Fig. 2. Part of the Hammer Collection at the Archive of the History of Geology, University of Vienna

Image, artifice and geology: mapping seen and unseen

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Ernst Hamm teaches in the Department of Science and Technology Studies at York University in Toronto. His areas of research include the sciences during the Enlightenment, science and Romanticism, and the history of the geosciences from the seventeenth to the twentieth century. He is co-editor, with Robert Brain, of the Routledge book series, *Science, Technology and Culture, 1700–1945.* He is Past President of the Canadian Society for the History and Philosophy of Science, and he served as President of the History of the Earth Sciences Society.

Maps and mapping have been foundational tools and practices of the geosciences since the eighteenth century, if not earlier, making visible large parts of the subterranean and surface world that are not directly or readily observable. Yet geological maps are vastly more than scaled-down two-dimensional representations of the Earth's crust made with the help of geometry. They require large-scale generalizations and numerous inferences, and are readily understandable thanks to many conventions about map-making and to hard-won consensus about the the structure and composition of the Earth's crust. For decades historians have been uncovering the rich history of maps (*e.g.*, in the multivolume *The History of Cartography*, ed. J.B. Harley and David Woodward, University of Chicago 1987) and the rich visual language of the geosciences (Martin Rudwick, "The Emergence of a Visual Language for Geological Science, 1760–1840", *History of Science* 14 [1976], 149–195), in relation to art, science and the problems of representation. But, there is always something lost in depicting the Earth's crust on paper, in translating fieldwork into a map. Visual language is based on the sense of vision; however fieldwork relies on all five senses. This paper aims to uncover and recover, albeit in a very partial way, the sensory experience of geoscientific fieldwork. Two iconic cases will be considered: Johann Gottlob Lehmann's eighteenth-century profile of the southern Harz Mountains and A.P. Coleman's early twentieth-century map of the Sudbury nickel region in Ontario, Canada. Lehmann's work is often taken to be the first geological profile; Coleman's map is considered one of the greatest feats of geological mapping of its time. Yet these images, for all their importance, leave out the physicality of the fieldwork that made them possible, and in doing so leave out much of the sensory experience that both Lehmann and Coleman, and many others, considered essential to geoscience.

"Special Commission" Meteorites: Fireballs and short-term sensations

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In the 19th century, the meteorite collection at the Natural History Museum in Vienna was considered one of the best and unique collections in the world. Continuous inventories were compiled about acquisitions on a global level, with some of them providing the names of the donors. However, what the inventories did not mention was the role of their circulation prior to the acquisition, the path of the materials as well as their stopovers. All of this changed their meaning, and this is what this paper will focus on. Unlike natural specimens, meteorites were documented according to the location of their initial appearance, one might say: the "scene" of the incident itself. Eyewitness interviews evoked and created object knowledge that was conveyed via "go-betweens" – sometimes far away in India or Africa. Subsequently, the finds transformed from incidents to changeable scientific objects through chemical analyses and depending on different epistemic approaches of many persons and different representations involved.

In 1751, a spectacular meteorite impact in Croatia created a sensation and criminological documentary interest among the authorities of the country. The object itself was immediately transported to Vienna and, next to insignia and memorabilia, incorporated into the Imperial treasure chamber. Apart from the explanation that the fireballs had just fallen from the sky, the view emerged that meteorites were extra-terrestrial in origin. Incorporated into the natural history collection, the documents, together with drawings, as well as the object were attributed a scientific meaning, and this triggered controversy. The object was given a new status, gaining relevance as evidence of a unique historical event. When, almost a hundred years later, meteorite research reached its peak, these documents and images were re-examined from a philological and natural science perspective; the "case" was re-opened and the object transformed and integrated into a new context.

How to become a professional earth scientist. Late 19th and early 20th century careers in the Habsburg Empire

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Careers in Earth sciences are not only made in the field, the survey, or the library, but also on a public stage among peers. Charismatic self-presentation is an equally important scientific practice as presenting data, as scientists must speak from a place of authority to disseminate their findings. Along with their field of study, Habsburg geologists in the late 19th century underwent a process of professionalization and formalization streamlining their careers. The archives of the Austrian Academy of Sciences holds a large number of CVs that newly elected members had to submit. This understudied vault of documents, often in surprising length and detail, reveals a new perspective on working in Earth sciences and their formalization and professionalization in the Habsburg Empire.

Three different life stories, that of Friedrich Becke (1855–1931), Carl Diener (1862–1928), and Bruno Sander (1884–1979), will be analyzed and compared. How did they become interested in Earth sciences, who did they learn from, and how did they pursue their ultimately very successful careers? First, this paper will identify supporting and inhibiting factors regarding social backgrounds, networks, entry points into professional scientific careers and promotions. Additionally, on a discursive level, this paper asks the question on how this information is being presented in the context of life writings. Scientists were themselves curious, critical and opinionated observers of and participants in their respective academic, social and political environments. Thus, autobiographies often presented as bold opinion pieces, social commentary, and strategic maneuvers to impress, justify or inscribe oneself into the history of science as being important and memorable. As it shows, family networks are significantly interwoven with academic ones, socio-political settings mobilize, direct, and restrict scientific interests, while class and gender shape their realities and story arcs. For example, Becke experienced financial hardships in his childhood and lived to purse rather bourgeois goals and dreams. By contrast, Diener was born into wealth; his education was swift and his travels adventurous and plentiful.

Fact and fiction of career strategies, as well as aspects of self-fashioning are all equally considered to assess supporting and inhibiting factors in careers in Earth sciences. Relationships, abilities, and contexts can be evaluated very differently. Likewise, the tone in autobiographical writing can be defensive, demanding, explanatory, or accusatory. Between the lines of subject positions and narrative strategies, new perspectives on knowledge production and circulation open up. As methods and organizational forms of Earth sciences are professionalizing, so are the gateways into the field. This metabiographical, comparative approach highlights the field's diversity while observing unifying tendencies.

Through the history of the Geological Survey of Russia: origin, development, and features

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1. Geological investigations and education (Mining School in Saint-Petersburg, 1773) in Russia have been guided by the Mining Department (founded in 1700).
2. The first maps with geological information were compiled by state and private mining enterprises. They would be considered economic geology maps, using modern terminology.
3. The geological survey in Russia (Geological Committee) was founded a few decades after other similar European institutions for several reasons: an insufficient number of professional geologists, the lack of a prospecting methodology, the overwhelmingly vast territory of the Russian Empire, and bureaucracy.
4. Geological maps were compiled during studies done by members of the Imperial Saint-Petersburg Academy of Sciences (1724), the Moscow Society of Naturalists (1805), and the Imperial Mineralogical Society in Saint-Petersburg (1817). The last-mentioned took responsibility for geological mapping during the "pre-GeolCom" era and had initiated the compilation of the first general geological maps (1824, 1841).
5. Leading Russian geologists (G.P. Helmersen, G.D Romanovsky, V.I .Moeller, V.G. Erofeev, N.P. Barbot de Marni) had been pressing for the geological survey foundation for over 20 years. Their efforts were crowned with a success in 1882. An academic, G.P. Helmersen was appointed the first director of the Geological Committee of Russia (GeolCom).
6. International cooperation in geological mapping under the aegis of the International Geological Congress (from 1878) had much influence in the foundation of the GeolCom. A discussion ensued about the tasks of the new institution, concluding in favor of geological mapping versus prospecting. The first instruction manual for the geological survey was compiled in 1883 (S.N. Nikitin, A.P. Karpinsky).
7. The beginning of the GeolCom was a truly heroic moment in time and history. The first 8 members were able to make significant progress working in such field as geological mapping and prospecting, paleontology, hydrogeology etc.
8. The geological library and the museum a part of the GeolCom from the very beginning. Such publications as the *Bulletin* and *Contributions* are considered a "treasure" on the history of geology in Russia.
9. The GeolCom maintained close cooperation with scientific institutions at home and abroad. Geological investigations under the leadership of the Russian GeolCom (1882–1929) have resulted in significant progress in geological mapping, prospecting, and geosciences development due to the perfect organization and high scientific level at the time.

Getting access. How female geologists in Britain struggled for membership in scientific societies

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In the early 19th century in Britain, geology was a fashionable science and was widely discussed in polite society. Numerous women collected fossils and minerals. Some of them were valuable assistants to renowned pioneers of geology, acting as secretaries, draughtswomen, curators and field geologists. A unique window of opportunity, framed by a unique combination of social status, science politics, general economy and female fashion, allowed these women a certain measure of participation in the new and exciting science. Access to a suitable geological education via public libraries and universities or membership in scientific societies was however largely denied to them.

What did they think about this disadvantage? We will explore their reaction in the face of sexist discrimination, paternalism, closed doors and societal conventions, and will look into their desire for recognition, their frustration of being excluded, their hope for change and their strategies to attain societal transformation. Finally, even the prestigious Geological Society in London had to bow before the major changes in society achieved by suffragettes and ultimately by the Great War.

XVIII century almanacs and their role in dissemination of geological knowledge in Poland

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First remarks on the selected minerals known from the territory of Poland appeared in herbariums published in XVI century (Stefan Falimirz, 1534; Marcin Siennik, 1568; Marcin z Urzędowa, 1595). Information on natural resources could be also found in treatises on Kingdom of Poland and Great Duchy of Lithuania by *e.g.*, Marcin Kromer (1577), Szymon Starowolski (1652), Andreas Cellarius (1659) or Bernard Connor (1698). Between the end of XVI century and the end of XVIII century, several books regarded as milestones in defining beginnings of geology of Poland were published in Latin (Schwenckfeldt, 1600; Helwing, 1717, 1720; Rzączyński, 1721, 1742), in German (Volkmann, 1720; Brückmann, 1727; Schober, 1750; Carosi, 1781–1784; Hacquet, 1790–1796) and in French (Guettard, 1764). *Opisanie Polskich Żelaza Fabryk* by Osiński (1782), *Świat we wszystkich swoich częściach większych y mnieyszych* by Łubieński (1740) and *Nowe Ateny* by Chmielowski (1754) were the only books published in XVIII century in Polish that contained scattered information on geology of Poland. This group of "proto-geological" publications published in the Polish language also include often neglected almanac by Stanisław Duńczewski entitled *Kalendarz Polski i Ruski*. The oldest calendars, or almanacs, were published in Poland towards the end of XV century, first in Latin, and then in Polish. They mostly contained astronomical and practical house-hold information, which gained them great popularity and status of the most sought-after books. In the XVIII century content of almanacs had broadened, it included also information on history and current scientific discoveries – they became popular science books, although they still contained information on astrology, magic and alchemy. Duńczewski's almanac, published in years 1725–1772, was without any doubts the most important and the most widely known almanac of the XVIII century. It contained an appendix entitled *Geografia Polska Y Wielkiego Xięstwa Litewskiego* published over several years in consecutive parts and containing wealth of information on geology of Poland (as it was understood back in XVIII century) such as distribution of various deposits, fossils, mining activities, mineral waters etc. Duńczewski's *Kalendarz Polski i Ruski* became one of the first publications that presented this kind of information in Polish to a relatively wide audience. Its scientific level was relatively high and was on par to the similar publications from abroad. Duńczewski's *Kalendarz Polski i Ruski* fully deserves to be included on the list of publications that defined beginnings of Earth sciences in Poland.

Fig. 1. Illustration and description of "subsurface mineral streams", Duńczewski, 1750, *Kalendarz Polski i Ruski* (public domain, www.polona.pl)

Fig. 2. Description of Wieliczka Salt Mine, Duńczewski, 1750, *Kalendarz Polski i Ruski* (public domain, www.polona.pl)

Georg Andreas Helwing (1666–1748) and his achievements in geology and palaeontology

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Georg Andreas Helwing (1666–1748), nicknamed "Prussian Plinius", spent most of his adult life as a Lutheran pastor in his native town of Węgorzewo (Angerburg), in the Duchy of Prussia. In the period of 1684–1691 Helwing travelled around Europe (Königsberg, Erfurt, Jena, Leipzig) and studied at several universities focusing on theology and botany. He maintained close contact with some of the brightest minds in science in Europe, such as Johann Philipp Breyn and Jacob Theodor Klein from Gdańsk (Danzig), or Johann Jakob Scheuchzer from Zurich. Helwing's contact with Scheuchzer has been analyzed using his letters held in Zentralbibliothek Zürich. The letters document that both scientists remained in touch for several years and that, between others, Helwing helped Scheuchzer with preparation of an index for the second edition of one of the Scheuchzer's most famous book *Herbarium Diluvianum* (1723). During his busy life Helwing published several books and assembled collections of plants, minerals and fossils. Helwing has been widely acknowledged for his work in botany; however his achievements in the fields of geology and paleontology are much less known. Helwing published two books containing illustrations of minerals and fossils from the territory of Poland: *Lithographia Angerburgica* (1717) and *Lithographiae Angerburgicae pars II* (1720). His first book contained the first-ever paleontological illustrations to be published in Poland. It is divided into 7 chapters, with the first two chapters containing general information about Węgorzewo and its surroundings, and about various types of rocks and soils (Terris, "earths"); these are followed by chapters devoted to various "stones" (*Lapidibus*). Helwing's classification of these objects depended on their external character and visual characteristics: he distinguished "Shapeless stones" (*De lapidibus certa figura carentibus*; chapter III), "Translucent stones" (*De lapidibus Diaphanis*; chapter IV) and "Shaped stones" (*De lapidibus certa figura praedatis*; chapter V). Chapter VI is devoted to "Stones representing natural objects" (*De Lapidus res naturales repraesentantibus*) and is further subdivided into 3 parts on the "Plant Kingdom" (*Ex Regno Vegetabili*), "Animal Kingdom" (*Ex Regno Animali*), and "Mineral Kingdom" (*Ex Regno Mineralis*). Part 1 consists of 4 sections: "Petrified fruits and seeds" (*Lapideos fructus & semina exhibit*), "Plants, fungi, leaves, wood and roots" (*Plantas, Fungos, folia, ligna & radices offert*), "Carbonate incrustations" (*Osteocollae generationem examinat*) and finally "Fossil corals" (*Corallia fossilia recenset*). Helwing collected his specimens in the Warmia–Mazury region, usually in close vicinity of Węgorzewo, e.g., in Okartowo (Eckersberg) and in Kal (Kehlen). This region, located above the SW edge of the East European Craton, is covered by mostly flat-lying Phanerozoic sedimentary succession. It is devoid of any large outcrops, and in many instances the collected fossils could have included locally derived Cretaceous or Cenozoic fossils and much older Paleozoic fossils transported from Scandinavia by glaciers. This was, of course, not known to Helwing, but he was aware that objects he had been collecting could be classified as fossil organic remains, as it is clearly stated in the section on fossil corals (Helwing, 1717, pages 47–54). The illustrations in Helwing's book were drawn with high attention to detail and are comparable to illustrations from other much better known contemporary works by Lhuyd (1699), Scheuchzer (1702), Lang (1708) and Mylius (1709) that were all cited by Helwing.

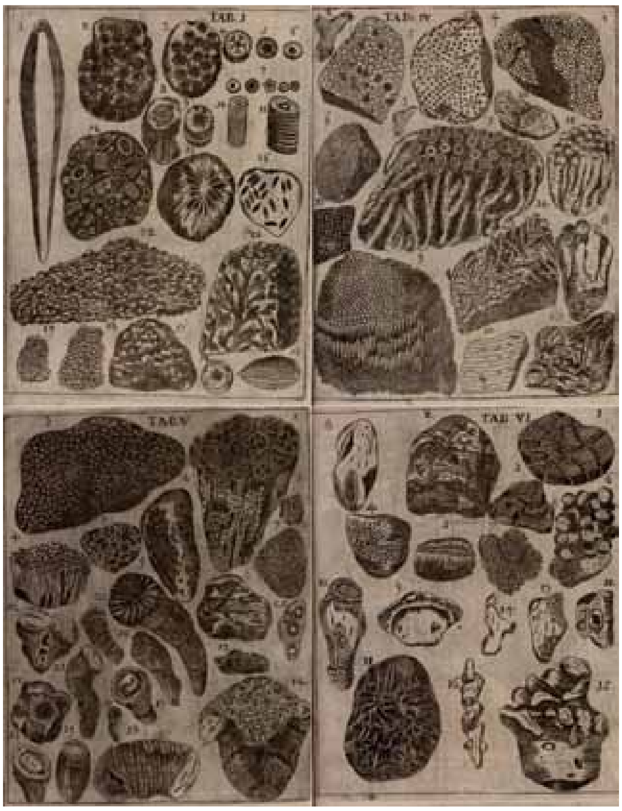

Fig. 1. Selected plates from Helwing's "*Lithographia Angerburgica*" (1717)

Petrographers and mineralogists over the 100-years of history of the Polish Geological Institute

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The Polish Geological Institute (PGI) was created on the 7 May 1919, in Poland – the country rekindled into existence after over 100 years of being partitioned. The organization and the leadership of this institution were given to Józef Morozewicz (1865–1941). He is remembered as one of the most significant Polish petrologists in the country's history. He was the head of the Institute until January of 1937. Among others, he organized the first, in the newly independent Poland, Petrographic and Chemical Department that conducted research in the Volhynian region. The scientific activity of J. Morozewicz was mostly related to magmatic rocks. Papers of J. Morozewicz pointed to his high interest in the experimental petrography (mineral and rock synthesis). He was the world wide pioneer in that problematics. His scientific activities concerned also a discovery of many minerals and rock.

Apart from the total destruction to the nation and the country, the period of the World War II resulted in a complete annihilation of the Institute's equipment. The Institute's activities, however, were quite vivid. Fieldwork and registration work, as well as partial prospecting for deposits continued during the war. These activities were continued after the war, becoming enriched by regional and stratigraphic research. This large group of postwar petrologists and mineralogists remained active for many years.

Dr Irena Kardymowicz (1899–1980) worked for PGI from 1952. She was the head of the Department for Petrography, and concentrated her studies on petrography and petrogenesis of plutonic rocks. As a researcher, she represented classical petrology combined with an excellent ability to apply chemical methods.

From 1957, Professor Tadeusz Wieser (1922–2005) was the head of the Department for Petrography and Geochemistry in the Carpathian Branch of PGI in Cracow. His research expertise concerned the Polish Mountains – the Carpathians, the Sudetes, as well as the Silesian region. Professor Wieser introduced the use of the rinsing method to geological prospecting in Poland.

Dr Henryk Pendias (1921–1994) began his work in 1950 in PGI's Lower Silesian Branch in Wrocław. First, he was the head of the Department for Geochemistry and Petrography and from 1962 the head of the Geochemical Department of Geological Institute in Warsaw. His research was mainly concentrated on the geochemistry and mineralogy of granitoids and volcanic rocks.

A very strong development of mineralogical, petrographic and geochemical studies in the Geological Institute in Warsaw occurred in the 1950's, particularly under the leadership of Professor Antoni Łaszkiewicz (1907–1980) – a crystallographer, mineralogist and petrologist. He began in 1955 as an independent scientific employee at the Geological Institute. In 1956 he reorganized the Department for Petrography and Geochemistry that had existed unchanged for over twenty five years. This department was the starting point in the careers of many future well-known and recognized professors.

Professor Wacław Ryka (1931–1996) began his work in 1956. He was a specialist in the field of petrography of magmatic and metamorphic rocks. From 1981 he was the Director of the Geological Institute.

Professor Anna Langer-Kuźniar (1931–2016) – the specialist in the field of petrography of sedimentary rocks, in particular the petrography of clay minerals, also started her work in 1956. Her area of interest was concerned with methodology, particularly that of X-ray and thermal analyses.

Professor Anna Maliszewska (1937) began her work in 1959. She has been a significant specialist in the entirety of the field of petrology. She dealt with the diagenetic processes in sedimentary rocks. At the Geological Institute she has founded a recognized diagenetic approach and formed a team of specialists – sedimentary rock petrologists.

The birth of the Institute of Geological and Mining Research

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The Institute of Geological and Mining Research (IGMR) of Cameroon was created by decree No. 79/495 on the 4 December 1979, organizing the General Delegation for Scientific Research, which would later, after several changes, become what is now the Ministry of Scientific Research and Innovation. IGMR is under the technical and financial supervision of both the Ministry of Scientific Research and Innovation and the Ministry of Finance. Its mission is to design fundamental research, elaborate and execute research programs in geology, mining, hydrology and energy for sustainable development.

These IGMR mission elements are specified by decree No. 151/CAB/PM, dated the 29 October, 1980, on the creation, organization and location of operational research structures. The designated structures are:

– Center of Geological and Mining Research (CRGM), Garoua: geology;
– Center of Hydrological Research (CRH), Yaounde: water;
– Energy Research Laboratory (LRE), Yaounde: Energy with a section of non-convectional energies and a nuclear technique section;
– Ore Processing Laboratory (LTM), Yaounde: Analyses of rocks and minerals;
– Image Processing Laboratory (LTI), Yaounde: Remote sensing;
– Geophysical and Volcanological Research Unit (ARGV), Ekona/Buea: Geophysics and Volcanology.

The Institute of Geological and Mining Research is working hard to accomplish Cameroon's desire to become an emergent country by the year 2035 by carrying out projects, collaborating with other researchers and countries and last, but not least, by empowering its personnel through extensive training programs.

The Saxon Geological Survey – a mainstay of economic development

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Saxony looks back on an early geological exploration record due to its wealth of deposits and economic development associated with them. Soon the first nationwide mapping of Naumann and Cotta on a scale of 1 : 120,000, carried out between 1835 and 1845, no longer met the requirements. The development of traffic, especially the construction of railroads and railroad routes in the second half of the 19th century required more detailed geological maps. Mining, which was very important in Saxony, also necessitated more precise and accurate geological information.

This was the starting point that led to the foundation of the Saxon Geological Survey in 1872, under the direction of the geology professor Hermann Credner in Leipzig. While a comprehensive geological mapping of the Kingdom of Saxony on a scale of 1 : 25,000 was important, the primary goal was to increase the knowledge of coalfields, to develop overview maps, and to create a rich rock, fossil, and thin section collection.

After only 23 years, the special mapping of 127 map sheets on a 1 : 25,000 scale was completed in 1895, with a nationwide homogeneous map series resulting from the endeavour. At that time, this was a unique achievement that was owed to the economic development of the Kingdom of Saxony and to the importance of geological exploration of the country.

From 1908 to 1932, the focus was on establishing a state groundwater service, the first in Europe. The area of activity was also dominated by extensive soil information, expert reports in traffic, and tunnel construction.

From 1933 to 1990, the focus was on raw materials issues. The striving for self-sufficiency, both in the period of the Third Reich (1933–1945) and the German Democratic Republic (1949–1990), led to intensive work on prospecting for and predicting ore, spar, energy raw materials, and bulk raw materials for the construction industry. This intensive exploration has led to a much higher level of knowledge when compared internationally.

This level of knowledge was clarified and made accessible through new mapping in the years after 1990. The storage of existing drilling information in databases forms a very solid foundation for knowledge of the subsurface in the following years.

Today, the geological service of Saxony is well-positioned to respond to current questions in a qualified manner. 3D models form the basis for the use of geothermal energy, for the search for a radioactive waste repository, or for the construction of new traffic routes. Worth mentioning is the new Dresden–Prague railway line, which runs through an approximately 25 km-long base tunnel, through the eastern Erzgebirge (Ore Mountains). Their work also focuses on the general digital indexing of the uniquely extensive archive inventory.

Saxony is the only German federal state to have a raw material strategy that defines it as a mining state. The aim is to ensure a sustainable economic mining.

Mapping Basutoland: Correspondence between geologists Gordon Murray Stockley and Alexander Logie du Toit (1938–1946)

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Basutoland is a former British Protectorate (now the Kingdom of Lesotho) nestled in the Maluti and Drakensberg mountains, completely surrounded by South Africa. Geological knowledge about Basutoland started with the activities of French missionaries in the 1830s, and continued to accumulate throughout the 19th century. Systematic geological mapping began in 1902–1904 with the work of Ernest Schwarz and Alexander du Toit, who, while working for the Geological Commission of the Cape of Good Hope, extended their mapping activities into southernmost Basutoland. In 1905 Revd. Samuel Dornan from Morija started studying the geology of that region of Basutoland. In the 1930s rumours about the finds of diamonds prompted the British Government to map the country geologically. Gordon Stockley, a geologist experienced in mapping Karoo-age rocks for the Geological Survey of Tanganyika, was seconded to Basutoland in late 1938. Stockley mapped the whole country in 11 months in 1939, and then returned to Tanganyika. His geological map, at a scale of 1 : 380,160 was published in 1946, and the report appeared in 1947. Stockley's work showed that the rocks of Basutoland consist entirely of parts of the Karoo Supergroup (the Ecca, Beaufort, Stormberg and Drakensberg Groups), comprising continental sedimentary rocks overlain by continental flood basalts, intruded by dolerite sills and dykes, and kimberlite pipes. Vertebrate fossils were described by Lieuwe D. Boonstra (Geol. Surv. S. Afr., Pretoria), and plant fossils were described by Wilfred N. Edwards (British Museum, London). At the start of his mapping, Stockley wrote to du Toit asking his advice on various matters related to the geology, geomorphology and palaeontology of Basutoland. Their correspondence lasted until 1946. Stockley's map and report on Basutoland geology laid the foundation for all future exploration, and led to the discovery of several diamondiferous kimberlite pipes in the 1960s, and to the establishment of several diamond mines that contribute significantly to the economy of modern Lesotho.

Talking images and painting words: Crossroads of knowledge and art in visual representations of caves (1750–1850)

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Johannes Mattes is a postdoctoral scholar at the Austrian Academy of Sciences and a lecturer at the Department of History at the University of Vienna. His two recent monographs *Reisen ins Unterirdische* (Böhlau, 2015) and *Wissenskulturen des Subterranen* (Böhlau, 2019) deal with the scientific and cultural history of caves and the underground in general. Mattes's current research examines the history of natural sciences in a cultural context, that of scientific societies and academies, popular science, relationship between politics, research and the public.

Caves, as spaces of a specific mediality and polyvalent imagery, were of interest to scholars, naturalists, travellers and artists. Their entrances represent intersections between day and night, reality and dream, empiricism and imagination. Serving as a bridge between different cultures of knowledge, the underground and its investigation functioned as a projection screen for desires, dreams and the visitors' claims of interpretation. In particular, depictions of caves represent attempts to design and arrange the knowledge of the subterranean world. On the one hand, the multisensory modes about how scholars experienced and depicted caves did not differ fundamentally from the practice of artists. On the other, naturalists used visualizations, aesthetic categories, and artistic patterns of representation to support their arguments. In that respect, Martin Rudwick associates the close relationship between science and art with the emergence of a "visual language" for geological sciences.

Studying this process through the example of underground space, the paper examines images as representations of specific location, but in particular as a space of representation, where discourses on knowledge, art and sense were visualized. Particular attention will be paid to the 1) multi-sensual perception of caves, 2) the visual practices of scholars and artists, and 3) their influence on representational conventions in science communication. The sources used for this study are comprised of paintings, drawings and maps made for scholarly and/or artistic purposes.

State geologist and bystander to genocide: William H. Brewer's fieldtrip across California and the destruction of California Indians (1860–1864)

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This presentation focuses on William H. Brewer (1828–1910) and the field journal he kept as he was serving under Josiah D. Whitney (1819–1896) for the State of California Geological Survey, between the years 1860 and 1864. While Brewer was travelling across California to collect a great variety of specimens, California Indians were suffering legal discrimination, *de facto* servitude, maltreatment in reservations, and recurrent massacres performed by U.S. military forces and, more often, by volunteer militias supported by state and federal funds. The systematic destruction of California Indians, which took a turn during the Gold Rush, was primarily motivated by the acquisition of lands and resources. The massive influx of immigrants coming to California severely threatened the Indians' established relationship with their natural environment. Under ever-growing pressure and threat, most Indian tribes were forced to relocate to the inhospitable mountains or to steal food from nearby towns. Stolen goods, horses and cattle, served as a common pretext to raise groups of armed volunteers and run punitive expeditions against Indian villages.

The journal of William Brewer represents a unique point of view on the regime of genocidal violence, which existed in California in the 1860s. During his many expeditions, Brewer crossed paths with a great number of victims, perpetrators, and bystanders. His journal regularly mentions wandering groups of Indians who had fled from their villages. While condemning their inhumane treatment, Brewer clearly adopts a dehumanizing rhetoric when describing the Indians that he encounters. Women are systematically described in terms of their sexual attractiveness. Men and women are often compared to animals or beasts lurking in the shadows. Racial and sexual slurs are also frequent across the text. Brewer's rhetoric gives us a glimpse at the kind of symbolic and physical violence California Indians were subjected to. While no historical evidence indicated that Brewer ever committed any crimes against Indians, his descriptions of them indicate that the Indians were widely perceived to be strangers and pests in their own homeland. Brewer's journal recounts moments of reflection about the problematic future of "mixed breeds", and what the author saw as the regrettable, yet inevitable extinction of Indians.

Through its tasks of collecting and describing, the State Geological Survey served to expand the Californian government's grasp on a territory, whose first inhabitants were being displaced and destroyed. Being the testimony of both, a geologist performing his mission of observation and a bystander to genocide, Brewer's journal constitutes an important object of inquiry connecting the history of geological surveys to the history of land appropriation. The purpose of this presentation is not to render any belated judgment, but to methodically delve into the complex story of one geologist trying to make sense of the violence he was witnessing while collecting specimens. Treating the history of the destruction of California Indians and the history of the Geological Survey as two separate historical phenomena risks making us forget what the root problem was: the finite territory of California itself. The history of geological surveys is inevitably tied to the history of territorial struggles. The case of Brewer's journal offers the opportunity to reconsider this most crucial connection.

Popularizing the history of mining: The two underground exhibitions *Le Monde Souterrain* and *L'Exposition Minière Souterraine* at the Paris Exposition of 1900

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In 1900 the mining engineer and geologist Louis de Launay (1860–1938) is charged by the French Central Coal Committee (*Comité Central des Houillères de France*) to conceive two exhibitions on the history of mining for the Paris Exposition that year: *Le Monde Souterrain* (the underground world) and the *Exposition Minière Souterraine* (the underground mining exhibition).

The former linked the reconstructions of ancient mines with materials used to build famous monuments, and also dioramas representing different geological eras, created in collaboration with artists and professors from the Museum of Natural History and the École des Mines. The *Exposition Minière Souterraine* was accessible through an assembled mining headframe or by using a slide. Whilst inside one could experience a reproduction of a contemporary mine, as well as view extraction techniques related to different substances, such as gold, coal, metallic ores, salt and diamonds. It was populated with wax sculptures representing miners at work. When visited, the two exhibitions offered a multi-sensory and immersive experience in the depths of the galleries under the Trocadéro Palace, and the contemporary press witnessed their success among a broad and non-specialized public.

The aim of this contribution is to present this rather unexplored experience trough the study of sources, and to analyze its importance within the frame of a growing popularization of Earth sciences, which experienced increasing popularity from the second half of the 19th century.

In this context, these exhibitions constitute one of the first experiences in popularizing, not only Earth sciences, but the mining activity itself, its history and its techniques. Their aim was, as de Launay states in the exhibition catalogue, to "reproduce in the heart of Paris the most important marvels of the underground world, make them accessible to the greater public and provide them the most attractive and diversified entertainment, and at the same time a durable teaching". Indeed, such marvels of science and techniques were presented in a particularly spectacular way, and within a public event which was also a political arena and a competition for progress, such as the Paris Exposition.

The Geological Survey of Namibia: From Colonial Office to National Geoscience Institution

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The Geological Survey of Namibia as a Department within the Ministry of Mines and Energy is the national institution for earth sciences and geological resources. The roots of the institution go back to 1903 when the first geologist appointed by the then colonial government took up his duties in Windhoek. After the discovery of alluvial diamonds near Lüderitz in 1908, mapping focused on the southern part of country, but the outbreak of World War I brought geological activities by the Government to a temporary standstill.

In 1926, the Government of the Union of South Africa opened a branch of the Geological Survey of South Africa in Windhoek. Initially mapping of the territory was its main duty; in 1932, it was additionally tasked to administer mining legislation. During World War II, the branch played an important role in the exploration for strategic minerals.

After World War II, while South Africa continued to administer the territory, the search for water became the foremost task in Namibia's arid environment, emphasized by the appointment of two hydrogeologists. By the early 1960s the draft of a Mineral Resources Handbook was completed, and in 1965 the first ever 1 : 1 million Geological Map of Namibia was published.

In 1979, the Geological Survey became an independent directorate within the Department of Economic Affairs of the Administration of South West Africa. Descriptions of the stratigraphy of Namibia were published and a new inventory of the mineral resources of the country was compiled. A year later, a revised edition of the 1 : 1 million Geological Map was published. Several 1 : 250 000 scale maps followed, cooperative projects with South African and overseas universities greatly expanded, and the flow of publications on regional geology significantly increased with the launch of three in-house publications.

Following Namibian Independence in 1990, the Geological Survey of Namibia became a Directorate within the newly established Ministry of Mines and Energy. Numerous cooperative projects with foreign countries were initiated, including the establishment of GIS and substitution of conventional cartography by digital methods. The totally revised, restructured and updated Mineral Resources Handbook was finally published in 1992. 1994 saw the relocation of the Geological Survey to a new building with improved facilities, such as modern geochemical and geotechnical laboratories, core shed, and the National Earth Science Museum and National Energy and Earth Science Information Centre.

Between 1993 and 2016 the total staff of the Geological Survey doubled to 142. Its functions and responsibilities increased proportionally, including the acquisition and interpretation of high-resolution, countrywide airborne geophysical data, environmental appraisal of the impacts of both human activities (*e.g.*, mineral extraction, urbanization) and natural hazards, maintenance of seismic stations as part of the Global Seismic Network and Global International Monitoring System, launch of a comprehensive geoscience database, and participation in a variety of international collaborative projects such as IGCP, and investment promotion. The High-Resolution Airborne Geophysical Data Acquisition Programme, which covers approximately 97% of the country, was completed in 2011. During the period of 2013 to 2019, 83 new 1 : 50,000 scale geological maps covering an area of almost 28,000 km^2 in southern Namibia were produced.

In 2016, the Directorate of the Geological Survey was elevated to the Geological Survey Department headed by a Deputy Executive Director of the Ministry of Mines and Energy.

The Geological Survey of Italy: Close to 150 years of activity

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The foundation of the Geological Survey of Italy at the end of the 19th century was part of a political context of a newly established country in continuous evolution. After the creation of the first National Geological Surveys in Great Britain, France and Austria, Italian scientists also began to argue for a unity of studies and geological research throughout the Peninsula.
At the time, the Italian Peninsula was politically fragmented into many different sovereign entities. Despite this political and cultural division, the first meeting of Italian scientists held in Pisa in 1839, was focused on how to overcome social and cultural resistance and diversities by proposing the creation of a cartographic project depicting the geological characteristics of the entire Peninsula.
Only after a lot of time had passed and three wars were fought to achieve national independence, followed by the unification of Italy in 1861, a Royal Decree was issued for the creation of an Advisory Council with the aim of studying the geology of the country. Quintino Sella, a prominent Italian scientist and politician was entrusted with the task of organizing the realization of the Geological Map of Italy. Due to economic, logistical and organizational difficulties, the project proposed by Quintino Sella was not implemented.
In a different decree of 1867 the Royal Geological Committee was established in Florence with the purpose to direct and organize the work for the geological mapping of Italy. This Committee was also unsuccessful, due to a lack of funds and of personnel. In 1870, however, the publication of the Bulletin had commenced with an active reorganization of the library that promoted and formed the core of the library of the future Geological Survey.
The establishment of a modern geological survey, in a way that was similar to other European surveys, occurred with the establishment of the Royal Geological Office in Rome as a Section of the Mining Corps on 15 June 1873 that promoted the guidelines for a systematic geological survey and for the mapping of the whole Italian territory. The main institutional task of the Geological Survey of Italy was, in fact, the "formation and publication of the Geological Map of Italy".
The History of the Geological Survey of Italy, which extends almost 150 years in the past, reflects the dramatically alternating social and economic changes that Italy experiences from time to time, while developing over this extensive time period. Despite these difficulties, the Geological Survey of Italy has always played a decisive role in development and popularization of the Geological Sciences, as well as in improving the recognition of the Italian territory.
Geologists and engineers who were a part of Survey's staff, have left traces and heritage of their research in the numerous geological and geothematic maps produced and published, as well as in a great number of works and grey literature preserved in the office archives. Their teachings have trained several generations of geologists, who largely contributed to the widespread presence and growth of our discipline in different fields of application. Still today, these teachings represent the spirit with which geologists and engineers of the Geological Survey of Italy continue their study and research activities in the service to their country. The role and contribution of geology remains fundamental in studying, analysing and exploring a wide range of subjects, which a multifaceted research institute such as ISPRA has to deal with as part of its institutional mission.

USSR Atomic Project: History of the Uranium Geological Survey

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Briefly examine the history of creation uranium mineral resource base of USSR. The work was carried within the framework of "Nuclear Project of the USSR". In the early forties in the Soviet Union, there were only five of small deposits. Stunning in scale and speed discoveries were made thanks to government policies. Government attracted huge financial and human resources. The geologists contributed significantly to successful completion of the first stage of the Project. The research was conducted with a high degree of secrecy. Therefore, the names of the prominent geologists remained unknown. At the beginning of the 1940s. the work was supervised by academicians V.I. Vernadsky, A.E. Fersman, D.I. Shcherbakov. In 1945, the First Main Geological Management was created (S.V. Gorуunov, Academician I.F. Grigoriev). Management supervised all geological work on uranium. It included several major expeditions. The Krasnokholmskaya expedition in Central Asia achieved the greatest successes (Laureates of the Lenin Prize A.A. Petrenko, F.N. Abakumov, etc.). Based on the example of the first Uchkuduk deposit, the foundations of bed-infiltration ore formation and a set of ore-bearing criteria were developed, which formed the basis of the forecasting, prospecting and exploration methodology for epigenetic uranium deposits. Applying this technique in practice, the joint efforts of industrial geologists (Krasnokholmskaya and Volkovskaya expeditions) and employees of a number of leading research institutes (VIMS, IGEM, VSEGEI, etc.) identified the world's largest Near-Tianshan uranium ore mega-provinces (sandstone type of uranium deposits according to IAEA classification) (Professors G.V. Grushevoy, V.N. Kholodov, A.I. Perelman and others). The main ore control is the relationship of uranium mineralization to the pinching out of zones of oxidation (geologists of the Krasnokholmsk expedition V.M. Mazin, G.A. Pechenkin, K.V. Kernosova and others, employees of research institutes E.M. Shmariovich, E.A. Golovin, A.I. Germanov, A.K. Lisitsin and others). The criteria developed by geologists were used for prospecting and exploration. More than 20 deposits were discovered in a short period of time. Now the Near-Tianshan uranium ore mega-provinces are the most significant provinces for industrial development using *in situ* leach (ISL) technology to recover uranium.

Polish Geological Institute – 100 years of activity for the economy, science and education

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The first attempt to organize geology, mining and metallurgy was the establishment of *Komisja Kruszcowa* (Commission for Ore Minerals) by Stanisław August Poniatowski on April 10, 1782 – a ministerial body headed by Bishop Krzysztof Szembek and 12 deputies subordinate to him, three of whom were geology experts. Although *Komisja Kruszcowa* finished its activity with the loss of Poland's independence in 1795, its enormous impact on public awareness of the need for organized actions in geology contributed to taking further steps in this direction. When Poland regained its independence (November 11, 1918), the idea of establishing a state geological survey was already highly advanced. It referred to both earlier Polish concepts and the structures of geological surveys that had been operating for several decades in Western European countries and elsewhere. A proposal to immediately establish the Polish Geological Institute (PGI) and to appoint expert geologists, submitted to the *Legislative Sejm* of the Republic of Poland on April 3, 1919, by a group of 36 deputies from the former Austrian Partition, It was forwarded to the Tax and Budget Committee, and then to the *Legislative Sejm* that passed it. However, without waiting for the final decision of the Sejm that was taken on May 30, the ceremonial foundation of the Polish Geological Institute at the Ministry of Industry and Trade took place on May 7 in the presence of the Minister of Industry and Trade. The PGI Statute was approved by the Council of Ministers at its meeting on February 28, 1921, and the employee count was completed on June 30, 1921. The first Director of PGI, Józef Morozewicz, was appointed on June 1, 1921. The nomination was signed by Józef Piłsudski (Chief of State), Wincenty Witos (President of Ministers) and Stefan Przanowski (Minister of Industry and Trade). Both J. Morozewicz and two successive PGI directors: Stefan Czarnocki and Karol Bohdanowicz, were once state geologists at the Geological Committee (*i.e.* Russian Geological Survey) in St. Petersburg. Karol Bohdanowicz was even its director at the end of his work for the Russian geological survey (1914–1917). Such professional roots of the geology luminaries (and not only of them) undoubtedly contributed to the fact that the PGI operated as a national geological survey from its very beginning. It is also significant that the French translation of the Institute's name was always Service Géologique de Pologne. The fact that the PGI is a geological survey does not raise any doubts for those living at that time.

The priority was given to study mineral resources. The gripe of the PGI was its too small team; moreover, it was reduced several times. At the turn of 1936, a discussion on the weakness of the PGI was initiated in the Legislation Chambers. In 1937, the PGI Reorganization Committee composed of representatives of the military, industry and science sectors was appointed, later transformed into the Interim Geological Council. The Polish Geological Survey was established by the Decree of the President of the Republic of Poland of March 31, 1938. The decree claimed that the state geological service consisted in conducting planned and systematic geological studies in the territory of the Republic of Poland in order to explore country's mineral resources and to enable their practical use for national economy. The basic geological tasks were fulfilled by: 1) The National Geological Council, and 2) The Polish Geological Institute, both subordinate to the Minister of Industry and Trade. The task of the National Geological Council – which was to be the body that controls and supervises the PGI activity – was to initiate and coordinate geological operations and to control the progress in these works. The main task of the Institute was still geological research aimed at extending the base of mineral resources, increasing the country's economic potential. In the wake of significant extension of tasks, resulting from the decree, the PGI budget was greatly increased, the research staff exceeded 100 persons, and the Institute itself was granted very wide powers. Soon, however, due to World War II, the flourishing works slowed down and finally stopped. The pre-war achievements of the PGI include the discoveries of mineral resources important for country's economy: iron ore in Rudki near Nowa Słupia, phosphates in Rachów nad Wisłą, and hard coal in the Bug River Basin, which was finally documented in 1971 and is currently known as the Lublin Coal Basin. Achievements in the field of geological mapping should also be appreciated In total, over 80 map sheets at various scales had been developed by 1939, a very significant achievement for such a small team.

In April 1940, the Institute was reorganized and incorporated into the general German Geological Survey – *Amt für Bodenforschung*. By the ordinance of the Minister of Industry of February 3, 1945, the PGI was reactivated in Cracow but soon, in the autumn of 1946, the Institute's management moved from Cracow to Warsaw, followed by the other organizational units. The role and tasks of geological sciences in Poland were finally determined by Jan Czarnocki, Director of the PGI, who defined two basic directions: geological surveying in the field of current economic needs of the state, and securing country's interests in the future needs of national economy through general geological research, with particular emphasis on prospective deposit issues.

Urgent needs in the restoration of the country forced the development of engineering geology and hydrogeology, which resulted in preparation of about 300 geological and engineering documentations for steel mills, power plants, as well as many hydrogeological documentations. Important achievements in this period include the research results on salt deposits under extraction and exploration of new ones in Kujawy and the discovery of a series of new lignite deposits of great economic importance. The effects of regional and basic research made it possible to develop a geological model of the country, which allowed designing research programs that were successively implemented in the 1950s, leading to the great discoveries of solid mineral resources that laid the foundations for the functioning of a mining-based economy. The decree of October 8, 1951 adjusted the organization forms of the geological survey to the system of central planning and the domination of state property, and the PGI (with the name changed to the Geological Institute) became a scientific-research institution. Favourable conditions created for the Institute's development led to enormous progress in the exploration of geological structure of Poland. The main effort was channelled towards the study of subsurface geological structure of the Polish Lowlands, which, according to the expectations at that time, was to provide the first assessment of the possibility of crude oil and natural gas occurrences. Great amounts of seismic surveys and deep drilling projects gave rise to the first geological synthesis of the Polish Lowlands presented in the monograph titled "The Geology of Polish Lowlands". In the following years, next monographs for particular regions were developed. Rapid progress in exploring the geological structure of the country resulted in discovering, identifying and documenting many mineral resources. Spectacular successes include the 1953 discovery of native sulfur deposits in the Tarnobrzeg region by Stanisław Pawłowski, the 1957 discovery of copper and silver ore deposits in the Fore-Sudetic Monocline by Jan Wyżykowski, as well as the documenting of hard coal deposits in the Lublin Coal Basin by Józef Porzycki in 1971, and the 1964 discovery of potassium-magnesium salt deposits in the Puck Bay region by Zbigniew Werner. In the mid-1970s, however, the first signs of crisis in geology appeared, and there was a slow decline in expenditure on raw materials research. In 1985, the Ministry of Environmental Protection and Mineral Resources was established, and many tasks of geological survey returned to the institute, hence this turned out to be appropriate to return, on June 19, 1987, to the historical name, PGI. In 2001, the Water Law Act entrusted to the PGI the responsibility in exploring, balancing and protecting groundwater resources, and in developing principles for sustainable management of available water resources in river basins, by establishing the Polish Hydrogeological Survey (PHS). Taking into account hydrological achievements of the PGI, the Institute was well prepared to perform the PHS tasks in terms of its merit, organization and personnel. Groundwater monitoring has been organized by the Institute since the mid-1970s as a network of stationary hydrogeological observations in the territory of the Poland.

Since 2009, the PGI has been operating based on the status of national research institute and is called the Polish Geological Institute – National Research Institute (PGI-NRI). Since 2012, pursuant to the Resolution Geological and Mining Law of January 9, 2011, the Institute performs also the function of Polish Geological Survey (PGS).

The centennial history of the PGI that has invariably acted in the interests of the state and society, clearly shows that all the basic responsibilities and commitments that are conventionally assigned to national geological surveys, were successfully fulfilled by the PGI that is a model example of modern national geological survey of a very wide expertise.

More than a Centenary of the Czech Geological Survey and its social and scientific impact

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The “More than a Centenary of the Czech Geological Survey and its social and scientific impact” paper describes the state geological service history and its most successful activities.
The story of the Czech Geological Survey is ordered chronologically with the activities post-1989 organized around themes with subchapter titles Geological Mapping, District Geological Administration, Minerals, Hydrogeology and Engineering Geology, Water- and Terrestrial Ecosystems Biochemistry, and Czech Geological Survey Abroad. The development of the state geological survey is outlined against the backdrop of the political history.

Professor Hanna Czeczott (1888–1982) – Polish palaeobotanist and the author of "The flora of the Baltic amber and its age", published in 1961

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Professor Hanna Czeczott (1888–1982) – an outstanding Polish botanist, palaeobotanist and museologist associated with the Museum of the Earth in Warsaw – is known to amber researchers as the author of an article "The flora of the Baltic amber and its age". Its first part was published in 1961, in the *Proceedings of the Museum of the Earth*. After consulting the literature prof. Czeczott verified the taxonomical determinations by her predecessors and compiled a list of 216 Latin names of Paleogene plant species or genera from amber forests in the forementioned publication. The first part of her paper also contains an analysis of the nature of the forest, the climate of resinous plant species, and the causes of resinosis.

There are archive typescripts by Prof. Czeczott, concerning amber flora, in the Polish Academy of Sciences Museum (PAS Museum) of the Earth in Warsaw, which would enable the reconstruction of the following parts: *Age of amber – Distribution of the Baltic amber – Comparison with Paleogene floras – Comparison with Recent floras – Paleogeography of the South Baltic area; Some varieties of the Baltic amber – Trip to Denmark and Sweden – Manifestations of volcanism in Denmark, Sweden, England – Relevant Literature – Summary of the results of work on the origin of amber.*

Prof. Czeczott obtained an education in Petersburg and in Warsaw, studying botany, geography, geology, chemistry, philosophy, as well as studying foreign languages. Her professors were, among others, a mineralogist and geochemist Aleksandr J. Fersman and a botanist Boleslaw Hryniewiecki.

As the wife of the mining engineer Prof. Henryk Czeczott, she accompanied her husband on scientific and research expeditions to the USA, Canada, Mongolia, Turkestan, Turkey and the Canary Islands. During these travels she collected plant specimens for the herbarium.

Before joining the Museum of the Earth, Prof. Hanna Czeczott was an employee in the Department of Botany of the Jagiellonian University in Cracow. She also worked at the Department of Plants Geography of the University of Warsaw; at the State Geological Institute; and as a dendrologist in the Research Institute of the Ministry of Forestry.

The first palaeobotanical work by Prof. Czeczott, on fossilized beech, was published in 1934, and on Miocene fossilized flora from Zaleśce near Wiśniowiec, collected in 1937, was published in 1951.

Prof. Czeczott's study on *The distribution of some species in northern Asia Minor and the problem of Pontide*, 1937, presents the possibility of the land-bridge connection between Northern Anatolia and Crimea in geological past.

The Palaeobotanical Laboratory in the Museum of the Earth in Warsaw was organized by Prof. Czeczott in 1946. For 14 years, she led it and explored the Polish fossil florae, simultaneously creating a catalog of angiosperm Cretaceous, Paleogene and Neogene plants. Above all, in 1947 she discovered and worked out the Miocene flora of the Turów lignite mine in Turoszów, SW Poland, based on plant remnants acquired during numerous field trips. Researchers from the PAS Museum of the Earth in Warsaw and from the Warsaw University published more than 20 scientific papers in *The fossil flora of Turow near Bogatynia*.

The palaeobotanical workshop at the PAS Museum of the Earth in Warsaw created by prof. Czeczott consisted of comparative contemporary plant collections and of specialized literature. She corresponded with scientists from the finest research centers in the world. She worked in almost all major natural history museums and botanical institutions in western and in southern Europe – in libraries, botanical gardens.

Olinto Dini (1805–1866) physicist by choice, naturalist by fatality

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Olinto Dini was born in Castelnuovo Gerfagnana (Lucca, northern Tuscany) on the 10 June 1804, to Emiliano of the late Massimo Dini and a noblewoman, Rosa, daughter of the late Colonel Carlo from Conti Carli. He graduated in Pisa, and received the title of professor on the 29 September 1828, from the Cabinet and the Chairman of Physics at this university. In August 1831, he abruptly left the Pisa University, for unclear "private" reasons, to retire to private life in his father's house in Castelnuovo Garfagnana. From that moment the naturalistic and more specifically geological interests of Olinto Dini were born, which will all focus on the Garfagnana area.

Olinto Dini participated in two of the *Riunioni degli Scienziati Italiani*, that of Florence in 1841 and that of Lucca 1843. In the first he presented a memoir on *Lignite* and *Serpentine* that are present in the Tuscan Apennines, and in the second by reporting on his discovery of Ammonite fossils in the Apennine formations of the Garfagnana.

His geological works, of which very few have been published, deal with various topics such as (i) the limestone in the mountains of Corfino and Sasso Rosso, (ii) some observations on the thermal waters of Pieve Fosciana and the drying up of the Prà di Lama marsh, (iii) geological notes about some Garfagnana caves , (iv) the already mentioned lignite and serpentine from Garfagnana, (v) on some fossils and on the geology of Garfagnana in general, (vii) some observations on the 1837 earthquake in Garfagnana, and (viii) also comprehensive list of the various types of marble outcropping in Garfagnana.

Among more than 300 handwritten letters in the "*Olinto Dini*" collection preserved at the library of the Domus Galilaeana in Pisa, many document Dini's relations of friendship and mutual scientific esteem with his former colleagues in the Pisan University and within a small circle of well-known geologists and naturalists of the time, such as Igino Cocchi, Paolo Savi, Ranieri Gerbi, Luigi Pacinotti, Giuseppe Menghini and others.

Between two worlds: Manuel Fernández de Castro (1825–1895) and the geological maps of Cuba and Spain

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Civil engineers were one of the most important professional elites during the 19th century in Spain. Their rise was closely linked to the state construction process that was going on at that time. In an attempt to strictly control the territory and society, the engineers were organized into state entities and played a key role in the identification, inventory and supply of a wide range of material resources. From the mid-nineteenth century onwards, these state engineers became responsible for promoting material and social welfare progress. Moreover, it was the mining engineers, the experts in the extraction of wealth from the subsoil, who became a symbol of the action of the State in the field of natural resources, both in the peninsula and overseas. After the emancipation of the American colonies at the beginning of the 19th century, it was necessary to organize the research of new geological mining activities in the last Spanish overseas territories: Puerto Rico, Cuba and the Philippines. This led to the creation of the Bureau of Mines in these territories to promote gold, copper and coal mining. This is also when Manuel Fernández de Castro (1825–1895) entered the scene, a mining engineer who became a key protagonist in the modernization of public administration for the development of new public resources.

When he was a child he accompanied his family when they emigrated to Cuba, but he returned to Spain to complete his academic training. Once he had finished his studies in mining engineering in Madrid in 1844, he joined the State corps of mining engineers and carried out various jobs in Spain and in France, until he was appointed head of the Bureau of Mines in Cuba in 1859. Amongst his responsibilities was to provide assistance to the island's mining companies and to collect data in order to prepare a geological map of Cuba. In 1849 the institutionalization of geological research had taken place with the creation of the Commission for the Geological Map of Spain with the aim of mapping the territory to explore its mining resources. Not only did members of this commission work on the preparation of the map, but the mining engineers assigned to the official mining districts also had to contribute by collecting data. Fernández de Castro is still remembered in Cuba for preparing the first geological map of the Antillian colony in the 1 : 2,000,000 scale, which he finished in 1883 when he had already returned to Spain after leaving his Cuban post in 1869.

Upon his return to Spain he was appointed as director of the Commission for the Geological Map of Spain in 1873, a position he held until his death in 1895. The Spanish Geological and Mining Institute is the direct heir to this Commission. The organization had been working for almost twenty-five years on the map without managing to complete it until Fernández de Castro joined the enterprise. He was a great ideologist and a magnificent manager, who organized the work of the Commission to focus on the completion of the map, which he achieved in 1889, in the 1 : 400,000 scale. Spain finally had its national geological map and the data was immediately incorporated into the Geological Map of Europe in the 1 : 1,500,000 scale, compiled by Ernst Beyrich and Wilhelm Hauchecorne in 1896.

"Or what good has any geologist ever done to Western Australia?"

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"Or what good has any geologist ever done to Western Australia?" This was the sentiment expressed by the Legislative Council of the then fledgling British Colony in the late 19th century. Three brief Government Geologist appointments between 1847 and 1885 had failed to convince the Council members of the value of "scientific gentlemen" over "the practical man". But gold discoveries in the Kimberley region that had been facilitated by the geological mapping of E.T. Hardman finally led to the passing of a resolution to establish a Geological Survey in the State, with the first permanent Government Geologist, H.P. Woodward, taking up the appointment on 9 January 1888. With a budget of only £1000 and no staff until 1893, Woodward set out to visit and study most of the gold deposits that were being discovered at the time and produced the first Geological Sketch Map of Western Australia in 1894. This was the first of 14 State maps published at roughly 10 year intervals. Viewed in succession, these maps illustrate how the understanding of the geological framework of Western Australia has evolved from the early days of travelling on the back of a camel in months-long expeditions, to the modern days of GPS-tracked 4×4 vehicles and helicopters.

By 1926, under the leadership of A Gibb Maitland, the Geological Survey of Western Australia (GSWA) had published maps covering nearly half the State, at a scale of four miles to an inch – a remarkable feat for a State with a surface area of just over a million square miles (2,645,615 km^2), a complex geological history spanning more than 4 billion years and a rich mining heritage. Full mapping of the State at 1 : 250,000 scale was achieved by 1980 under the directorship of J.H. (Joe) Lord, who also expanded and re-organized the Survey to complement the greater degree of specialization that had developed in geology. Subsequent directors have stressed the "dual objectives of conducting practical, increasingly focused, field-based research and providing geoscientific advice to Government, industry and the public". From the late 20th century, the systematic application of increasingly mainstream analytical techniques such as geochronology and isotope mapping, the use of remote sensing (from early aeromagnetic and gravity images to active and passive seismic profiling), and the construction of 3D models have resulted in deeper understanding of Western Australia's geology from the crustal level to the microscale. Both legacy and new data/information collected by staff of the Geological Survey in the course of its 133 years of existence are collated into modern datasets that contribute to make Western Australia one of the top investment destinations in the world. Collaboration with external organizations at a State, national and international level contributes to geoscientific knowledge that supports the resources sector. Since 2009, the Western Australian Exploration Incentive Scheme (EIS) managed by GSWA and its geologists is estimated to have returned $31 for every dollar invested in support of the State's resource industries – thus proving those doubtful Legislative Council members decisively wrong!

History of the meteorite collection at the Museum of Geology of the Vilnius University

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The history of the meteorite collection of the Museum of Geology of the Vilnius University (VU) is inseparable from the history of the University itself. The peripetias of historical events influenced the size and fate of this collection. The route taken on its "journey" through the twists and turns of history: Vilnius University – Imperial University – Imperial Vilnius Academy of Medicine and Surgery – Various Tsarist Russian Higher Education Institutions – Vilnius Museum of Antiquities (VMA) [Collections left in Vilnius] – Museum of Natural History of Vilnius Public Library (MNH VPL) – Stephen Báthory University + in parallel Vytautas Magnus University in Kaunas – Vilnius University.

Information about meteorites in VU mineralogical and geological collections can be found in the catalog compiled by Ignacijus (*vel* Ignotas) Jakovickis (Ignacy Jakowicki 1794–1847) (Jakovickij, 1836). There were 9 units of iron meteorites with two names and 10 units of stone meteorites with five names. It is known that one of them – Bragino (iron) – was studied by brothers Janas Sniadeckis (Jan Chrzciciel Władysław Śniadecki 1756–1830), Andrius Sniadeckis (Jędrzej Śniadecki 1768–1838) and mineralogist Ignas Horodeckis (Ignacy Horodecki 1776–1824). Unfortunately, the forementioned meteorites have not yet been detected and recovered.

The oldest sample in the collection is from 1893 September 22. A meteorite that fell in Zabrodje (*vel* Zabrode), which after being analyzed in Odessa, was returned to Vilnius by Romulas Prendelis (Romul Aleksandrovich Prendel' 1851–1904), and Nikolajus Segijevskis (Nikolaj Aleksandrovich Sergijevskij 1831–1900) handed it over to the MNH VPL on 30 April 1894. R. Prendelis cut a 448 gram piece from the meteorite for research. Chemical and mineralogical composition was determined by Prof. P. Melikov (Piotr Grigorjevich Melikov *vel* Melikishvili 1850–1927). After the analysis was complete, the remaining 300 gram piece was transferred to the Odessa University Museum. Two small fragments were sent to the Vienna National Museum (5 grams) and the British Museum in London (3 grams).

Since the remains of the VMA and MNH VPL collections were stored at the Stephen Báthory University, we assume that the Zabrodje meteorite was among them. It was "found" among the samples at the Department of Geology of Vilnius University in 1965.

Kaunas Vytautas Magnus University had collected meteorites that had fallen in the territory of Lithuania: Andrioniškis (Padvarninkai) – fell on 9 February, 1929 near Andrioniškis (Anykščiai district); Žemaitkiemis – on 2 February, 1933. Meteoric rain fell on the surroundings of the Rundžiai, Kliepšiai, Volai and Žemaitkiemis villages (Ukmergė district). Professor Mykolas Kaveckis (1889–1969) was the first to study them.

M. Kaveckis enriched the collection by exchanging the meteorite samples that fell in territory of Lithuania for the meteorite samples that had fallen in other countries.

The meteorites found in Lithuania have been studied by the following scientists: K. Sleževičius, B. Kodatis, K. Bušas (Busz), S. Horstas (Horst), A. Brezina, V. Vasiljevas, A. Juška, V. Suchockis, M. Bukovanska, T.R. Ireland, J. Jancike, A.El. Goresy, H. Palme, B. Spettel, F. Wlotzka, K. Misawa, A. Yamaguchi, H. Kaiden, L.E. Nyquist, D. Bogard, H. Wiesmann, C.Y. Shih, H. Takeda, H. Mori, A. Shukolyukov, F. Begemann, M.M. Grady, G. Motuza, T. Kohout, etc.

Today, the meteorite division is quite rich. We have 67 samples of 40 different meteorites. The collection is supplemented by thin sections of various meteorites for microscopic examination.

The Tuscan Shaft of the Montemassi – Ribolla Mine (1841–1844)

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The Tuscan Shaft (from Italian: *Pozzo Toscano*) was one of the great works of mining engineering. It was dug in 1841–1844 near Montemassi by the French mining engineer François Pitiot on behalf of the "Compagnia per la Ricerca e l'Escavazione di Carbon Fossile" of Livorno. The Shaft sparked immediate interest among naturalists and scientists due to its depth and it allowed for the expansion of knowledge on the geology of Tuscany. As a matter of fact, it integrated the fragmentary surface measurements with the first complete stratigraphy of the "serie lignitifera miocenica" and provided the paleontological data, all which were necessary to more accurately define the age and nature of "Tuscan coal". Moreover, by measuring the increase of temperature of the rocks and the air throughout the Shaft, it gave a remarkable contribution to the first studies on the origin of terrestrial heat and to the interpretation of the Tuscan geothermal phenomena. A faithful copy of Pitiot's original stratigraphy of the Shaft was reproduced in the 1930s by the Montecatini mining company and preserved in a private mining archive in Ribolla. The stratigraphy of the well was very important, at the time, for studies on the Miocene, while contemporarily it is considered an important historical document.

Lithuanian Geological Survey – milestones of the 80-years-long geological road

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History of Lithuanian Geological Survey (LGT) is discussed by dividing into three periods: 1940–1958, 1958–1991 and 1991 onwards. In the 1940–1958 period, the first detailed Quaternary geological and geomorphological maps were compiled, and a number of deposits of mineral resources (clay, gravel, dolomite) had been prospected. From 1957, when the Geological Board – the central body for the governing of geological work was established – geological exploration (mapping, prospecting and exploration, drilling of boreholes, etc.) was carried out very intensively and by 1990 mapping on the 1 : 200,000 scale (based on a number of boreholes) was completed, while mapping on the 1 : 50,000 scale had commenced, covering part of country. In parallel, the mapping of Precambrian crystalline basement, offshore on the Baltic Sea, geophysical etc. were carried out, and hundreds of mineral resource deposit and groundwater intakes were prospected.
When Lithuania restored its independence, the Lithuanian Geological Survey (Lietuvos geologijos tarnyba, LGT) was founded on 11 March 1991 and was based of the former Geological Board. All enterprises formely subordinate to the Geological Board were privatised. From 1991 LGT has been developed according to the model of Geological Surveys of most Western European countries. Currently LGT have 3 main tasks: 1) geological research; 2) regulating underground management; 3) maintaining a state information system. The SWOT analysis is proposed as an approach to look into the present situation of the Geological Survey and reveal problems constraining its development.
A wide range of opportunities have come up related to a number of new environmental aspects for research (*e.g.*, arsenic, pesticides in groundwater), international cooperation projects etc. LGT is capable for better cooperation with national institutions presenting the value of geological information.
LGT would be much more effective operating not under the Ministry of Environment, but under other institutions responsible for the development of sustainable underground management. Geological mapping must be developed as a way of comprehensively understanding of subsurface.

100 years of the Polish Geological Society

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The Polish Geological Society (PGS) was established on 21 April 1921, following a proposal by a group of Polish geologists led by Prof. Władysław Szajnocha. This was one of many initiatives aimed at reintegrating the Polish scientific community after 123 years of Poland's partition, during which activities of Polish scientists were divided between three different countries: Russian Empire, Kingdom of Prussia and Austro-Hungarian Empire. Since its inception, PGS headquarters had been based in Kraków at the Jagiellonian University, as Kraków was the largest and the most active center of geological studies prior to Poland regaining independence in 1918. For over 100 years the main forms of activity of the Society had been annual conferences organized in different parts of Poland and publication of the *Annales Societatis Geologorum Poloniae*.

Three periods can be distinguished in the history of the Society. During the first period, spanning the years 1921–1939, the activities of the PGS were focused on providing an integration platform for geologists from different parts of Poland, the development of local branches (Lwów, Warsaw, Borysław and Wilno), the introduction of geology to school curricula, and on state administration support for geological studies . International activities included participating in the establishment of the Carpathian-Balkan Geological Association and the International Union for Quaternary Research (INQUA). The rapid development of PGS was brought to a halt due to the onset of WWII in September of 1939.

The second period of history of the Society encompasses the war years of 1939–1945. During this time several tens of the PGS members lost their lives; despite all the dangers the conspiratorial activities of PGS continued and the Society did not perished.

The third period started right after the end of WWII, in 1945, when the first PGS meeting took place in Kraków. Next, local PGS branches in other cities reestablished their activities. Due to significant post-war political changes and shifted state borders in central Europe, branches in Lwów, Borysław and Wilno ceased to exist, but a new branch was established in Wrocław. The reconstruction of the Polish industry in the post-war period led to a rapid development of geological sciences and to the publication of numerous volumes dealing with various aspects of the geological structure of Poland and its mineral resources. These activities peaked in 1960's – 1980's, when several new local branches and special sections have been established, membership reached 1454 active members, and the attendance of annual meetings was in order of hundreds of participants, often including guests from abroad. Apart from activities aimed at an audience of professional geologists, popular science activities meant for schools etc. remained an important part of PGS' undertakings; geological symposia and conferences were often accompanied by popular science lectures for the wider audience interested in Earth science. During the crisis years of the 1980's PGS remained fairly active; after political changes in 1989–1990 it significantly increased its international contacts. On the other hand, membership has been gradually decreasing. In 1990' representatives of the Society were invited to AEGS, EFG and AAPG which led to the organization of numerous international conferences attended by geologists from abroad (*e.g.*, 31st IAS Meeting in Kraków in 2015). One of the important initiatives was the organization of the Polish Geological Congresses. Apart from them, annual PGS meeting with their field trips and valuable field guides, and the associated publications all remain very popular and have always had excellent attendance.

From Franz von Hauer to Othenio Abel. Viennese paleontology up to 1945 – a history of institutions and people

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For some time, the working group "History of Earth Sciences" at the Austrian Geological Society, which exists since 1999, has set itself the aim of researching the history of earth science institutions and the personalities who work in them. The aim of these studies is to present scientists in their social and scientific environment. This basic research can also be of use as basic work for collective biographies, which significantly expand and enrich our insights into the development of earth sciences.

In 2017 a study on Graz earth scientists was published, in 2018 a description of the development of paleontology in Vienna from its beginnings in the 19th century to 1945 was presented. In this work, written by Fritz Steininger, Daniela Angetter and Johannes Seidl, the focus of the presentation is on the development of paleontology at the University of Vienna, although the beginnings of teaching and research at the Montanistische Museum in Vienna is also mentioned.

Toward a history of the geological associations in Italy: The *Società Geologica residente in Milano* (1856–1859)

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On the 8 February, 1856, the first 56 members of a new Geological Society gathered at the *Istituto Robiati* in Milan. It was the final step in a project to create a "geognostical" society within the Lombardo-Venetian Kingdom, linked to the Geological Institute of Vienna and based on Austrian institution model called the *geognostisch-montanistische Verein*. One of the main aims of the *Società Geologica* was to promote the formation of "provincial geognostical collections", particularly by the systematic organization of fieldwork and the compilation of geological maps and memoirs published in the annual proceedings. The Society was open to scholars residing in the Lombardo-Venetian Kingdom in northern Italy; however, the admission of foreign members required the previous approval by the Austrian lieutenancy in Milan. Some of the best geologists from Lombardy and northern Italy were involved in the early stages of this academic project. The first president was Giulio Curioni, soon replaced by Emilio Cornalia, while Giovanni Omboni was nominated as secretary and later was joined by Antonio Stoppani as second secretary. The first volume of *Atti della Società Geologica residente in Milano* (which included the reports of the activities from 1856 onwards) was published at the end of 1859, when Lombardy was no longer part of the Austrian Monarchy. In January 1860, the Society was renamed as the *Società Italiana di Scienze Naturali* (Italian Society of Natural Sciences), a denomination kept to date. The aim of this paper is to present the role and the scientific activities of a still little-known geological association, during a period of political, cultural and social changes, which led to the unification of Italy and later to the establishment of the Italian Geological Society.

From the Prussian State Geological Survey to the Federal Institute for Geosciences and Natural Resources, the German Federal Geological Survey (BGR)

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Although the official date for the founding of the Prussian Geological Survey (PGL) is 1 January 1873, the establishment of this state geological survey had gradually developed from the Prussian mining administration, who were then responsible for geological mapping. The PGL was initially attached to the Royal Mining Academy in Berlin before becoming an independent organisation in 1907. Apart from mapping the Prussian territory and safeguarding its geoscientific data, the PGL developed special expertise concerning public health and raw material issues, the latter stimulated by the requirements during World War I. Germany, through the Imperial central government, administered colonies in Africa, Oceania and Asia up to World War I, During this time the PGL became responsible for various geological issues. When the Nazi Party gained government control in 1933, the federal system in Germany was changed to a centralised government. As a result, in 1938 the PGL was transformed into the Imperial Agency for Geological Investigations (*Reichsstelle*, later *Reichsamt für Bodenforschung*, RfB), and all the state geological surveys became branches of the RfB. The work of the RfB was then primarily focused on efforts to achieve autarchy, through the search for ore deposits and, especially, oil to fuel the military machinery for the war preparations of the Nazi regime. After the German capitulation in 1945, and following the intermediate period of allied occupied zones in Germany, the federal government system was re-established, however with a more rational state structure than that existing before 1933. Because Lower Saxony included the principal hydrocarbon region of Germany, a strong branch of the RfB had existed in Hannover/Lower Saxony from 1934. This branch became the nucleus for the Lower Saxony Geological Survey and, later in 1958, for the German Federal Geological Survey, named the Federal Institute for Geosciences and Natural Resources (*Bundesanstalt für Geowissenschaften und Rohstoffe*, BGR). The separation between state tasks and federal tasks in Germany is very strict. The responsibility for geology and raw materials lies with the states. The task of the BGR is to fulfil German international geoscientific obligations of, such as training the geological surveys of developing countries or being the National Data Centre for the Comprehensive Nuclear Test Ban Treaty Organisation CTBTO, which is based in Vienna. Other tasks include providing advice to the Federal Government and undertaking research and development (comprising about 40% of BGR's funds). The only tasks of the BGR within Germany relate to the overall responsibility of the Federal government for geoscientific matters that are a state obligation, and for geoscientific aspects of the nuclear "cycle", in particular nuclear waste disposal.

Research on imperial edicts of earthquakes in Ancient China: Content and value

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In Ancient Chinese history, an emperor had often issued imperial edicts, in particular in response to earthquakes. The phenomenon first started in the Han Dynasty and lasted until the Qing Dynasty. The contents included as followings: First, introducing the time and place of the earthquake and the extent of the resulting damage. Secondly, as an emperor often regarded earthquakes to be a punishment and warning from the heaven for his moral flaws or policy faults, it contained the expression of the emperor's self-blame for his own incompetence and asking his subjects to give him advice and suggestions in order to supplement and improve existing policies. Last, an imperial edict also arranges disaster-relief measures such as providing food and money, the reduction of taxes, the lending of royal lands to refugees, the burial of the dead, etc. The imperial edicts had presented their value in research of the History of Geological Science as followings: first, it provided basic historic details of earthquakes such as time and place. Second, an imperial edict opens a window to observe the technology level and disaster-relief methodology of ancient China. Last but not least, researchers can observe the disaster relief philosophy and even the cultural concept system of Chinese feudal society. For example, after the earthquake in 408 A.D., the emperor of Northern Liang Dynasty, Meng Xun regarded an earthquake as signals for his military triumph. In summary, emperor edicts are valuable windows through which researchers could observe China's history of Geological Science.

Ignacy Domeyko (1802–1889) – *Carte Geologique de la Pologne* – a story about the history of one map

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Ignacy Domeyko was an outstanding Polish geologist, mineralogist, mining engineer and academic teacher. He was born on July 31, 1802 in Niedźwiadka (presently located in Belarus). He studied at the Faculty of Physics and Mathematics at the University of Vilnius, were he obtained a Master's degree in Philosophy. In 1823 he suffered tsarist repressions for participating in patriotic activities of the "Philomath Society". Domeyko took part in the failed November Uprising of 1830, after which he was forced to escape, emigrating via Germany to France. He studied at the Sorbonne and the Collège de France, where, thanks to the's persuasion of *Léonce Élie de Beaumont*, he finished his studies at the School of Mines (*fr. École des Mines*) obtaining a mining engineer diploma. On the recommendation of another excellent professor of this school, Pierre-Armand Dufrénoy, Domeyko went to Chile, where he spent the remainder of his life. The importance of his research and organizational work for this new homeland cannot be underestimated. A detailed analysis of Ignacy Domeyko's achievements is the subject of study by historians of science in Poland, Lithuania, Belarus and Chile. Each of these countries recognizes him as their compatriot.

"Carte Géologique de la Pologne", which Domeyko compiled during the Parisian episode of his life, deserves special attention. This map is almost completely unknown, due to the fact that it has not been published in its original form. Before leaving for Chilein February of 1938, the manuscript of this map was ready and its author undertook efforts to publish it. He ran out of time, so he asked his friend and the greatest Polish poet, Adam Mickiewicz, to take care of its publication, leaving a certain amount of money for this purpose. Being already in Chile, Domeyko urged Mickiewicz to publish it, sending more money, but it was to no avail, however. Mickiewicz, absorbed in political and patriotic activities, did not care about such "*trifles*" as the publication of a geological map of Poland – a homeland partitioned. Currently, individual manuscripts of this map are in the collections of the Polish Academy of Art and Science and the Library of the Jagiellonian University in Kraków. This map, slightly altered from its original form, was included, most probably without the author's own knowledge, into the atlas published in 1850 by A.F. Dufour and F. Wrotnowski, entitled *"Atlas de l'ancienne Pologne"*.

Domeyko prepared this map without any possibility of verification in the field, as he was considered *persona non grata* in the former territory of Poland . His work based solely on previously published materials, therefore it is considered to be a typical compilation map. The northern part of this map is based on the map by William Thomas Horner Fox-Strangweys (1795–1865),

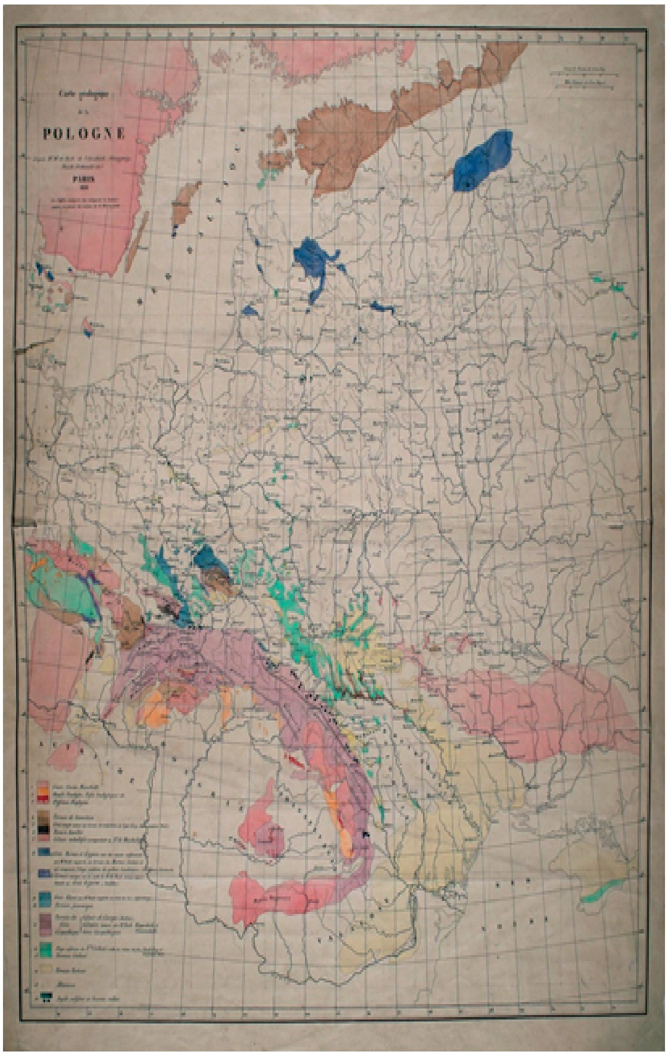

Fig. 1. Ignacy Domeyko's map manuscript *"Carte géologique de la Pologne"* (1837)

who in 1824 developed the first geological (petrographic) map of the European part of Russia. Domeyko used the Fox-Strangweys map, although in reference to the areas marked in blue (sandstones, marls and gypsum of recent sediments) (Fig. 1) he refers to the descriptions by Georg Gottlieb Pusch (1790–1846), contained in his two-volume work "*Geognostische Beschreibung von Polen*" (1833 and 1836). In terms of developing the lithology and stratigraphy for the southeastern part of his map and to mark the border of the Carpathian flysch, Domeyko used the "*Carte geologique du Bassin de la Gallicie et de la Podolie Austrichienne*" (1830) prepared by Karl Lill von Lilienbach (1798–1831). Characteristic in this area are picturesque erosional river valleys. Older rocks are exposed on the valley slopes, which adds aesthetic value to the map. To develop the cartographic image of the Holy-Cross Mountains, the Lublin Upland, the Silesia-Kraków area, the Carpathians and the Tatra Mountains, Domeyko abundantly used maps compiled by G.G. Pusch, included in his "Geognostyscher Atlas von Polen" (1836). To develop the western part of the map, in particular the area of Lower Silesia (Sudetes), Domeyko was able to use two cartographic studies prepared by Leopold von Buch (1774–1853): "*Mineralogische Karte von Schlesien*" (1802) and "*Geognostische Karte von Deutschland und den umliegenden Staaten in 42 Blattern*" (1826).

Summarizing, it should be stated that:

- It is a lithological map with elements of stratigraphy and references to regional geology. Such a mixture is typical for regional maps for the first half of the 19^{th} century;
- If this map was published immediately after its elaboration, it would have been one of the best maps of the first half of XIX century;
- Considering the fact that two of Domeyko's professors from Paris (de Beaumont and Dufrénoy) were the authors of the "*Geognostische Uebersichtskarte von Deutchland, Frankreich, England und den angrenzenden Landern*" issued in 1839, one may wonder whether and how Domeyko's work was used to develop their map.

Jan Hempel: Author of first geological and mining maps in the Kingdom of Poland

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Jan Marian Hempel, son of the Napoleonic officer Joachim Hempel, was born on the 12 of December 1818 in Burzec, a village near Łuków in Podlasie Region. At the age of 22, he started working in the mines in the Western Industrial District of the Kingdom of Poland. In 1841 Hempel was employed as an assistant geodetic engineer to copy plans. Six years later, after the apprenticeship at the Mining Department in Warsaw, he came back to Dąbrowa to organize a surveying service (pol. *służba markszajderyjna*) for the coal mines.

In 1856 Jan Hempel finished four-year-long work on the "Geognostic map of the coal basin in the Kingdom of Poland" (pol. "*Mapa geognostyczna zagłębia węglowego w Królestwie Polskiem*"). The map was published in 1857 by M. Fajans in Warszawa. It was printed on 18 sheets in various dimensions, on a 1 : 20,000 scale. Hempel's map presents a very detailed image of the area between Czeladź (in the west) and Olkusz (in the east); it reaches Ujejsce and Ząbkowice in the north and the national border located along the Biała Przemsza and Czarna Przemsza rivers in the south. It consists of many topographical details, elaborated using Lehmann's hachure method. Moreover, it gives the locations of particular buildings. All of the topographical data was collected from photographs, from a special table for measurements and from other cartographic information that was available at the time. For better orientation special mounds or "mining pyramids" were used – they usually served as landmarks and stabilization points for mapping. The geognostic map contains not only geological formations, but also indicated ore deposits (*e.g.*, hard coal beds, red calamine, iron ore, cement limestone, fireclay and others) and industrial plants. To emphasize the efficiency of his work, Hempel was appointed to the position of Director for the Western Industrial District in 1861. 15 years later, he became the chief administrator for mining in the Kingdom of Poland and held this position until his retirement in 1885. Hempel died at the age of 67 on the 19 January 1886.

Hempel greatly contributed to the development of geological knowledge of the Upper Silesia region. He undertook the very difficult task of creating a geological map, although he didn't possess a specialist geological education. His activity was underlain by his great knowledge of mining, which enabled him to determine the structural components of hard coal beds. In the 19th century, the information provided by Hempel on his map had significant impact and influence on both mining and geological knowledge of the Upper Silesian region.

Fryderyk Krumpel: The first mining geologist in the Western Industrial District of the Kingdom of Poland

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The development of geological-mining knowledge of the Western Industrial District of the Kingdom of Poland, was mostly related to prospecting for and providing access to hard coal deposits, as well as zinc and lead ores.

Fryderyk (Fridrich) Wilhelm Krumpel (born in 1792, presumably died sometime after 1855) was one of the very first geologists working in the Western Industrial District. He graduated from the School of Mining (*Bergschule*) in Freiberg, with very good grades on Easter of 1809, at the age of seventeen, and then applied to the Academy of Mining (*Bergakademie*) in Freiberg, asking the Academy to waive his tuition. From 1809 to 1813 he studied mining, geology, pure, applied and higher, mathematics, physics, mining law, practical marketing, records' keeping, mineralogy, drafting and civil engineering.

On the 30 July 1816, Fryderyk Krumpel requested an appointment to the Polish mining industry, from the Mining Office in Freiberg. Most likely in the autumn of that year, he came to work in Kielce. He took on various roles, including junior engineer in the Mining Directorate, a surveying officer (pol. *markszajder*), and a mining engineer in the Olkusz–Siewierz area. Due to his position in the Western Industrial District being passed onto Jan Marian Hempel, on the 17 May 1847, he took over the position of Chief Stationmaster for the mines of the eastern region.

Krumpel had proven himself useful to the mining efforts of the Kingdom of Poland, as he completed a series of tasks which had paramount significance for mining documentation. Among the surviving manuscript cartographic materials, many are authored by Krumpel himself. Over the years, they served as the basis for supplementations and were often used for subsequent studies. These are mainly plans and location maps of mines and mining works in progress. They rarely contain geological information on the presence and quality of minerals.

Based on the surviving archival materials, it can be concluded that Frederick Krumpel, during his work in the Western Industrial District (1816–1848), prepared or collaborated the preparation of 131 geological-mining plans and maps (including 114 independent studies) of various topics. He was a versatile geologist, undertaking a variety of subjects. This probably testified to his professionalism and knowledge of the submitted deposit problems. In the materials we note his use of German, as well as Polish.

Józef Tomaszewski: The first professor of mineralogy and geology at the Jagiellonian University in Cracow and the Mining Academy in Kielce

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The foundation of university geological sciences in Poland is related to the work done by the National Education Commission. In 1811, thanks to Stanisław Staszic's initiative, a separate Department of Mineralogy and Geology was established at the Cracow Academy (later becoming the Jagiellonian University). It was at first led by Józef Tomaszewski, professor of physics, mineralogy and geology.

Józef Tomaszewski was born in 1783, most likely in Warsaw. Thanks to a scholarship from the Chamber of Public Education he began his studies at the Mining Academy in Freiberg in 1809. While there, he studied geology, mining, mining administration and others. Tomaszewski was also sent to Paris to supplement his studies. He attended mineralogy lectures led by René Juste Haüy at the Minerals Gallery of the National Museum of Natural History in Paris.

On the 7 January 1814, Tomaszewski was appointed by the Directorate of National Education to the position of deputy professor of mineralogy and geology at the Cracovian Central School (pol. *Szkoła Główna Krakowska*). 22 days later, he asked the dean of the Philosophy Department to introducemineralogy and geology (based on the Werner's and Haüy's lectures), as well as a mining course.

Tomaszewski assumed his academic duties on the 1 February 1814, and carried them out for the next three academic years. Lectures were held, according to schedule prints, every day from 10:00 to 11:00 AM, with the exception of Thursdays. He prepared extensive course curricula, supplemented by detailed handouts available for his lectures.

From the spring of 1816, Tomaszewski was formally associated with the Central Mining Directorate, initially operating in Warsaw and later in Kielce. In the newly established, again due to Staszic's initiative, Mining Academy in Kielce, Tomaszewski was appointed the position of professor. As one of the few professors, he lectured in Polish, covering mineralogy (3 hours per week) and geology (2 hours per week). He remained at the Academy of Mining until 1830.

Between 1816 and 1841, Tomaszewski also worked in mining administration for the government of the Kingdom of Poland. He participated in the work of a collegiate body, the Salt Delegation of the Mining Directorate, and gave opinions on the exploration of salt using various mining methods (shafts, drilling) in the southern part of the Kingdom of Poland.

In 1828–1832 he was employed in the Secretariat of the Mining Department as the Secretary General and Head of the Secretariat. On the 27 May 1830, he met Aleksander Humboldt in Warsaw, where he expressed his critical opinion on salt prospecting in the southern part of the Kingdom of Poland. In 1837–1838 Tomaszewski was appointed as Mining Director of the Northern Industrial District for mines in the Mining Department of the Bank of Poland.

He most likely did not leave any publications. Some of the documents prepared and signed by him were published by other officials of the Central Mining Directorate. Tomaszewski died on the 30 April 1844, in Radomice near Kielce.

The foundation of the Geological Survey of Japan

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Japan's doors remained closed to western countries until 1854. After opening the doors, Japan had to invite many Western geologists and send Japanese students to learn western scientific methods in order to investigate its own natural resources. The Meiji Era started in 1868, with western education, lifestyle, and technology etc., coming to Japan. Geology was one of the coming education subjects. Next, it was followed by an introduction of the simple history of geosciences of Japan in the late 19th century which mainly focused on geological maps.

Many foreign geologists were invited. From the United States, W.P. Blake, R. Pumpelly, B.S. Lyman, and H.S. Munroe accepted the invitation. Lyman and his Japanese colleagues compiled the first regional geological map in Japan, that is "A geological sketch map of Yesso (main island in the northern part of the Japanese Archipelago, *i.e.* Hokkaido), Japan", which was published in 1876. From France, F. Coignet was invited for some mining developments. T. Takashima, who was trained by Coignet, who was also a well-known painter, drew the first geological map in Japan in 1878, that is, the "Geological Map of Yamaguchi Prefecture" (the westernmost prefecture in the main island of Japan, Honshu), in the 1 : 200,000 scale. The geology was classified into nine categories with captions both in Japanese and French. Despite of the complex geology of the area, the map is quite comparable with modern ones. From Scotland J.G.H. Godfrey was invited. He created the "Geological sketch map of Japan" by applying Lyman's geological classification in 1878, which became the first geological map of Japan.

Edmund Naumann (1854–1927) was invited to join from Germany as the professor of geology at the University of Tokyo in 1875. In 1877 he left the position and founded the base for what would later become the Geological Survey with his Japanese colleague Tsunashiro Wada, under the guidance of Japanese government. This "Pre-Geological Survey" commenced operations in 1879, with four German geologists leading four sections: geology, geography, geochemistry, and soil analysis. The geochemistry section was used for mine investigations, while the soil analysis section was concerned with the development of agriculture.

The Geological Survey of Japan (GSJ) was founded officially in 1882. Since then, GSJ has conducted nationwide geologic survey work and published their outcomes in the form of various geological sheet maps. For example, when in 1885 Naumann presented the reconnaissance geological map of Japan at the International Geological Congress (IGC) in Berlin, it was met with approval and applause.

"The geological map of the Japanese islands, 1 : 3,000,000" (1890) was drawn by the Japanese geologists Toyokichi Harada (1860–1894), generalized the geology of Japan for the first time as early as 1890, eight years after the establishment of the GSJ. Harada's idea that the Japanese archipelago consisted of two arcs between the Fuji (volcanic) Belt in central Japan. He advocated the "connected-arcs theory" against Nauman' mono-arc theory. His map, the "Geotectonic division of Japan" is a part of the "Atlas: Agricultural production of the Japanese Empire" at the Imperial Geological Office (previously, the Geological Survey of Japan). He was educated by a German pedologist, Dr. Max Fesca who contributed to the soil survey of GSJ and depicted the major characteristics of the country's geology (rock distribution) quite well, given that little data was available at that time.

The "Geological map of the Japanese Empire, 1 : 1,000,000" was compiled after the compilation of the "Preliminary geological maps" consisting of five map pieces, all in the 1 : 400,000 scale, and was published by the GSJ in 1899. The English version, with similar content to the Japanese version, was published in 1900 and 1902. It was sent as an exhibit to the International Exposition and the 8th IGC in Paris. The publication and its high-quality printing technology drew the attention of geologists from around the Globe.

A historiography of geoscience during Japanese imperialistic expansion: Tokyo Geographical Society and Ogawa Takuji (1870–1941)

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When in 1926 the geographer-geologist Ogawa Takuji (1870–1941) described the short history of Japanese geography, it consisted of ten chapters, from the Pre-modern Era to the Great Kanto Earthquake of 1923. In his writings, Ogawa stressed the role of the Tokyo Chigaku Kyōkai (Tokyo Geographical Society) founded in 1879, eleven years after the Meiji Restoration. In five chapters 3–7, he traced the development of the contents of the society's periodical *Tokyo Chigaku Kyōkai Hōkoku* (Reports of the Geographical Society) and its publications during the expanding phase of Japanese imperialism. We can recognize four stages: 1) early lectures of travels, 2) survey reports after the Sino-Japanese War (1894–95), 3) geological investigations after the Russo-Japanese War (1904–05), and 4) the Taisho Period (1912–26). The first stage represented a trend of contemporary expeditions in the age of imperialism. Among the lecturers of travels, the Lieutenant Commander Fukushima Yasumasa (1852–1919), who accomplished the horse-ride Siberian traverse from Berlin (via Warsaw) to Vladivostok, which took place between February 1892 – June 1893. In 1892, the Society was merged with the Geological Society in the University of Tokyo, which had published the *Chigaku Zasshi* (Geological Journal) edited by the Professor Koto Bunjiro (1856–1935). Since then, academic geological articles occupied the contents of the journal. Ogawa, graduating from the University of Tokyo, got a position in the Geological Survey in 1897 and became an editor of the journal. He published a geoscientific monograph of Taiwan in 1896 and investigated the geology of China as a member of the Survey, which was conducted by the administrator and mineralogist Wada Tsunashiro (1856–1920), in the years 1901–02. In stage three, we can see Ogawa, on the one hand as an imperialistic geologist; and an academic geographer on the other, who was a professor at the Kyoto University since 1908. Ogawa devoted himself to the study of ancient and contemporary geography of China at the University until 1920. Thus, we can understand the historiography of geoscience by Ogawa as a straight-forward nationalistic expression of the imperialistic expansion of Japan during the Meiji-Taisho periods. At the same time, considering his participation in the Expo and the 8th International Geological Congress in Paris and his attendance of Eduard Suess's (1831–1914) lectures in Vienna, we should note Ogawa's international exchanges on geoscientific scholarship. During these periods, Ogawa summarized the geotectonics of the Japanese Islands, making a theory of global tectonics, and established the beginnings of an academic school of human geography. We will also discuss the internal as well as the external approaches applied to the history of the geoscience and outlined above.

Between fieldwork and classroom training: The School of Geology and the Early Geological Survey in China (1913–1916)

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In 1913, the School of Geology affiliated with the Geological Survey of China was established. The aim of the school was to train specialists in carrying out geological surveys. During the years 1913–1916, the School of Geology had cultivated talented people with different educational backgrounds. At the beginning of 1916, the old Geological Section of the Bureau of Mines was reorganized into an independent geological survey, and became the National Geology Survey. Dr. Johan Gunnar Andersson (1874–1960), then Director of the Swedish Geological Survey, was appointed Mining Adviser to the Chinese Government, and his two assistants F.R. Tegengren and E.T. Nyström, all became members of the Geological Survey in 1916. In the summer of the same year, the students who graduated from the School of Geology also became members. Several geological surveys were organized during 1913–1916. This paper combines an investigation of some newly discovered materials with an exploration of the past, to trace the routes by which geology developed in modern China. The author will focus on geological surveys conducted by Chinese geologists between 1913 and 1916. Since then Chinese geologists conducted careful investigations in Northern and Eastern China, and could be considered some of the earliest geological surveys organized by Chinese authorities. This was a period when China trained geological specialists at the School of Geology, and established the National Geological Survey of China. China became able to conduct its own independent geological surveys after the students from the School of Geology graduated and became qualified professionals.

Problem driving: The "landing" of plate tectonics theory and the response from Chinese Academia

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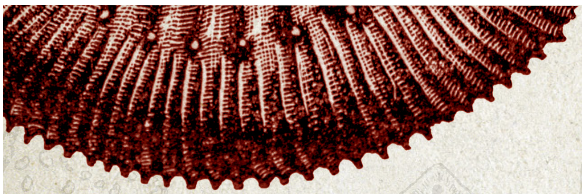
Problems are the soul of scientific research, and the history of science can be seen as the history solving problems. In the 1960s and 1970s, the theory of plate tectonics based on marine surveys triggered a scientific revolution, which made the Earth sciences enter into a new and conventional stage. In the new stage, the question of how to use the plate tectonics theory to explain the continental geological phenomenon, has become an important scientific problem. The focus of geoscience research was shifted from the ocean to the continent. After the introduction of the theory of plate tectonics, the Chinese academic circles learned, applied and developed the theory, and made contributions, to enable the "landing" of the theory of plate tectonics in China. This paper examines the theoretical verification process by the Chinese and American seismological communities in the continental region of China, reproduces the origin, dissemination and solution process of scientific problems, and analyzes how scientific problems determine the direction of scientific research, how to obtain the recognition of the scientific community, and how to drive the dissemination and progress of science. The importance of problem awareness in scientific research is explained throughout other empirical studies.



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ISBN: 978-83-66509-93-1