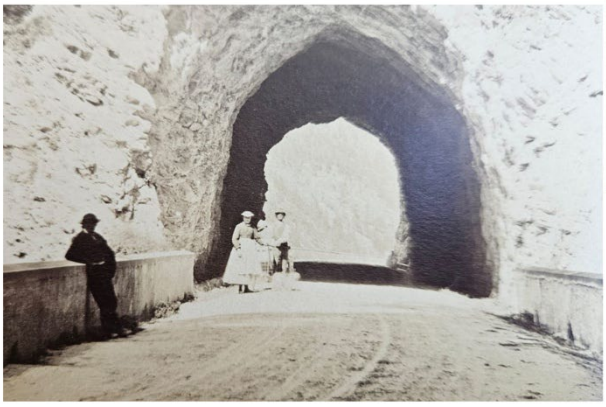

Christoph Hilgers

Geology in the Changing Course of History and Society

200 years of Applied Geosciences at KIT on its 200th anniversary in 2025

This is an English translation of the original book by the author entitled Geologie im Wandel der Geschichte und Gesellschaft: 200 Jahre Angewandte Geowissenschaften am KIT im Jahre 2025, published in June 2025 with KIT Scientific Press. The translation by Rustam Niftaliyev and Dr. Chaojie Cheng as well as the editorial support by Dr. Benjamin Busch is greatly appreciated.

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Foreword

In 2025, the Karlsruhe Institute of Technology (KIT) will celebrate its 200th anniversary. Founded in 1825, the Polytechnic School of Karlsruhe developed into Germany's oldest technical university and became KIT in 2009 through the first merger of a state university with a federal research institution.

After my appointment to KIT in 2016, the idea arose to compile the history of geology at KIT, as the history of the Institute of Applied Geosciences AGW at KIT was largely unknown. One of the founding fathers of the Karlsruhe Polytechnic School, later KIT, and its second director was the geologist and mineralogist Mining Councilor Professor Dr. med. Friedrich August Walchner. During his tenure, the first KIT building was constructed on Kaiserstrasse and occupied. Friedrich August Walchner was a member of the preliminary parliament in Frankfurt's Paulskirche in 1848. Since 1825, he and subsequent generations have stood for fundamental and applied research for the benefit of humanity and society.

Applied Geosciences at KIT deal with the topics of geoenergy, groundwater, and raw materials. In addition to the supply of energy, water, and raw materials, this also includes the safe use of building land, resource management with improved recycling, the efficient removal of pollutants from the environment, and the large-scale underground storage of energy sources. Our graduates work in the fields of environmental use and environmental protection.

KIT facilitates unique collaborations with other engineering and natural sciences as well as with the humanities, social sciences, and economics in order to make environmental use and protection more efficient and to ensure the supply of energy, raw materials, and water for society in a livable, natural and built environment.

The content does not claim to be as detailed as one would expect from professional historians. Likewise, the people of recent history are certainly not described in sufficient detail. The book outlines the history of geology through the ages and society, with a special focus on developments in Baden, particularly at KIT. It begins by describing the historical development of geology in general and in Baden. It then goes on to present the professors and examples of their work in society. A number of digressions supplement the topics of the time.

I would like to express my sincere thanks to Prof. Dr. Marcus Popplow, Professor of History of Technical and Scientific Civilization, and Dr. Klaus Nippert, Scientific Director of the KIT Archives, for their advice and access to sources. I would like to thank Ted Rose

(Royal Holloway University London) and Martina Kölb-Ebert (LMU) for sending me further information on German geologists during the Second World War. I would also like to thank Karl Fuchs (†2021) for his information on the "Spirit of Karlsruhe."

Many thanks to Agnes Kontny from the Chair of Structural Geology and to Arnfried Becker for their support. Many thanks to my predecessors Reinhard Greiling and Gerhard Eisbacher, as well as Philipp Blum (KIT-AGW Institute of Applied Geosciences), Thomas Bohlen (KIT-GPI Geophysical Institute), Kirsten Drüppel (KIT-AGW), Nico Goldscheider (KIT-AGW), Heinz Hötzl (KIT-AGW), Peter Hubral (KIT-GPI), Judith Käpplinger (KIT Archive), Jochen Kolb (KIT-AGW), Utz Kramar (KIT-AGW), Birgit Müller (KIT-AGW), Thomas Neumann (now TU Berlin), Joachim Ritter (KIT-GPI), Gerd Röhling (DGGV), Frank Schilling (KIT-AGW), Michaela Spieske (State Museum of Natural History Karlsruhe SMNK, now University of Bonn), Heinz Stosch (KIT-AGW), Werner Smykatz-Kloss (KIT), Robert Trusch (SMNK), and Hans-Jürgen Weyer (BDG) for their numerous comments and suggestions.

Above all, I would like to take this opportunity to thank my family and my team at the Chair of Structural Geology at the Institute of Applied Geosciences, who gave me the freedom to implement this project.

Karlsruhe, November 2025

Christoph Hilgers

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1 From Polytechnic School to KIT

KIT is Germany's oldest technical university and was founded in 1825 as a polytechnic school.

After the **École Polytechnique de Paris**, founded by Nicolas Carnot and Gaspard Monge in Paris in 1794, and the polytechnic schools in **Prague** (founded in 1806) and **Vienna** (founded in 1815, renamed Technical University in 1875), KIT is the fourth oldest polytechnic school in the world [Werner 2006: 199].

In Karlsruhe, an independent concept for higher education in industry and administration was developed. This concept later led to the founding of further polytechnic schools in Germany, such as the Technical University of Munich, and abroad, such as ETH Zurich and MIT, as well as to a reform of the older schools in Prague and Vienna [Nippert 2011].

Applied geology have been part of KIT since its founding 200 years ago. Geologist and mineralogist **Professor Friedrich August Walchner** was one of two founding professors in 1825 and, after the reorganization by State Councilor Nebenius in 1832, became the second director of what was then the Karlsruhe Polytechnic School.

Then as now, **the Institute for Applied Geosciences at KIT** continues to develop expertise in natural resources and put its findings into practice. Geologists research the processes of the Earth in order to use and protect the environment. They provide society with energy, raw materials, and groundwater, secure building sites, construct and operate large underground geostorage facilities, remediate natural and built-up environments, and store waste materials safely in landfills and underground. Accordingly, the Applied Geosciences department at KIT addresses the topics of resource management of geoenergy, groundwater, and raw materials, as well as safe building ground at the interface between environmental use and environmental protection under the slogan "*Sustainable use of the environment, above and below ground*."

1.1 The founding of the Karlsruhe Polytechnic School

The Baden Polytechnic School was founded on October 7, 1825[1], in Karlsruhe by **Grand Duke Ludwig I of Baden** (*1763 in Karlsruhe – †1830 ibid.) [Hoepke 2007: 23] based on plans by Gustav Friedrich Wucherer. After establishing a polytechnic institute in Freiburg, Wucherer proposed the creation of a similar institution in Karlsruhe "*for the education of the people in all walks of life.*" In May 1824, Wucherer was asked *to "make a well-considered proposal as to how such an institution (*note: in Karlsruhe) *could be founded in accordance with the needs of the Grand Duchy..."* [Wucherer 1833: 9]. He became the first director of the Karlsruhe Polytechnic School on December 1, 1825, serving until 1832 [Schreiber 1844: 23].

The Protestant city and university pastor of Freiburg and physicist **Gustav Friedrich Wucherer** (*1780 in Karlsruhe – †1844 in Freiburg) was a full professor of physics and technology in Freiburg from 1813 to 1823 (Fig. 1). In 1821, he was appointed from Freiburg to Karlsruhe as a physics teacher at the Lyceum and as curator of the physics cabinet, succeeding the physics teacher **Karl Wilhelm Böckmann** (*1773 in Karlsruhe – †1821 ibid.), who had died in 1821.

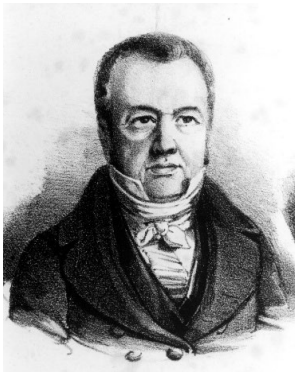

Fig. 1. The planner and first director of the Karlsruhe Polytechnic School, Professor Gustav Friedrich Wucherer [Image: University Archive Freiburg, reference number UAF D 13 / 802].

[1] Otto Lehmann [1911: 36] wrote: "*In 1825 (October 14), the long-planned establishment of the polytechnic school under the direction of Wucherer finally took place ...*".

1.1.1 Good conditions for a polytechnic school in Karlsruhe

Karlsruhe already had

- the **Margrave's Natural History Cabinet**, first mentioned in 1752, which was founded by Margravine Caroline Luise von Hessen-Darmstadt (*1723 in Darmstadt – †1783 in Paris), wife of Margrave Carl Friedrich of Karlsruhe, "*the most beautiful and richest institution of its kind in Germany*" [Koch 1848: 228],
- since 1768, with temporary closures, an architectural institute for builders, which master builder **Friedrich Weinbrenner** established in 1796 as an architectural school (a publicly funded private school, "building school"),
- application-oriented school classes ("Realklassen") [Lehmann 1911: 16] of the Bismarck Gymnasium opened by Margrave Carl Friedrich in 1774 (the Bismark high school founded in 1586 as a Gymnasium illustre in Karlsruhe-Durlach and relocated to Karlsruhe city center in 1724), in which the focus was more on mathematics, mechanics, and natural history than in the grammar school classes,
- the **Margrave** Carl Friedrich's **physics cabinet**, founded in 1778,
- the engineering school founded in 1807 by **Johann Gottfried Tulla**.

This gave Karlsruhe sufficient interfaces to drive forward the desired industrialization supported by a polytechnic school, and to develop an independent concept for further education in industry and administration.

1.1.1.1 The Margrave's Natural History Cabinet

First mentioned in 1752, the **Margrave's Natural History Cabinet** was founded by Margravine Caroline Luise of Hesse-Darmstadt (*1723 in Darmstadt – †1783 in Paris), the wife of Margrave Carl Friedrich, and gained recognition beyond the borders of Baden. The Margrave's Natural History Cabinet was initially headed by **Carl Christian Gmelin** (*1760 – †1837, botanist). As a natural scientist, Gmelin was active in many fields. He preserved knowledge about the medieval silver mine in Wiesloch. In 1803, he conducted his own investigations near Nußloch after the Nußloch master carpenter Jacob Meixner had previously brought him ore samples of galena and calamine, iron ore, and slag. During the flight from the French army in 1793, part of the natural history cabinet's collection was brought from Karlsruhe to Ansbach.

In 1837, Gmelin was succeeded by his student **Alexander Braun** (*1805 in Regensburg – †1877 in Berlin, botanist). Braun became professor of botany and zoology at the Karlsruhe Polytechnic School in 1833. He founded the **Karlsruhe Natural Science Association** in 1840. In 1851, Alexander Braun accepted a position in Berlin and later became rector of the University of Berlin. He was succeeded as head of the Natural History Cabinet by his student **Moritz August Seubert** (*1818 in Karlsruhe – †1878 ibid.), a botanist and

zoologist. From 1878, the geologist **Adolf Knop** was in charge of the Grand Ducal Natural History Cabinet.

The Margrave's Natural History Cabinet became so extensive that in 1875 it moved to the new building completed in 1872 (today the State Museum of Natural History Karlsruhe SMNK). The wars of 1866 and 1870 had delayed construction. To this day, the Karlsruhe Natural History Museum houses the collection of the Margrave's Natural History Cabinet.

1.1.1.2 The Margrave's Physics Cabinet

The **Margrave's physics cabinet** was established by church councilor **Jakob Friedrich Maler** and run from 1736 to 1764. His teaching "*... as well as that of his successors over the next 50 years, consisted of two parts, 'applied mathematics' and 'physics,' alternating with pure mathematics, with four hours of lectures per week*." [Lehmann 1911: 8]. The physics cabinet was then continued by the physicist **Johann Lorenz Böckmann** (*1741 in Lübeck – †1802 in Karlsruhe) at the Baden court from 1764 to 1802 [Lehmann 1911: 11]. In 1778, he set up a meteorological station in Karlsruhe and founded the "**Badische Witterungsanstalt" (Baden Weather Institute)** [Gilbert 2014, Güll 2015], invented the optical telegraph, and was a member of the Electoral Bavarian Academy of Sciences and the Royal Society of London. His son **Karl Wilhelm Böckmann** (*1773 in Karlsruhe – †1821 ibid.) succeeded his father as professor of physics and mathematics at the Lyceum Karlsruhe and supervisor of the physics cabinet from 1802 to 1821 [Lehmann 1911: 28]. **Gustav Friedrich Wucherer** (born in 1780 in Karlsruhe, died in 1844 in Freiburg) headed the cabinet from 1821 [Lehmann 1911: 34]. He was succeeded by Ludwig August Seeber (*1793 in Karlsruhe – †1855 ibid.) from 1834 to 1840 and then by **Wilhelm Friedrich Eisenlohr** (*1799 in Pforzheim – †1872 in Karlsruhe), who headed the cabinet from 1840 to 1865 [Lehmann 1911: 45]. In 1847, Eisenlohr initiated the **first telegraph line** in the Grand Duchy of Baden from Durlach to Karlsruhe.

1.1.1.3 The schools of Tulla and Weinbrenner

As early as 1808, engineer and civil servant **Johann Gottfried Tulla** (*1770 in Karlsruhe – †1828 in Paris) and architect **Friedrich Weinbrenner** (*1766 in Karlsruhe – †1826 ibid.) had pushed for the establishment of a polytechnic school in Karlsruhe in the constituted General Study Commission [Böhtlingk 1899: 68] (Fig. 2).

Johann Gottfried **Tulla** (*March 20, 1770 in Karlsruhe – †March 27, 1828 in Paris) was sent by Margrave Karl Friedrich to Karl Christian von Langsdorf (*1757 in Nauheim – †1834 in Heidelberg), then saltworks inspector in Gerabronn and later professor, for training from 1792 to 1794. Margrave Karl Friedrich then sent him to study chemistry, geology, and mineralogy at the Freiberg Mining Academy from 1794 to 1796 and to the École Polytechnique in Paris in 1801, among other places. The Baden senior engineer Tulla later

planned the straightening of the Upper Rhine in a riverbed secured by levees, which led to **permanent navigability,** the gain of **cultivated land**, and the reduction of **malaria, typhoid, and dysentery**. Tulla founded an engineering school in Karlsruhe in 1807. Tulla was appointed an officer of the French Legion of Honor in 1827. He died in Paris in 1828 and was buried as Jean Godefroy Tulla in the Montmartre Cemetery in Paris.

Fig. 2. Johann Gottfried Tulla (left) and Friedrich Weinbrenner (right) [Images: KIT Archive, 28010_ I/2982 and 10001_2515].

The master builder and architect Johann Jakob Friedrich **Weinbrenner** (*November 24, 1766 in Karlsruhe – †March 1, 1826 ibid.) was born in Karlsruhe as the son of court carpenter Johann Ludwig Weinbrenner. He took over the business, then studied architecture in Vienna, Dresden, and Berlin from 1790 to 1792, and continued his education in architecture, archaeology, and art in Italy from 1792 to 1797. After stays in Strasbourg and Hanover, he became Director of Public Works for Baden in 1801 and was responsible for state construction projects. Among other things, Weinbrenner designed the town hall, the Protestant town church, the Catholic town church of St. Stephen, the Ständehaus as Germany's first parliament building, the synagogue, the mausoleum of Margrave Karl Wilhelm on the market square, the mint, the Kurhaus in Baden-Baden, and presumably the residence of the chemist Prof. Karl Weltzien in Karlsruhe and that of the physician Herrmann

Walchner[2] in Bühl. Weinbrenner reestablished the school of architecture in Karlsruhe in 1796. Weinbrenner died in Karlsruhe in 1826.

The Baden State Councilor and Freemason Karl Friedrich Nebenius may also have gained impressions of applied education during his stay in Paris in 1809 [Bavarikon 2024].

1.1.2 Wucherer and the threatened closure of the University of Freiburg in 1816

Rumors circulated in Freiburg that the university there was to be closed and that the Grand Duke only wanted to use the capacities of the University of Heidelberg. In 1816, the **vice-rectors Gustav Friedrich Wucherer** and **Johann August Gottlieb Schafroth** traveled to the court of Baden, equipped with a *promemoria* from their colleague Karl von Rotteck, in an attempt **to avert** the **Grand Duke's planned closure of the University of Freiburg.** "*On December 27, 1816, the delegates set out on their fateful journey and spent weeks with the gentlemen of the government and at court, as tireless as they were unsuccessful; until they finally succeeded, through the mediation of Margravine Amalie, in obtaining an audience with her elusive son, Grand Duke Karl, and winning from him the comforting words: 'that one must leave things as they are.'*" [Schreiber 1844: 16]. Thus, "*... the delegates returned to Freiburg on January 11, 1817 ...*" [Schreiber 1844: 17].

Whether lower tax revenues due to the eruption of the Tambora volcano in Indonesia in April 1815, which led to a year without summer in Europe in 1816 and a year of beggars with famine, poverty, starvation, and emigration to Russia and America in 1817, or whether the planned closure had other reasons, remains to be determined. After successfully preventing the closure, **Wucherer** became an honorary citizen of the city of Freiburg in 1818.

1.1.3 Digression: Infant mortality in all social classes and low salaries – The example of Wucherer

The following aspects of Gustav Friedrich Wucherer's family may provide some insight into the times: *"Wucherer married three times; in 1806 to Friederike Gockel, in 1819 to (her sister) Auguste Gockel, who died in childbirth, and in 1821 to (her sister) Salome Gockel, the deeply grieved widow, all daughters of the church councilor and dean Christ.*

[2] Herrmann Walchner was the brother of Friedrich August Walchner. Alongside Wucherer, Friedrich August was one of the two professors in the founding council of the Karlsruhe Polytechnic School, now KIT, in 1825.

Bernh. Gockel, who died in Emmendingen. Ten children were born from the first marriage, of whom one son and three daughters are still alive. One daughter from his second marriage died very young. A married daughter bore him three grandchildren." Or his request for a salary for his teaching at the University of Freiburg in 1811 "*For five years, during which time Wucherer received no salary from the university, his vigorous nature had endured so many varied exertions ... that he finally allowed himself to make the request: either to dissolve his association with the university, or at least to ease it and secure it for the future ... so that he could breathe out now and then and occasionally enjoy the benefits of the third commandment: six days thou shalt work, etc. Wucherer asked in vain*." The request was not granted until 1813 "*with half a natural competence and 300 fl*." [Schreiber 1844] (note: per year, South German guilder = florin, 300 fl. corresponds to a purchasing power of €6,000 annual salary in 2020). A teacher's earnings are stated as 75 fl., the natural produce allowance as 2 fathoms (2 cubic meters) of wood, ¼ session of field, 15 Pester Metzen of fruit (1 Pester Metzen ≈ 64 liters).

1.2 The beginnings of the Polytechnic School in 1825

The twelve founding members of the Karlsruhe Polytechnic School in 1825 were the two professors from Freiburg, **Gustav Friedrich Wucherer** for physics (*1780 in Karlsruhe – †1844 in Freiburg, first director from 1825 to 1832), **Friedrich August Walchner** for geology, mineralogy, and chemistry (*1799 in Meersburg – †1865 in Karlsruhe, second director from 1832 to 1836), **Wilhelm Ludwig Volz,** who held a doctorate in mathematics and mechanical engineering (*1799 in Rastatt – †1855 in Tübingen, third director from 1837 to 1840), while the other lecturers were high school teachers and craftsmen.

Anonymous [1899: 8] describes the purpose of establishing the Polytechnic School: *"With the founding of the 'polytechnic school' in 1825, we also see a 'higher vocational school' coming into being as part of it. In this school, "in addition to several auxiliary sciences and other knowledge necessary for anyone who claims to have some education, students learn about plants and minerals that are suitable for use in various trades; it is shown which natural substances or which components of natural substances, either on their own or in combination with others, have useful and necessary applications in trade, how they are prepared for use, and how they must be used."*

Teachers from the schools of Tulla and Weinbrenner were sent to the polytechnic to teach basic courses at the Lyceum, while advanced teaching was carried out in their **schools**, **which remained independent**. The Lyceum began operating in 1807 in the south wing of the Protestant town church on Karlsruhe's market square. Both Tulla and Weinbrenner's

schools remained independent until Nebenius restructured them into technical colleges within the Polytechnic School in 1832 [KIT Archive 2023].

The problems of the Polytechnic School began as early as its founding in 1825. The lecturers were poorly paid and the Polytechnic School did not have enough funding to purchase equipment and models for teaching. From 1825, the Polytechnic School was initially housed in the new south wing of the already overcrowded Lyceum Karlsruhe. At the same time, tuition fees were high and the curriculum was disorganized. The widely read Polytechnisches Journal pointed out the problems:

*"Some remarks on the new **polytechnic institute** in Karlsruhe. ... Advances in mathematics and the natural sciences have paved the way for progress in technology, and in order to make it accessible to all, polytechnic schools need to be established, as France has shown us. Such an institute is now being founded in Karlsruhe; however, according to the plans and arrangements that have become known, it seems that the concept of a polytechnic school has been interpreted differently there. The basis of such institutes is applied mathematics, and however different the future civil occupations of the individual students may be, their path is initially one and the same, for the carpenter, the locksmith, the joiner, the mechanic, the engineer, the manufacturer, etc. require common elementary knowledge and training, and they only diverge when each is properly equipped to follow his own particular path and apply what he has learned in a specific trade or craft. In a well-organized polytechnic school, not everyone can take whatever portion they want on a whim, as at a restaurant table; it is a closely connected organic whole, and as in any natural course of development, no branch or twig should form in the air; it must grow from the common trunk, just as the trunk grows from the common root. ... This means of information would not be necessary if the institution had the proper basis and if a major part of its material had not been used to decorate the building. Anyone familiar with the polytechnic institute in Paris also knows how consistently the task has been solved there and how the form has been derived from the purpose. Hence the great simplicity and strictly regulated course of the entire institution. In fact, this is not a matter of pure science, but of its application to the productions of various artists and craftsmen, ... World history is assigned to the preparatory class. But you cannot lecture 13- to 14-year-olds on world history. ... If a polytechnic institute is to have the charitable consequences that must necessarily underlie its intentions, then, in addition to being appropriately equipped, it must also be generally accessible and exclude no talent. The fees for the Karlsruhe school are set at 16 florins per year for the preparatory class and 44 florins for the other classes, not including registration fees. Those who attend only one lesson pay 11 florins, etc. Books, drawing materials, etc. also cost money. There is no question of exemption for the poor. However, polytechnic institutes are mainly intended for the sons of the middle class, and in Germany this class can no longer be considered wealthy. It would indeed be desirable for such institutions to make things as easy as possible for apprentices. This is certainly not in the interests of a*

government that is so willing to encourage talent, reward merit, and promote everything that is useful, good, and beautiful. Perhaps the fledgling institute still lacks funds? In that case, we sincerely hope that rich, generous patriots will step in." [Dingler 1825: 475-477].

Heinrich Schreiber's memorial speech in 1844 on Wucherer in the University Church in Freiburg highlights Wucherer's role in the founding of the Karlsruhe Polytechnic School in 1825:

*"By ministerial decree of May 7, 1824, Wucherer was requested to draft and submit a plan for the establishment of such an institution (*note: establishment of a polytechnic school in Karlsruhe*): "because he had already contributed significantly to the establishment of such an institute in Freiburg, which, although modest in size, as was inevitable given the circumstances, was nevertheless beneficial in its effects; he had therefore devoted considerable time and thought to this matter and had had the time and opportunity to familiarize himself with the educational institutions in Karlsruhe; he was therefore best qualified to make an expert proposal as to how such an institution could be founded in accordance with the needs of the Grand Duchy and in proportion to its resources, in order to maintain the balance with all other essential state institutions. Wucherer met expectations so well that, while retaining his teaching position at the Lyceum, he was entrusted with the management of the new state institution, which opened on December 1, 1825. He also proposed the professors for the first appointments, with whom he worked tirelessly to introduce the mathematical and natural sciences into the sphere of practical life, where they had been bearing such good fruit in Germany for twenty years." [*Schreiber 1844].

1.3 The reorganization of the Karlsruhe Polytechnic School in 1832

The liberal Baden State Councilor and Freemason **Carl Friedrich Nebenius** (*1784 in Rohdt – †1865 in Karlsruhe) became State Councilor and Ministerial Director under Interior Minister Winter, a friend of Grand Duke Leopold, in 1830. In 1831, he was given the important Respiciat for universities and higher education institutions. In 1832, he restructured the Polytechnic School to support industrialization, which he had found to be "*a true monstrosity*." After years of disputes with the state authorities, Director Wucherer ended his work in Karlsruhe by swapping positions with Seeber from Freiburg and returned to the University of Freiburg in 1834 [Schreiber 1844: 25].

The geologist **Friedrich August Walchner** was appointed second director of the Polytechnic School from 1832 to 1836. During this time, the Polytechnic School was able to leave the Lyceum building and move into **the new building at Kaiserstrasse 12** (Fig. 3). Nebenius merged the engineering school of the late Tullas, the architecture school of the

late Weinbrenner, and the state forestry school of the Polytechnic School completely with the Karlsruhe Polytechnic School. In addition to a basic course of study, **five technical colleges** were established in 1832, a structure that neither the École Polytechnique nor the previously leading Vienna Polytechnic School could boast.

Fig. 3. The new building of the Polytechnic School shortly after its completion in 1836. The portal figures depict the polymath Johannes Kepler (1571–1630) and cathedral architect Erwin von Steinbach (1244–1318), designed by the Karlsruhe sculptor Alois Raufer (1794–1856) [Image: KIT Archive, 28015_1].

Walchner also headed the **technical school for chemists, fermentation engineers, mining, and metallurgy**. This was one of the five technical schools of the Karlsruhe Polytechnic School. Mechanical engineering was also based there with Wilhelm Ludwig Volz.

In addition to classes for basic mathematical training, there were five technical schools:

1. Engineering school
2. Construction school
3. Forestry School
4. Technical school for chemists, fermentation, mining, and metallurgy
5. Business school.

The number of teachers was increased to over 30 and the age of admission to the technical school was raised from 15 to 17. Nebenius' reform led to better remuneration for lecturers and improved organization, but despite the reform, the Karlsruhe Polytechnic School had

no budget and had to request approval from the Ministry of the Interior for any purchases. The faculty continued to be poorly paid, and even in 1840, the Ministry of the Interior's letters of appointment did not guarantee a nominal subject, on the grounds *that* "*it is not customary in polytechnic schools and because the government cannot abandon the principle of employing its civil servants at its own discretion*" [from Hoepke 2007: 38].

1.4 Digression: Nebenius & Rotteck – volcanic eruption, year without a summer, Baden constitution

Carl Friedrich Nebenius had written the Baden Constitution, which came into force in 1818, with a bicameral parliament together with Karl von Rotteck. In it, the two Freemasons had enshrined the protection of property and personal freedoms, freedom of religion, suffrage, and independent jurisdiction.

The reason for the constitution was the emerging unrest: the eruption of **the Tambora volcano** in what is now Indonesia in April 1815 led to **a year without summer** in Central Europe in 1816, with crop failures, starvation, and looting, as well as **a year of beggars** with a great famine in 1817. In Baden, more people died than were born. About 20% of the inhabitants of the Grand Duchy of Baden, approximately 18,000 people, emigrated out of necessity [Volkmann 2016], mainly to America and Russia. A contemporary witness reports: "*On New Year's Day, it was as hot as summer. In May, it was as cold as it usually is in February. The wells were frozen over, so you couldn't get any water. Then in June, it started raining and wouldn't stop. The grain rotted in the fields. In July, hail destroyed everything that had grown*" [from Storck 2018].

Emergency slaughter, including of horses, deprived people of their mobility, leading to the widespread adoption of the running machine (and later bicycle) developed by **Karl Freiherr von Drais** (*1785 in Karlsruhe – †1851 ibid.). In response to the famine, the **Württembergische Landessparkasse** was established in 1818 through the founding of a state foundation by Queen Katharina of Württemberg. King Wilhelm I of Württemberg and Queen Katharina founded the **Central Office of the Agricultural Association** and, on Wilhelm I's 37th birthday a harvest festival to celebrate the end of the famine in 1818 was organized as the **Cannstatter Wasen** near Stuttgart for the first time, annually recurring until today.

Despite the famine, taxes were collected in Baden:

"Announcement. The majority of the local population is still in arrears with the tax amount payable for the months of May, June, and July of this year. According to the highest

instructions available, a longer delay in payment can no longer be tolerated. In addition to everything else, this public request for the immediate rectification of these arrears is being made with the request that, for those individuals who have not paid their debts in full by the end of the current month at the latest, the legal coercive measures and that in future, in the event of any delay in tax collection, these measures will be applied without further ado. Karlsruhe, July 11, 1871. Grand Ducal Revenue Office." [Karlsruhe Intelligenz- und Wochenblatt, Wednesday, July 23, 1817].

Nebenius saw the **development of technology and production** as the solution to the problem of overpopulation in the Grand Duchy of Baden; the population of Karlsruhe rose from 10,597 inhabitants in 1810 to 23,484 inhabitants in 1840. Nebenius wrote that "*... only a more skillful use of the means of production would be able to* avert *the unforeseeable consequences of overpopulation in Baden*" [from Hoepke 2007: 34-35]. Today, Karlsruhe has 308,710 inhabitants (as of 12/2022).

Nebenius was also responsible for the state-financed construction of **the railway** between Mannheim and Basel in 1836. The Mannheim - Heidelberg line was opened in 1840, Heidelberg - Karlsruhe in 1843, Karlsruhe - Freiburg in 1845, and Freiburg - Basel in 1855. In 1870, the direct Mannheim - Graben-Neudorf - Eggenstein - Karlsruhe line was completed [Böhtlingk 1899, Hennl 2015].

From 1830, Carl Friedrich **Nebenius** rose through the ranks of the state apparatus under Grand Duke Leopold of Baden to become Minister of the Interior of Baden in 1838, but was overthrown by a plot by Foreign Minister Friedrich Landolin Freiherr **von Blittersdorf**, an opponent of the Baden Constitution. By 1843, von Blittersdorf had failed and Nebenius had been appointed to the First Chamber by Grand Duke Leopold in 1843. Nebenius headed the Ministry of the Interior again from March 28, 1845, to December 1846. He accepted this task only on the condition that a suitable successor be found as soon as possible. In 1846, Nebenius was also president of the Baden State Council [Koch 2013].

The **Baden Revolution of 1848/49** came to a bloody end with the **defeat of the Baden revolutionary army by the Prussians** on June 23, 1849, at the fortress of Rastatt. Like all his friends, Nebenius was removed from office during the violent suppression of the Baden Revolution and retired on July 1, 1849.

1.5 Digression: On polytechnic schools & universities in 1848

The "*Staats-Lexikon: Encyklopädie der sämmtlichen Staatswissenschaften für alle Stände*" (State Lexicon: Encyclopedia of All Political Sciences for All Classes), published in its

first edition in 15 volumes from 1834 to 1843, was edited by Freiburg professors Carl von Rotteck and Carl Theodor Welcker [e.g., von Rotteck & Welcker 1856]. The Staatslexikon contains contributions from important liberal and democratic thinkers of the time, including the philosopher and political scientist **Professor Karl Herrmann Scheidler** from Jena and the geologist, mineralogist, and chemist **Bergrat** (mining councilor) **Professor Dr. med. Friedrich August Walchner** from the Karlsruhe Polytechnic School.

Mining councilor Walchner, professor at the former Karlsruhe Polytechnic School since the founding of KIT in 1825, wrote about the Polytechnic School in the second edition of Rotteck & Welcker's Staatslexikon in 1848 and presumably also in the first edition, although signed with the abbreviation X [Becht & Grothe 2018: 147].

1.5.1 Walchner on application-oriented education & free access to education

Walchner [1848: 40-44], who was certainly well acquainted with his liberal colleagues Rotteck and Welcker from their time together in Freiburg, contributed to their work *Encyklopädie der sämmtlichen Staatswissenschaften für alle Stände* über *Schulen, polytechnische (Encyclopedia of All Political Sciences for All Classes on Schools, Polytechnic)* and wrote:

"Schools, polytechnic schools, have the task of teaching and disseminating the knowledge that promotes production and enables the appropriate execution of the technical work of state administration." (p. 40)

"The higher scientific and technical education that a polytechnic school should provide to technicians is based on knowledge of mathematics, natural sciences, the most important living languages, and proficiency in drawing" (p. 41).

"With regard to the nature of the teaching, it should be noted that, since technicians must not only have ***knowledge*** *and a theoretical scientific education, but also the* ***ability to execute and produce*** *material goods, teaching at a polytechnic school must not consist solely of providing as thorough a theoretical education as possible, supported by sensory observation, experiments, repetition, and exercises; but the students must also be trained, as much as possible, in practical work in the field, in laboratories, and in workshops.*" (p. 42)

Walchner alluded to underfunding and the Baden government's access to topics specified by the State Ministry: *"Collections and equipment used in general scientific and special technical courses are generally more or less useful and necessary for all technical colleges. This grants ... the ... highly valued advantage that one can employ competent teachers trained for each science, and does not have to, as is often the case with isolated technical*

colleges due to a lack of sufficient funds, employ teachers who take on or are assigned several completely different subjects, precisely because they have not studied any particular science." (p. 41)

Walchner noted the ideal conditions for polytechnic schools that existed in Karlsruhe: *"The location of a polytechnic school ... Where there are scientific collections, a physics laboratory, a botanical garden, a lively commercial sector with workshops and factories, and where a great deal of work is carried out in the technical branches of public administration; that is where it belongs*." (p. 43)

Walchner criticized the fees charged to students: "***Admission to the polytechnic school should be granted to anyone who has the necessary prior education*** *and meets the prescribed conditions." "Neither the choice of subjects nor the order in which they are taught can be left to the students*." (p. 44)

Walchner favored the model of the École Polytechnique and learning that was not limited to the study of literature, as was often the case at universities at the time: ***"Frequent examinations*** *and* ***practical exercises*** *led by teachers****,*** *as well as* ***excursions lasting several days****, encourage and maintain the private diligence of the students and create a closer relationship between them and their teachers, in which the latter can be very useful*." (p. 44)

Whether Walchner [1848] meant more than he wrote in the last half of the sentence with regard to the coming revolution of 1848/49: *"The* ***material advantages*** *that accrue to the citizenry as a whole through the influence of polytechnic schools are unmistakable. Wherever mathematical, scientific, mechanical, and technical knowledge in general is applied, beneficial consequences for all parts of society are evident at all times. Expanded scientific and technical knowledge will initially find useful application in the field of technical work in state administration, thereby providing general benefits. The application of this knowledge will teach the correct use of the natural forces of the soil, the better use of natural forces, the improved design of machines and their more appropriate use; it will reveal* ***many advantageous changes in production methods, many better uses of materials,*** *the valuation of waste previously considered useless, improve many products, teach how to prepare new ones, and increase the certainty of success in all technical work and all branches of production. The* ***beautiful intangible benefit****, however, will be that true education will permeate those respectable, productive bourgeois streets, thereby spreading a higher morality*." (p. 44).

In the third edition of Carl Theodor Welcker's 14-volume Staatslexikon (Rotteck died before the second edition was published) [Welcker (ed.) 1856, first volume, third edition], Walchner wrote in volume XII on "*Schools,* polytechnic" [Walchner 1848: 40-44]. In this

third edition, which was published between 1856 and 1866, Walchner also wrote in Volume II on mining and mining law [Walchner & Rotteck 1858: 527-536] and in Volume III on chemistry [Walchner 1859: 510-512, Becht & Grothe 2018: 188ff.].

1.5.2 Digression: "Freedom of research and communication of its results" (Scheidler 1848)

The philosopher and political scientist **Prof. Dr. Karl Herrmann Scheidler** (*1795 in Gotha – †1866 in Jena), associate professor in Jena from 1826 and full professor from 1836, wrote as early as 1848 on the role of universities in the Staatslexikon (State Encyclopedia) by von Rotteck & Welcker:

"Since man only becomes truly human through teaching and education, wherever civilized life or culture in the true sense has developed, in accordance with the law of the division of labor, the concern for intellectual education is a distinctive feature of public and state life, and thus schools or educational institutions of various kinds naturally arise everywhere to obtain and disseminate technical, religious, and moral knowledge.

*Actual schools for scholars, i.e., associations of teachers and learners in which individuals are to be **educated** in science so that they **in turn can further develop science themselves**, are found only among the more noble peoples, among whom, on the one hand, an exceptional energy of intellectual power and a lively interest in higher or ideal life are fundamental characteristics of the national character and, on the other hand, the other conditions of life, especially political and religious ones, do not stand in the way of **the basic prerequisite of all science, namely the freedom of research and the communication of its results**."* [Scheidler 1848: 621-622].

Scheidler, a member of a fraternity, participated in the Wartburg Festival in 1817 and later linked the natural sciences that developed in the 18th century with the political nationalism of the 19th century.

As a proponent of liberalism, Scheidler advocated for the autonomy of free universities, which he believed could only produce politically active citizens without state influence (such as the University of Wittenberg, which offered Martin Luther protection), and for the autonomy of free churches, which he believed could initiate religiously inspired social movements [Barbour 2021]. In his publication [Scheidler 1838], Scheidler emphasized Kant's criticism of an overly caring state and moral perfectionism aimed at collective happiness rather than individual freedom [Barbour 2021].

1.6 The further development of the Karlsruhe Polytechnic School

Ferdinand Jacob Redtenbacher (*1805 in Steyr, Upper Austria – †1863 in Karlsruhe), appointed professor of mechanics and machine theory in 1841, initiated the division of the Higher Trade School (technical school) into a

1. **Chemical-technical technical School** (from 1860 Chemical School) and a
2. **Mechanical-technical technical School** (from 1860: Mechanical Engineering School).

Redtenbacher succeeded **Wilhelm Ludwig Volz** (born in 1799 in Rastatt, died in 1855 in Tübingen), who, after serving as director of the Karlsruhe Polytechnic School from 1837 to 1840, was a full professor of technology in Tübingen from 1841 until his death in 1855, where he also served as rector in 1848/1849.

Redtenbacher headed the Polytechnic School as its seventh director from 1857 to 1862. In Germany, Redtenbacher is considered the founder of scientific mechanical engineering. In a letter to a friend, he wrote: *"I hope to prove to people that mathematics is not a luxury and that it can be used to achieve something in mechanical engineering, provided that one understands practical matters and knows exactly what is necessary for life*" [Redtenbacher Gesellschaft Steyr 2024].

One of Redtenbacher's students was **Carl Benz** (*1844 Mühlburg, now a district of Karlsruhe - †1929 Landenburg north of Heidelberg), the inventor of the automobile. Carl Benz's father was a locomotive driver and died early; his mother could not afford to send him to a secondary school outside the city and sent him to the Karlsruhe Lyceum and then to the Karlsruhe Polytechnic School [Nippert 2011]. Carl Benz's wife, **Cäcilie Bertha Benz** (*1849 in Pforzheim – †1944 in Ladenburg), was the first to prove the everyday practicality of the automobile when she drove the "Benz Patent Motor Car No. 3" approximately 100 km from Mannheim to her parents' home in Pforzheim with her children and without her husband's knowledge [Potthast 2024].

At the same time as Redtenbacher, **Karl Weltzien** (*1813 in Saint Petersburg – †1870 in Karlsruhe) began teaching at the Lyceum and the Polytechnic School in Karlsruhe in 1841 [KIT 2024]. Weltzien attended school at the Lyceum in Karlsruhe, then studied medicine in Heidelberg from 1831, then in Göttingen and again in Heidelberg. Weltzien, a member of the Corps Suevia Heidelberg since his studies, received his doctorate in Heidelberg in 1835. From 1841, he taught at the Lyceum Karlsruhe and the Karlsruhe Polytechnic School. In 1850, he was appointed full professor and a chemical institute was built for him by 1851. Weltzien is considered the founder of scientific chemistry. In 1860, he organized

the first international chemists' congress in Karlsruhe. Walchner, a founding member of the Polytechnic School, was replaced by Weltzien as director of the Chemical-Technical School in 1850. Whether this was due exclusively to dwindling student interest, Walchner's view of chemistry as more of a technical field of processing, or Walchner's political involvement in the 1848/49 revolution remains to be determined.

The Karlsruhe Polytechnic School became a model for other polytechnic schools such as ETH Zurich (founded in 1855, renamed ETH in 1911), TU Darmstadt (founded in 1836), TU Dresden (founded in 1828, renamed in 1890), TU Braunschweig (polytechnic school founded in 1862), TU Munich (founded in 1827), and RWTH Aachen (founded in 1870). The Karlsruhe Polytechnic School (now KIT) offered interdisciplinary courses for architects, civil engineers, mechanical engineers, and chemists, and geosciences (then called geognosy) had also been part of the curriculum since its founding.

The founding director of the Massachusetts Institute of Technology (MIT), **William Barton Rogers** (born in 1804 in Philadelphia, died in 1882 in Boston, physicist and geologist), noted during his visit to Karlsruhe in 1864 that the Carlsruhe Institute corresponded better than any other institution to what was planned for the Massachusetts Institute of Technology ("*The Polytechnic Institute at Carlsruhe, which is regarded as the model school of Germany and perhaps of Europe, is nearer what it is intended the Massachusetts Institute of Technology shall be than any other foreign institution*.") [KIT 2023].

1.7 Technical University (TH) since 1865

The Polytechnic School had been operating independently since 1847. Redtenbacher's successor, **Franz Grashof** (*1826 in Düsseldorf – †1893 in Karlsruhe), professor of theoretical mechanical engineering from 1863 to 1891, succeeded in having the Karlsruhe Polytechnic School awarded **university status** by Grand Duke Friedrich I of Baden **in 1865** [KIT Archive 2023b].

Fig. 4. The main building of the Karlsruhe Technical University around 1890 [Image: KIT Archive, 28010_III / 36].

University status entailed a certain degree of **self-administration and academic freedom**, as well as the awarding of **diplomas** since 1867 and the **right to award postdoctoral qualifications** (Habilitationsrecht) since 1868 in mathematics, natural sciences, mechanical engineering, and engineering sciences [Hoepke 2007: 185]. However, the name "Technical School" (Technische Hochschule) was not introduced until 1885. In 1899**,** the Karlsruhe Technical University was granted the **right to award doctorates,** with the exception of mathematics and physics [Hoepke 2007:185, KIT Archive 2023b]. From 1902, the Karlsruhe Technical University was also known as **Fridericiana** in honor of Grand Duke Friedrich I. The university building at Kaiserstrasse 12 was expanded between 1861 and 1864 (Fig. 4). An overview of the development of KIT at that time can be found in the commemorative publication marking its 125th anniversary [Terres 1950].

1.8 University of Karlsruhe (TH) since 1967

The renaming of the Technical School (Technische Hochschule) to Technical University was accompanied by a restructuring of the faculties. As early as 1966, an independent computer center was established next to the university library, and in 1972 the Faculty of Computer Science, the first of its kind in Germany, was established. In 2000, a **university**

council consisting of external personalities elected by the senate and appointed by the state of Baden-Württemberg was established to serve as an advisory, planning, and supervisory body [KIT Archive 2023c]. The commemorative publications marking the 150th and 175th anniversaries provide an overview of the development of KIT at that time [Draheim 1975, Kunle & Fuchs 2000].

1.9 Karlsruhe Institute of Technology (KIT) since 2009

The merger of the state-funded University of Karlsruhe (TH) and the federally funded Karlsruhe Research Center (part of the Helmholtz Association of German Research Centers since 2002) on October 1, 2009, resulted in the formation of the Karlsruhe Institute of Technology (KIT) [KIT Archive 2023c]. This makes KIT the only university in Germany with a university section financed by the state and a large-scale research section financed by the federal government. In 2021, the different sections were merged with state and federal funds via the state of Baden-Württemberg.

Hermann von Helmholtz (*August 31, 1821, Potsdam – †September 8, 1894, Charlottenburg) was already familiar with KIT, which was then still called the Karlsruhe Polytechnic School. At that time a professor of anatomy in Heidelberg, the polymath attended the annual conference of the Society of German Natural Scientists and Physicians (GDNÄ) in Karlsruhe in September 1858 and presented his scientific findings in physics and anatomy [see Eisenlohr & Volz 1859].

1.10 Applied Geology at KIT since 1825

Applied Geology has been part of KIT since its foundation in 1825 with its founding member, geologist and mineralogist Prof. Dr. med. Walchner. In 1825, it was located in the Higher Trade School. Geology and mineralogy became part of the technical school "*Höhere Gewerbeschule für Chemiker, Gärungsgewerbe, für Berg- und Hüttenwesen*" (Higher Technical School for Chemists, Fermentation Industry, Mining and Metallurgy) as a result of the reorganization by State Councilor Nebenius in 1832 and the appointment of the second director of the Polytechnic School, mining councilor Professor Walchner.

In 1847, the Higher Trade School was divided into a chemical school and a mechanical-technical school, and in 1860 it was renamed the Chemical School, headed by Weltzien, and the Mechanical Engineering School, headed by Redtenbacher [Hoepke 2007: 55]. Geology and mineralogy under Fridolin Sandberger was one of three prestigious chairs at

Weltzien's chemical school. The other chairs were chemical technology under Karl Seubert and physics under Wilhelm Eisenlohr [Hoepke 2007: 57].

As a result of the restructuring of the faculties in 1969, the Faculty of Mathematics and Natural Sciences was dissolved and geology became part of the Faculty of Biological and Geosciences. In 2002, Applied Geosciences was transferred from the Faculty of Biological and Geosciences to the Faculty of Civil Engineering, Geosciences, and Environmental Sciences (BGU) together with Civil Engineering and Geodesy. Applied Geosciences is still part of the Faculty of Civil Engineering, Geosciences, and Environmental Sciences (BGU) in the university area of KIT.

2 The history of geology since 1345

Geology is the science of the Earth (γῆ gä – Earth, λόγος logos – science). The **natural science of geology** deals with the development of the geosphere, which includes the subsoil with the solid earth (the lithosphere), the soil (the pedosphere), water and ice (the hydro- and cryosphere), the living world (the biosphere), and the atmosphere with climate change. In practice, the **engineering science of geology** has been concerned since prehistoric times with the search for and processing of **rocks** and the **minerals** they contain as raw materials for paint, medicinal purposes, and other materials. Geology was closely linked to **medicine**. With the search for and extraction of raw materials such as metals, geology is intertwined with **mining** and **civil engineering, metallurgy**, and **chemistry**.

2.1 Geology, mining, and sustainability

Mining for flint began in the Upper Paleolithic period around 30,000 BC in Egypt and around 5,000 BC in Germany. Copper mining heralded the end of the Stone Age and the beginning of the Bronze Age around 2,200 BC. This was based on knowledge of usable deposits and thus an understanding of geology.

The **word geology** probably first appeared in history in the Middle Ages in the book **Philobiblon** (English: On the Love of Books) by the English bishop **Richard de Bury** (*1281 – †1345), which he completed in 1345. Philobiblon was first published in Cologne in 1473 and printed by G. Gops in Euskirchen; the first edition in England appeared in Oxford in 1598/1599 [Thomas 1889: 1i – 1ii]. In Cap. XI, 174, we read:

"... . Ex quibus liquido satis constat, quod sicut leges nec artes sunt nee scientiae, sic nec libri legum libri scientiarum vel artium proprie dici possunt; nec est haec facultas inter scientias recensenda, quam licet ***geologiam*** *appropriato vocabulo nominare. Libri vero liberalium litterarum tarn/tam utiles sunt scripturae divinae, quod sine ipsorum subsidio frusta ad ipsius notitiam intellectus aspiret."* [Thomas 1888: 102].

Thomas [1888: 219] translates this part of the Philobiblon as: "*From which it is seen clearly enough, that as laws are neither arts nor sciences, so books of law cannot properly be called books of art or science. Nor is this faculty which we may call by a special term* ***geologia****, or the earthly science, to be properly numbered among the sciences. Now the books of the liberal arts are so useful to the divine writings, that without their aid the intellect would vainly aspire to understand them*" [Thomas 1888: 219].

West [1889: 98] translates it as: "*From these things it is sufficiently clear that as laws are neither arts nor sciences, so the books of law cannot properly be called books of art or science; nor is this faculty to which we give, by an appropriate term, the name* ***geology*** *or the science of earthly things, to be reckoned among the sciences. But books of the liberal arts are so useful for Holy Scripture that without their aid the intellect would aspire in vain to understand it*."

" *Daraus geht ganz klar hervor, dass ebenso wie Gesetze weder Kunst noch Wissenschaft sind, auch die Gesetzesbücher nicht richtig die Bücher der Kunst oder Wissenschaft genannt werden können. Es gibt keine Möglichkeit, solche Wissenschaften zu überprüfen, die man als Geologie, die irdische Ordnung, mit einem passenden Namen benennen kann. Die Bücher der freien Künste sind so nützlich für die göttlichen Schriften, sodass ohne ihre Hilfe der Intellekt vergeblich danach strebt, sie zu verstehen*" [based on Blei 1912].

Thus, the word geology was probably coined in 1345 by Richard de Bury in Durham, England. However, the meaning of *geologiam* did not correspond to today's understanding. Geologia = the science of earthly order was understood to mean the laws of the earth or the study of laws. Art and science, on the other hand, were placed in relation to God. Richard de Bury thus contrasts **geologia, the earthly order,** with **theologia, the divine order** [Mierow 1930: 345].

Ulrich Rühlein von Calw (*July 4, 1465 Calw, Black Forest – †1523 Leipzig), physician, mining scientist, and mayor of Freiberg in Saxony from 1514 to 1519, had already published on the geology of deposits, mining, and metallurgy in 1518 [von Calw 1518, 1535, 1539].

Nevertheless, **Georgius Agricola** (Georg Bauer, *1494 – †1555) is considered **the founding father of modern mining science and modern geology**. In several of his books, such as *De ortu et causis subterraneorum* (1544), *De natura fossilum* (1546) and *De re metallica* (1556), he dealt with the geological subsoil, minerals, deposit formation, mining, and smelting. Instead of divine creation, he explained the formation of minerals through **"petrifying fluids"** (Fig. 5).

In the 17th century, people began to associate the development of life with fossils from a former world of living beings and the formation of landscapes through sedimentation and erosion with scientific processes. The Italian naturalist **Ulisse Aldrovandi** mentioned the word **Giologia** in his will in 1603, in which he defined geology, botany, and zoology [Vai 2003]. **Petro Cally** published a chapter on **geology** in his book in 1695**.** He assigned geography, fire and earthquakes, magnetism, the compass, and iron, salt, oil, and other substances of the earth such as stones, silver, and other metals to geology [Howarth 2020]. Later, the term geology was used in **Zacharias Grapius's** 1700 dissertation "*Natural Science of the Creation and Preparation of the Earth*."

Fig. 5. Sketch by Agricola on finding veins with divining rods (A) and prospecting (B) [Image: Augsburg State and City Library, see Georgius Agricola, 1566. De Re Metallica Libri XXII: page 28].

The term **geognosy** was coined in 1761 by Georg **Christian Füchsel** (*1722 Illmenau – †1773 Rudolfstadt), one of the founders of **stratigraphy**. The influential Freiberg geologist **Abraham Gottlob Werner** (*1749 – †1817) introduced **mountain science** in 1780 alongside his lectures on **mining**. In 1783, he renamed geology **geognosy.** Werner, who had traveled little**,** propagated the (false!) theory of **Neptunism,** according to which all rocks (the ancient plutonic rocks, above them the magmatic rocks, the metamorphic rocks, and finally the sedimentary rocks) had been precipitated from seawater during the Flood.

Neptunism was opposed by the Scottish geologist **James Hutton** (*1726 – †1797) and English geologists such as **Charles Lyell** (*1797 – †1875), who proved the (correct!) principle of **Actualism** and derived the formation of rocks from processes occurring today.

According to this theory, magmatic plutonites and volcanites are formed from molten rock, metamorphic rocks through reactive transformation deep underground, and sediments through deposits on the Earth's surface.

Many of the **17 UN Sustainable Development Goals** are based on geological expertise. No. 2 Zero Hunger, No. 5 Quality Education, No. 6 Clean Water, No. 7 Affordable and Clean Energy, No. 8 Economic Growth, No. 9 Industry, Innovation and Infrastructure, No. 11 Sustainable Cities and Communities, No. 12 Responsible Consumption and Production, No. 13 Climate Action, and No. 16 Peace involve applied geological topics such as the exploration, extraction, and resource management of raw materials and energy, water, and building land. This use of the environment goes hand in hand with environmental protection.

It was not without reason that the term sustainability was first defined by mining administrator Hans Carl von Carlowitz from Freiberg (Saxony) in 1713 in his book *Silvicultura oeconomica*. Wood was becoming scarce in Germany's mining regions. More wood was needed as a raw material for the expansion of mines and as an energy source (charcoal) for smelting metal from ore.

"But since the lowest part of the earth has been revealed through so much effort and expense, there will now be a shortage of wood and coal to make up for it; Therefore, the great art/science/diligence/and organization of this country will rest on how to conserve and cultivate wood so that there is ***continuous, consistent, and sustainable use****, for it is an indispensable thing, without which the country cannot remain in its essence ...* (von Carlowitz 1713).

Today, more energy and raw materials are needed than ever before in human history; more groundwater, more stones, and more metals such as copper or rare earths. However, the most important raw materials are human knowledge, creativity, and innovation.

2.2 From polymaths to specialist disciplines

Universal scholars of the 18th and 19th centuries such as Alexander von Humboldt (*14.1769 Berlin – †6.5.1859 ibid.), Lorenz Oken (born August 1, 1779 in Offenburg, died August 11, 1851 in Zurich), Friedrich August Walchner **(**born September 2, 1799 in Meersburg, died February 17, 1865 in Karlsruhe), Herrmann von Helmholtz (*31.8.1821 Potsdam – †8.9.1894 Charlottenburg) and others saw themselves as chemists, physicists, geologists, physicians, mineralogists, as well as astronomers, botanists, zoologists, and climatologists. They mark the transition from natural philosophy to exact natural science.

At Oken's instigation, Germany's oldest interdisciplinary scientific association, the **Society of German Natural Scientists and Physicians** (GDNÄ), was founded in Leipzig in 1822. In 1828, specialist sections were established within the GDNÄ, including the Geology, Mineralogy & Paleontology Section. Since 1890, a chairperson has been elected, including geologists such as Eduard Suess in 1894 and Rolf Emmermann (*1940), formerly professor at the University of Karlsruhe (TH), in 2001/2002. Rolf Emmermann was coordinator of the Continental Deep Drilling Program (KTB) from 1986 and founding director of the Helmholtz Centre German Research Centre for Geosciences (GFZ) in Potsdam in 1992. To this day, the GDNÄ brings together the natural sciences, medicine, and technology.

Gradually, professional societies such as the German Physical Society in Berlin (founded in 1845), the **German Geological Society** (DGG) founded in 1848, and the German Chemical Society in Berlin founded in 1867 were formed. This followed the trend in Great Britain, home to the world's oldest geological society, the **Geological Society of London**, founded in 1807. The aim of the DGG was "*to give the study of geology a more widespread and new impetus and to 'bring together the scattered forces for joint action*'" [Lang 1999]. From 1850 to 1868, the DGG meetings were still held as part of the GDNÄ, but from 1869 onwards they were held independently. The 13 founding fathers of the German Geological Society were, in addition to geologist Leopold von Buch (*1774 – †1852) and naturalist Alexander von Humbolt (*1769 – †1859), other geologists, miners, metallurgists, and mineralogists (Röhling et al. 2019, Röhling et al. 2023).

Subsequently, political developments led to the formation of **further geological societies** in Germany, such as the Upper Rhine Geological Association (OGV), founded in southern Germany in 1871 (now with a regional geological focus), and the Society of Geosciences (GGW) of the former GDR, founded in 1954 (merged with the German Geological Society (DGG) in 2004). In 1910, the internationally oriented Geological Association (GV) was founded (merged with the German Geological Society in 2015 to form the DGGV). In addition, the Paleontological Society (PalGes) was founded in 1912, the German Geophysical Society (DGG) in 1922, and other societies. The German Mineralogical Society (DMG) was founded in 1908 on the basis of a resolution passed by the GDNÄ in 1907 [Röhling et al. 2019], 60 years after the founding of the German Geological Society and about three decades after the Mineralogical Society of Great Britain and Ireland, which was founded in 1876 and is still active today.

With increasing **environmental awareness,** new professional fields developed in **environmental use and protection**, such as contaminated site remediation and much more, alongside the traditional job profiles of geologists in state authorities, museums, universities, mining companies, building sites, and groundwater. After the establishment of a professionally oriented group in the German Geological Society failed in the early 1980s, professional representatives founded the Federal Association of German Geologists (BDG) in

Bonn in 1984, a professional association for geologists, geophysicists, and mineralogists, which is now called the **Professional Association of Geoscientist in Germany** (BDG) [Weyer pers. com., Röhling pers. com.]. Following the example of the merger of the scientific Geological Society (founded in 1807) with the professional Institution of Geologists (founded in 1972) in 1991 to form the Geological Society, a merger of the German Geological Society DGG and the professional association BDG was initiated at the end of the 1990s, but unfortunately remained unsuccessful [Weyer pers. com., Röhling pers. com.].

2.3 Geology, geosciences, mineralogy, and other terms

The Heidelberg professors **Karl Cäsar von Leonhard** (*1779 – †1862) and his son Professor **Gustav von Leonhard** (*1816 – †1878) described in their books *Geology and Geognosy* [von Leonhard 1835, 1846, 1847], the processes of the Earth as described by James Hutton (*1726 – †1797) and Charles Lyell (*1797 – †1875) in accordance with the principle of actualism. They described **geology (**also known as **geogeny** at the time) as the science that determines the underlying physical and chemical processes involved in the formation and development of the Earth. **Geognosy (**Geo γη Earth, Gnosis γνώσεις Knowledge) was the science that researched the current state of the solid Earth and the age relationships derived from its stratification [von Leonhard 1846: 2-3]. In addition, the terms **oryctognosia** (**mineralogy)** and **oryctology (**the study of fossils, **paleontology)** were used in Germany.

The old term **geology** has dominated the literature from the 1820s to the present day, while the use of geognosy, geogeny, and orictognosy as terms has steadily declined [Howarth 2020]. Accordingly, **geological societies** (Geological Society founded in 1807, German Geological Society founded in 1848, Geological Society of America founded in 1888) and **mineralogical societies** (Mineralogical Society of Great Britain and Ireland founded in 1876, German Mineralogical Society founded in 1908, Mineralogical Society of America founded in 1919) were established in e.g. the UK, USA and Germany.

In addition to the term geology, Richthofen and others used the word **geosciences** [1862, see Howarth 2020, alternatively **earth sciences**] to refer to other disciplines related to planet Earth besides geology. In addition to geology, these include meteorology, oceanography, physical geography, and others. However, today's curricula for geosciences and geology rarely differ in terms of subject range, and the terms geology and geosciences are used interchangeably.

In the mid-1980s, some people in the USA promoted the term *earth system sciences* in order to better understand the development of the global earth system, to be able to make

statements about the future development of the earth, and to raise more research funds for earth observation [NASA Advisory Council 1986]. To this end, a range of disciplines was drawn upon, including geology, meteorology, oceanography, physical geography, biology, and other subjects. In the early 2020s, fourteen fundamental researchers, some of whom were retired, campaigned for the establishment of Earth system science in Germany, among other things to generate research funding for observation systems such as satellites and ships, and to advocate for a degree program in Earth system science [Leopoldina 2022]. Earth system science did not establish itself as a separate research discipline and degree program in the US and elsewhere, presumably because the necessary expertise and skills of the respective disciplines in research and on the job market are too different and collegial cooperation between various established disciplines has become the norm.

University teaching of geology includes the fundamentals of natural sciences and mathematics and the study of space and time. Applied geology also includes engineering subjects. **Space** is not limited to the solid earth (lithosphere), but requires knowledge of all aspects of the geosphere in the past, present, and future in research and professional practice. The **geosphere** includes the atmosphere (the air), hydrosphere (water), biosphere (living organisms), pedosphere (soil), solid upper lithosphere (solid rocks), molten asthenosphere (plastic rocks), mesosphere of the lower mantle, and baryosphere of the Earth's core. **Geological time** is not limited to the history of the Earth, evolutionary history, and climate history, but requires an understanding of the time that shapes the landscape, the time that utilizes resources, the present time, and the future in research and professional practice. The relevant time periods range from the movement of continental plates to earthquakes; in engineering and geological applications, they range from the safety of final storage facilities, the stability of tunnels, rock slopes, and caverns to the safe operation of mines, geothermal plants, drinking water wells, and gravel pits.

In their diverse activities related to environmental use and protection, professional geologists are closely tied to the engineering sciences, particularly in the areas of building ground, geoenergy/geothermal energy, groundwater, raw materials, and the environment, whether in mining, metallurgy, or civil engineering.

2.4 Geology & mining in Baden and Württemberg from the 17th century onwards

2.4.1 Salt mining in Baden and Württemberg

The presence of salt in Baden and Württemberg is documented by river and field names such as Saalbach (formerly called Salzbach), Salzach, and others, as well as by historical

sources from the Middle Ages. For example, salt was extracted from the salt works near the hamlet of Salzhofen, which is documented as far back as 1483 and is now part of the town of Bretten [Carle 1964: 20]. The saltworks dried up as early as the Middle Ages. A spring in Bruchsal and the artesian spring near Ubstadt, which has been producing salt since 1615, also testify to the presence of salt deposits in the region [Carle 1963]. This led to an intensified search for raw materials such as salt in Baden and Württemberg. In 1806, the internationally renowned professor **Karl Christian von Langsdorf** (*May 18, 1757, Nauheim – †June 10, 1834, Heidelberg) was appointed full professor at Heidelberg University from the University of Vilnius.

From 1784, von Langsdorf had been the Ansbach saltworks inspector in Gerabronn in Franconia, where he taught Johann Gottfried Tulla from 1792 to 1794. As early as 1777, von Langsdorf published a 48-page book entitled *Beitrag zur Aufnahme der Salzwerkkunde* [Contribution to the Study of Saltworks] [von Langsdorf 1777]. Von Langsdorff became a full professor of mathematics and mechanical engineering in Erlangen in 1796, accepted a position as full professor in Vilnius (now Lithuania) in 1804, and accepted a position as full professor of mathematics in Heidelberg in 1806. Von Langsdorf's lectures in Heidelberg covered not only mathematics but also subjects such as mechanical engineering, hydraulics, waterway construction, and bridge building. In Heidelberg, von Langsdorf wrote the textbook *Neue leichtfaßliche Anleitung zur Salzwerkskunde* [von Langsdorf 1824].

Von Langsdorf is considered the initiator of the successful rock salt drilling campaigns from 1812 to 1824 near Offenau (1816), Wimpfen (1818), Dürrheim (1822), Rappenau (1823), and other drilling sites in Baden and Württemberg; however, his success remained limited to Württemberg [von Beech 1875]. In Jagstfeld, now part of Bad Friedrichshall, rock salt was successfully drilled for the first time in April 1816 at a depth of 150 m, and in January 1818 a boiling plant was put into operation, which was supplied by brine extracted from the borehole. In 1820, King Wilhelm of Württemberg named the saltworks **Friedrichshall** in memory of his father**.** Salt from brine was also extracted in the region around Karlsruhe in Bretten, Bruchsal, Königsbach, and elsewhere.

Von Langsdorf had many detractors in government circles and at Heidelberg University, who restricted his practical activities. As a result, he was recalled from his research into salt deposits in Baden to the university, where he lamented that "*there has been no shortage of academic teachers for centuries, but there has always been and still is a shortage of salt experts*" [Carle 1964: 30].

Whether the difficulties of practical research at Heidelberg University could have been a reason for the founding of the Karlsruhe Polytechnic School remains to be determined.

2.4.2 Further mining

In addition to the exploration activities, which were supervised by the margrave and later grand ducal mining authority in Karlsruhe, numerous ores and other raw materials were mined and smelted in Baden and Württemberg [Metz 1977, Werner & Dennert 2004] (Table 1).

Raw material extraction included: in the Münstertal valley (fluorspar, lead, zinc, silver); in the Kinzigtal valley (barite, fluorspar, lead, zinc, copper, antimony, silver, bismuth, nickel, cobalt); white earth and glass sand in the Upper Rhine region with porcelain and faience factories; iron ore and smelting works as well as barite, e.g., in the Lower Murg Valley mining district in the northern Black Forest near Rotenfels, Gaggenau, and Bühlertal; Barite, iron, copper, silver, fluorite in the Neuenbürg mining district near Pforzheim; Copper, bismuth in the Neubulach mining district; Barite, copper, iron in the Freudenstadt mining district; the mining areas along the Upper Rhine Graben fault, such as the lead and zinc ores near Wiesloch, the lead, copper, and iron mines between Durlach and Achertal, the areas from Baden-Baden to Badenweiler with the Schauinsland mine (lead, zinc, silver) east of Freiburg; lime burning; rock salt through brining and boiling in Kraichgau, and much more.

In the Münstertal valley, ore formation took place gradually in veins of tectonically fractured rock as precipitates of gangue minerals and ore minerals. There are ore mineral sequences of arsenopyrite (arsenic pyrite) FeAsS, pyrite FeS_2, zinc blende ZnS, fahlerz (silver-bearing copper-antimony-arsenic sulfides), chalcopyrite, galena PbS, argentite Ag_2S, stibnite Sb_2S_3 to red glass head Fe_2O_3 and brown glass head $Fe^{3+}O(OH)$, as well as gangue minerals of quartz SiO_2, fluorite CaF_2, barite $Ba[SO_4]$, dolomite $(Ca,Mg)CO_3$ and calcite $CaCO_3$ [Werner & Dennert 2004: 58].

Table 1. Extraction from deposits in Baden with examples of mines [Metz 1988 et al.]. *Italics* - in operation.

Iron and manganese ores (Neuenbürg, Freudenstadt, among others)	Uranium ore (near Baden-Baden and Menzenschwand)	Rock salt (*Heilbronn*, Dürrheim, etc.)
Silver and lead ore deposits (Christophstal near Freudenstadt, among others)	Rhine gold (Rheinhausen, among others)	Potash salt (Buggingen)
Silver and cobalt ores (Heubachtal Grube Anton)	*Fluorite and barite (Wolfach, Käfersteige near Pforzheim)*	*Gypsum and anhydrite*
Lead and zinc ores (Schauinsland mine)	White earth pits for porcelain (Malsch, etc.)	Coal (Diersbach, among others)
Nickel ore (Horbach Friedrich-August mine)	*Clay for ceramics and bricks (Rettigheim, Malsch, etc.)*	*Petroleum (Landau, Weingarten, etc.)*
Copper ore mining (Neubulach, etc.)	Sand for glassworks (Altglashütte, Glaswald/Alpirsbach)	*Limestone (Wössingen, Knittlingen, etc.)*
		Stones and earth

2.4.3 Development of the Baden mining authority

Since mining had a longer and older tradition in the Grand Duchy of Baden than in Württemberg, the Baden Elector Carl Friedrich issued an organizational edict for mining and salt production as early as 1803 [Häußermann 1997]. There are reports of a **mining commission in Freiburg** from 1822 and, from 1825, a **directorate of salt works, mines, and smelting works** subordinate to the Ministry of Finance at Stephanienstr. 26 in Karlsruhe [Metz 1988]. From 1833, the directorate was headed by mining engineer Christian Friedrich Münzing [Address Book of the Capital and Residence City of Karlsruhe 1832]. In 1832, the mines and smelting works were transferred to a **directorate of forests and mines in Karlsruhe**. It was subordinate to the Ministry of Finance [Mall 1832: 39, 1833: 20]. In 1890, the directorate in Karlsruhe was transferred to a *forestry and domain directorate* as the highest mining authority in Baden [Häußermann 1997, Address Book of the Capital and Residential City of Karlsruhe Mall (ed.) 1832, 1833]. A **mining supervisor** was appointed in Karlsruhe and, at times, in the Bad Dürrheim salt works in the Schwarzwald-

Baar district as the lower authority. In 1922, the term **"mining office"** was introduced. In 1943, the responsibilities were expanded in the newly created **Reich Mining Authority in Karlsruhe** with the subordinate Reich Mining Offices in Karlsruhe (responsible for Baden), Mühlhausen in Alsace, and Stuttgart (for Württemberg and Hohenzollern). After World War II, a mining office was established in Heilbronn in the American-occupied part of the state in 1945 and a mining office in Freiburg in the French-occupied part. With the founding of the state of Baden-Württemberg in 1952, a mining authority was established in Freiburg with subordinate mining authorities in Karlsruhe (dissolved in 1954), Freiburg, and Heilbronn (dissolved in 1968). The Freiburg Mining Authority was renamed the Baden-Württemberg State Mining Authority in 1973 [Häußermann 1997].

The **Grand Ducal Baden Geological Survey** was founded in Heidelberg in 1888. Heidelberg geologist Professor Karl Heinrich Ferdinand Rosenbusch (*1836 Einbeck – †1914 Heidelberg) became its first director in 1888 and was a founding member of the Upper Rhine Geological Association (OGV) in 1871. This was preceded by the **geological survey** on a scale of 1:50,000, which was carried out by Professor Carl Ludwig Fridolin Sandberger from Karlsruhe in 1856. In 1907, the Grand Ducal Baden Geological Survey was moved to Karlsruhe and in 1910 to Freiburg. In 1998, the Geological Survey and the State Mining Authority in Freiburg were merged to form **the State Office for Geology, Raw Materials and Mining (LGRB)** of the State of Baden-Württemberg.

2.4.4 Baden Mining Association

The **Kinzigthal Mining Association**, based in Karlsruhe, was founded in 1826 to revive mining in the Black Forest. In 1835, it merged with other mines to form the **Baden Mining Association** (Badischer Bergwerksverein, also known as the Baden General Mining Association), based at Langestrasse 141 in Karlsruhe [Anonymous 1843: 228-229]. "*To this end, 2,000 shares at 200 florins and 4,600 shares at 1,000 florins* were *brought together to form a capital of millions*" [Anonymous 1843: 228-229]. The shareholders of the Badischer Bergwerksverein included the banker Louis von Haber, Professor August Walchner, the secretaries Hartmann and Rupprecht, the domain councillors Abbeck and Eberlein, Major Kunz, senior auditor Klausing and Dr. Weindel [Günter & Würtz 1987].

Mines in the Münstertal valley and four mines in the Kinzigtal valley were incorporated into the Baden Mining Association [Günter & Würtz 1987]. The **St. Anton mine** in the Heubach Valley (the Heubach near Schiltach is a tributary of the Kinzig in the Black Forest) produced around 750 kg of silver and 190 kg of cobalt ore between 1834 and 1850 [Markl 1990, Harter 2016]. The cobalt ore was used to produce cobalt oxides in the blue dye factory, which were used as blue pigments. From 1972 to the present day, the St. Anton mine near Schiltach has been operated as the Wolfach Geoscience Observatory (**Black**

Forest Observatory) by KIT and the University of Stuttgart. In addition to cobalt ore, the mine also contained silver deposits in barite.

As the Grand Duchy was no longer able to raise the capital for the necessary deeper mining from the 1840s onwards, the **Badisch-Englischen Bergwerksverein / Kinzigthal Mining Association** (also known as the Kinzigthaler Bergbauverein or Kinzigthaler Bergbaugesellschaft) was founded in 1847 with headquarters in Karlsruhe and London. The share capital raised initially enabled the expansion to proceed, but the company then ceased operations in the Kinzig Valley in 1857 and sold the mines to a French company in 1859 [Günter & Würtz 1987]. In 1864, the Baden Mining Association (Badischer Bergwerksverein) also ceased its activities in the Kinzig Valley.

3 Important geologists of Baden

3.1 Sen. Mining Councilor Carl Friedrich Erhard

Senior Mining Councilor (Oberbergrat) Carl Friedrich Erhard (*1740 Karlsruhe – †1811 Rastatt) was sent by Margrave Karl Friedrich to study at the Freiberg Mining Academy in 1773. During this time, until 1780, he collected minerals for Margravine Karoline Luise in Freiberg, Clausthal, Goslar, Dillenburg, and Sulzberg. Back in Karlsruhe, he was appointed mining councilor in 1783, chamberlain in 1786, and senior mining councilor in 1806. He later became the owner of the Umweger coal mine (probably near Steinbach/Varnhalt south of Baden-Baden) [Mayer 1961].

3.2 Senior Mining Councilor Karl Wilhelm Volz

Senior Mining Councilor (Oberbergrat) Karl Wilhelm Volz (*1766 Sulzburg – †1817 Karlsruhe) studied at the Freiberg Mining Academy and subsequently worked in Sweden before joining the Oberweiler Mining Office in 1797 and the Karlsruhe Rentkammerkollegium (Revenue Chamber) in 1801. He was appointed Senior Mining and Forestry Councillor in 1807.

3.3 Mining Councilor Christian Friedrich Münzing

Mining Councilor (Bergrat) Christian Friedrich Münzing (*1778 Kieselbronn – †1853 Karlsruhe) studied at the Freiberg Mining Academy and worked in Alpirsbach in the Black Forest and Freiberg before becoming director of the salt works, mines, and smelting works in Karlsruhe in 1825 [Mayer 1961]. In the winter semester of 1828/1829, he taught mining at the Polytechnic School in Karlsruhe. In 1833, he was mining advisor to the Directorate of Forests and Mines, which was subordinate to the Ministry of Finance [Mall 1833].

3.4 Johann Heinrich Daub

Johann Heinrich **Daub** (*1803 Salchendorf, Siegen district – †1870 Wiesloch) worked for the Badischer Bergwerksverein (Baden Mining Association) in Münstertal near Staufen from 1834 onwards, later becoming its director. When the mine was taken over by an

English company, he was appointed director in 1852. In 1853, he became representative of the Société des Mines et Fondieres de Zinc de la Vieille Montange in Karlsruhe and advisor to the Wiesloch ore mines. Later, he was commissioned with the extraction of the Wiesloch ore mines [Mayer 1961]. At the 34th GDNÄ conference in Karlsruhe in 1858, the Daub mining sector was part of the extended organizing committee [Eisenlohr & Volz 1859 : 3].

3.5 Mining Councilor Wilhelm Caroli

Mining councilor (Bergrat) Wilhelm Caroli (*1810 Lahr – †1899 Karlsruhe) studied in Freiberg from 1833 to 1836 and then worked for an English mining company in Mexico, followed by the salt works in Rappenau, then in the smelting works in Hausen and Kollnau, and from 1845 as salt works administrator in Dürrheim. Caroli was appointed mining councilor and member of the directorate of the forestry, mining, and smelting works in Karlsruhe in 1854 [Mayer 1961].

3.6 Mining Councilor Max Braun

Mining councilor (Bergrat) Karl Alexander Max Braun (*1814 Karlsruhe – †1883 Baden-Baden) was the brother of the director of the Karlsruhe Natural History Museum, Professor Alexander Braun (*1805 – †1887). Max Braun studied geology at the Karlsruhe Polytechnic School under Walchner. In 1832, Max Braun accompanied his brother Alexander and his friend **Louis Agassiz** (*1807 Canton of Fribourg, Switzerland – †1873 Cambridge, USA) on their nine-month study trip to Paris [Wolkersdorfer 2007].

The Swiss Louis Agassiz later became one of the world's most famous naturalists and is considered the discoverer of the Ice Age, about which he published in 1840 [Agassiz 1840]. In 1833, Agassiz married the daughter of Professor Alexander Braun, Cecilie (*1809 Karlsruhe – †1848 Neuchâtel), with whom he had three children. He became a professor in Neuchâtel and, from 1847, professor of zoology and geology at Harvard, Cambridge MA, USA.

Max Braun worked as a mining and metallurgical candidate in several mines in the German Ore Mountains (Erzgebirge) and in 1837 became a mining and metallurgical intern in the Münster and Kinzig valleys in the Black Forest [Wolkersdorfer 2007]. After working in the Ore Mountains, Kinzigtal, and Münstertal, Max Braun worked in the Pyrenees and Spain, and in 1840 in Clermont-Ferrand, France, as an ingénieur de la Compagnie d'exploration des Mines Métalliques des Corbières [Mayer 1961]. In the same year, he published a study on **uranium deposits** in the Black Forest at the same time as **Walchner**. The following year, while working in Algiers (North Africa) and Huy (Belgium), he rose to

become **director of Moresnet,** Belgium, at the Société des Mines et Fonderies de Zinc de la Vieielle Montange.

Max Braun was also co-founder of the chemical factory **Hasenclever & Co. in Stolberg-Atsch near Aachen**, which was initiated by Friedrich Wilhelm Hasenclever in 1852 and renamed Rhenania AG in 1856. Hasenclever & Co. produced sulfuric acid from the zinc blende mined in Aachen-Stolberg. Friedrich Wilhelm Hasenclever, Max Braun, and Eugène Godin then developed a process for producing **sulfuric acid** from the zinc blende mined in Stolberg**,** and from this**,** soda and later also Glauber's salt and **mineral fertilizer**. Through various mergers, Rhenania AG first became part of Verein Chemischer Fabriken Mannheim, then Kaliwerke Friedrichshall AG, Kaliwerke Neu-Staßfurt, and in 1928 was renamed Kali-Chemie AG, which was taken over by **Solvay GmbH** in 1992.

Max Braun met his English wife Louisa Nisbett (*1817 London – †1884 Rome) in southern France, where she was staying as a companion to her cousin. Max Braun and Louisa married on September 2, 1841, in Karlsruhe and had eight children. In the mid-19th century, infant mortality was high: Emmelie died in Carcassonne in 1842, the year she was born; Max (born in 1858 in Moresnet, died in 1859 in Moresnet) died after one year; Alfred (born in 1844 in Clermont-Ferrand, died in 1864 in Menton, Monaco) died of tuberculosis at the age of 20; Sarah (*1851 Moresnet – †1884 Rome) died at the age of 32, and their daughter Emy (*1855 Moresnet – †1892 Venice) died of pulmonary tuberculosis at the age of only 34 [Wolkersdorfer 2007]. Only three of the eight children lived to be older than 50: Carl (*1850 Moresnet – Tanga, Africa) died at the age of 57, Lousia (*1847 Huy – †1917 Aachen) lived to be 70, and Liane (*1854 Moresnet – †1932 Berlin) lived to be 78 [Wolkersdorfer 2007]. Max Braun lived in Aachen since his retirement in 1874. He died of food poisoning while taking a cure in Baden-Baden and was buried in Moresnet, Belgium [Wolkersdorfer 2007].

3.7 Mining Foreman August Fischer

Mining Foreman (Bergmeister) August Fischer August Fischer (*1813 Karlsruhe – †1884 Durlach) studied mining at the Polytechnic School in Karlsruhe. After graduating, he gained practical experience in the Black Forest, Nassau, Westphalia, and the Harz Mountains from 1833 to 1835 [Mayer 1961]. After working for the management of the Baden Mining Association from 1836 to 1841 and managing the blue dye works (extraction of blue pigment from cobalt-containing ore) near Alpirsbach in the Black Forest until 1841, he moved to the Sophienau blue pigment works near Hildburghausen in Thuringia and then to Upper Carinthia in 1849 to work in iron and copper mining [Mayer 1961]. In 1856, he moved to the Rappenau salt works, which he managed from 1859 until his retirement in 1877 [Mayer 1961].

3.8 Prof. Dr. Philipp Platz

The teacher at the Realgymnasium in Karlsruhe Prof. Dr. Philipp Platz (*1827 in Wertheim – †1900 in Karlsruhe) was co-founder and first chairman of the Karlsruhe section of the German Alpine Club (DAV) on January 31, 1870. The section was founded only nine months after the DAV was founded on May 9, 1869, in Munich. Philipp Platz was co-founder of the Upper Rhine Geological Association, initiated by Professor Adolph Knop from the Karlsruhe Polytechnic School and colleagues, which was founded on August 17, 1871, in Bad Rotenfels in the Murg Valley. He also contributed numerous geological articles to the proceedings of the Karlsruhe Natural Science Association [e.g., Platz 1868].

3.9 Senior Mining Councilor Herrmann Honsell

Senior Mining Councilor (Geheimer Oberbergrat) Herrmann Honsell (*1842 Konstanz – †1918 Konstanz) studied at the Karlsruhe Polytechnic School and the Freiberg Mining Academy. He traveled to Bohemia, Silesia, and Galicia, entered the civil service of Baden, and became mining master of the Dürrheim salt works in 1875, mining councilor at the Domain Directorate in Karlsruhe in 1881, senior mining councilor in 1893, and privy senior mining councilor in 1904 [Mayer 1961].

3.10 Mining Director Leonard Buchrucker

Mining Director (Bergdirektor) Leonard Buchrucker (*1863 Zeulenroda – †1940 ibid) was employed as a mining master (Bergmeister) in Karlsruhe in July 1891 after completing his studies in Freiberg and obtaining his doctorate in Munich. In 1896, he became mining master at the Dürrheim salt works in the Black Forest. In 1898, Buchrucker went on a year-long expedition to China, possibly with Karl Futterer, the newly appointed professor of geology and mineralogy at the Karlsruhe Polytechnic School. In 1903, he became mining director of the Black Forest ore mines, in particular the Schauinsland mine near Freiburg [Mayer 1961].

4 Geological traditions

4.1 Glückauf!

In the 16th century, the greeting **Glückauf!** emerged in the Ore Mountains, which is an abbreviation of the greeting ***Ich wünsche dir Glück, tue einen neuen Erzgang auf! (I wish you luck, open up a new ore vein!)***. In official and private correspondence, Glückauf is used in the salutation *Glückauf Frau/Herr X (Glückauf, Mrs./Mr. X),* as well as in the closing *Mit freundlichem Glückauf! (With kind Glückauf!*).

4.2 Saint Barbara

The patron saint of geologists and miners is **Saint Barbara** of Nicomedia, now Izmit in Turkey (3rd century). Her father Dioskuros locked the beautiful and intelligent Barbara, who had been secretly baptized and refused to renounce her Christian faith, in a specially built tower for nine years. When she still refused to renounce her faith, her father brought her before the Roman governor Marcianus. Despite his cruel torture, Marcianus was also unable to make Barbara renounce her faith, because Christ repeatedly healed her wounds. Finally, according to legend, the martyr was beheaded at the age of 29 on December 4, 306 AD by her own father, who was then struck by lightning and burned to death. December 4 is dedicated to **Saint Barbara,** who stands for steadfastness and bravery. This memorial day is often accompanied by a parade of miners in festive costumes and a hearty Barbara festival.

4.3 Miners‘ coat and tools

The **miners' coat**, introduced in Saxony as early as 1719, features nine gold buttons on the front, the top three of which are worn open in memory of the **Trinity** (faith, hope, love). Together with the five gold buttons on each of the cuffs and on the chest, the number of buttons commemorates the 29 years of St. Barbara's life. The black miner's coat symbolizes the darkness underground, while the golden buttons represent the light of the sun. The **pelerin collar** on the shoulder with its nine points, originally designed to protect against dripping water, commemorates Saint Barbara's nine years of imprisonment. The **braided trim** on the shoulders symbolizes the wicks of a miner's lamp. The **velvet heart** on the right shoulder indicates affiliation: black for coal mining, green for ore mining, red for potash

mining, and gray for stone and earth mining. Above it, on the shoulder, is the **emblem** of a crossed **hammer and iron** for mining. Smelters wear cruciform tongs crossed with a slag iron instead. Each mining district and each corresponding university has slightly different mining coats. In Baden-Württemberg, the former potash mining in Buggingen, active ore mining in the Kinzig Valley, active rock salt mining in Heilbronn, and stone and earth mining, among others, have preserved the tradition to this day.

The **miner's hammer** (der Schlegel, Fäustel) with a square cross-section on both sides is used to strike the **iron** (das Eisen). The mining iron has a flat striking side for the hammer, known as the "**Bahn,**" and a pointed side, known as the "**Örtchen**." They are **placed** in the shape of a **St. Andrew's** cross, with the hammer resting on the mining iron and the handle of the hammer pointing downwards to the right. The pointed mining iron has an **eye** in the middle into which the handle (Helm) is loosely inserted so that when the mining iron is driven deep into a crevice, the helmet can be pulled out beforehand and the mining irons, which become blunt during a shift, can be replaced. The handle of the pickaxe lying underneath points downwards to the left because it was held with the left hand and lay under the hammer (Fig. 6). This enabled the miners to reach for their tools even in the dark **in the mine**. Since the 16th century, crossed hammers and pickaxes have symbolized the miners' coat of arms.

Fig. 6. Hammer and pickaxe in the shape of St. Andrew's Cross.

In addition, the miners carried their personal **miner's lamps** (Grubenlampe) for working underground. Any type of artificial light source underground is referred to as **miner's lamp** (Geleucht).

The foreman uses the foreman's stick (Häckel) to determine the stability of the rock by tapping on it (Fig. 7). The foremen are the supervisors for assigned areas of the mine, and the **chief foreman** (Obersteiger) is the highest supervisor in the mine.

Fig. 7. Foreman's stick (Häckel) with measurements every 10 cm.

The miners leather apron (Bergleder), colloquially known as arse leather (Arschleder), protected against moisture when working in a seated position and when sliding down wooden slides into the mine (Fig. 8).

Fig. 8. Miner’s leather apron with straps that are tied around the hips and legs.

Miners used to be short in stature (see Snow White and the Seven Dwarfs by the Brothers Grimm) because they had to work underground in low light conditions from an early age, which led to vitamin D deficiency, among other things. The work was hard and dangerous. Initially, they protected their heads with straw-filled caps similar to the pointed caps worn by the seven dwarfs.

The miners had the privilege of carrying weapons known as **Bergbarte** or Barte, a broad battle axe. The Bergbarte served to protect them from attacks on their way from their safe place at home to their remote workplaces. Originally used as a defensive weapon by miners, the Bergbarte is now heavily decorated as **a ceremonial weapon**. The miners were exempt from military and corvée labor and had the right to bake bread and distill schnapps. This right is also recorded in a verse of **the Steigerlied** (miners’ song), which was first documented in its present form at a festival in Schneeberg in 1678 in the Ore Mountains.

4.4 Barbara celebration and miners' song

The annual **Barbara celebration (Barbarafeier)** in honor of Saint Barbara, patron saint of geologists and miners, is often held on the first Friday in December. One of the traditions of the Barbara celebration is the **"Ledersprung"** (leather jump), the initiation ceremony for first-year students in the mining industry. After answering the questions: What is your name, your origin, your status, your motto? and drinking a glass of beer, the students jump one after the other from a beer barrel over the leather apron (**Arschleder)**, held by the hands of the two highest-ranking persons if necessary. The student thus acquires the title of "Ehrenbergfrau" or "Ehrenbergmann" and has the right to wear a miner's coat. At other universities, the initiation ceremony is performed with the "**Barbarataufe**" (St. Barbara's baptism). The "Steigerlied" (miner's song) from the Ore Mountains, which first appeared in the 16th century, is also part of the St. Barbara celebration:

1. Glückauf, Glückauf! The miner is coming,
   l: and he has his bright light in the night :l
   already lit, already lit.
2. He has lit it, there is a glow,
   l: and with it we drive into the night :l
   into the mine, into the mine.
3. Into the mine, where the miners are,
   I: who dig for silver and gold at night, :l
   from rock, from rock.
4. They dig the gold out of rock,
   l: and the black-brown maidens, at night, :l
   to whom they are devoted, to whom they are devoted.
5. And when I return home to the maiden,
   l: then the miner's greeting resounds in the night, :l
   Glückauf, Glückauf, Glückauf, Glückauf!

   and at the farewell song in the late hour also:
6. We miners are good, honest folk,
   I: for we wear leather over our backsides at night :l
   and drink schnapps, and drink schnapps.

Meanwhile, in addition to the Freiberg version from the Ore Mountains, the Clausthal and Ruhr versions of the Steigerlied have slightly different lyrics. Today, the Steigerlied is still the greeting of soccer fans e.g. at Schalke. In 2023, the Steigerlied was added to the nationwide UNESCO list as intangible cultural heritage.

5 Applied Geosciences at KIT since 1825

5.1 Friedrich Walchner 1825–1855 (Geology, Mineralogy, Chemistry)

Bergrat (mining councilor) Professor Dr. med. Friedrich August Walchner (*September 2, 1799 in Meersburg – †February 17, 1865 in Karlsruhe) became the first professor of geology, mineralogy, and chemistry in Karlsruhe in 1825 (Fig. 9). Together with his 11 founding colleagues, including himself and Wucherer as professors, they established the Polytechnic School in Karlsruhe. Walchner studied in Göttingen and Freiburg, became a general practitioner in 1821, and received his doctorate in medicine in Freiburg in 1822. He completed his habilitation in chemistry and mineralogy in Freiburg in 1823 and, in the same year, accompanied the geologist Ernst **Heinrich Carl von Dechen** (*March 25, 1800, Berlin – †February 15, 1888, Bonn) on his journey through Central Europe "... *to the Swabian salt works on the Neckar and Kocher rivers, where mining for solid rock salt had just begun ...*" [Laspeyres 1889].

Fig. 9. Founding member and second director of the Polytechnic School, Professor Dr. Friedrich August Walchner in 1844 [Image: WikimediaCommons 2025].

Walchner taught geognosy, mineralogy, and chemistry as an associate professor at the University of Freiburg from 1824, where he also established the university's rock collection. With the founding of the Karlsruhe Polytechnic School in 1825, he was appointed there. In Karlsruhe, Walchner taught "geognosy" (geology), chemistry, and "oryctognosy" (mineralogy).

Following the restructuring by State Councilor Nebenius, Walchner was **director of the Polytechnic School** in Karlsruhe from 1832 to 1836. During this time, the Polytechnic School was able to move out of the southern extension of the Lyceum in Karlsruhe, which had been completed in 1824, and into the **new building at Kaiserstrasse 12** in Karlsruhe in 1836.

From at least 1832, Friedrich August Walchner was an advisory member of the **board of directors of the salt works, mines, and smelting works** at Stephanienstrasse 28 in Karlsruhe. In 1838, Walchner was appointed **mining councilor** and awarded the Baden Order of Knights of the Zähringer Lion. In the 13th annual report from 1846/1847, Walchner is listed as an honorary member of the Mannheim Society for Natural History [Löw 1847: 51]. In 1848, Walchner was elected a corresponding member of the Bavarian Academy of Sciences. In 1851, *"Mr. Walchner, senior mining councilor and professor in Carlsruhe, proposed by Messrs. v. Carnall, Beyrich, and Zerrenner,"* joined the German Geological Society (DGG), which was founded in 1848 [von Carnall et al. 1851: 337, von Carnall was chairman of the DGG in 1860 and Beyrich was secretary].

In 1855, Walchner *"... retired and subsequently became involved in numerous mining enterprises, where his knowledge of the geological conditions of the country stood him in good stead*." [Seubert 1875]. In 1857, Walchner also retired from the Grand Duchy's administration; the Karlsruher Zeitung No. 222 of September 22, 1857 wrote: *"Today's Government Gazette No. 42 ... I. Direct supreme resolution of His Royal Highness the Grand Duke ...*" announced "*the dismissal of mining councilor Dr. Walchner from his position as advisory member of the Directorate of Forestry, Mining, and Metallurgy."* After his retirement, Walchner was involved in a number of mining ventures [Gaston 1961]. He also contributed general articles on the sources of the Danube and on trade and industry, such as "*The Clock Industry in the Black Forest*" [Walchner 1859, 1860 a-c].

5.1.1 Walchner and geological teaching at the Polytechnic School

In addition to teaching geology, mineralogy, and chemistry, Walchner *"also served as director of the chemical-technical school for almost 30 years as a popular teacher distinguished by his brilliant lectures*" [Seubert 1875: 421]. The two-year "*Höhere*

Gewerbeschule" (higher vocational school), which Walchner headed, aimed to educate "*such pupils ... who devote themselves to a trade or branch of industry ...*".

The following courses were offered:

1. Year *"In the first year, nine teachers teach: general technical chemistry (4 hours, **Walchner**), elementary statistics (5 hours, **Kayser**), descriptive geometry (6 hours, **Schreiber**), practical geometry (4 hours, **Schreiber**), mechanical engineering (6 hours, **Volz**), construction (6 hours, **Keller**), botany and zoology (7 hours, **Alex. Braun**), history (4 hours), accounting and commercial studies (2 hours, **Bleibtreu**), French language (3 hours), English language calligraphy, freehand drawing, workshop work."*

2. Year *"In the second year, there are 9 teachers: Geognosy and mineralogy (4 hours, **Walchner**), technical physics (3 hours), special technical chemistry (2 hours, **Walchner**), elementary mechanics (6 hours, **Kayser**), mechanical engineering (6 hours, **Volz**), general course in architecture (4 hours, **Eisenlohr**), first course in water and road construction (6 hours, **Bader**), construction (6 hours, **Keller**), or popular road and water engineering (2 hours), ethics (3 hours, **Stieffel**); Languages, work in the chemical laboratory and in the workshops."*

   [from Anonymous 1843: 179, lecturers added in bold from Anonymous 1899: 58]

From 1851 onwards, Walchner only taught geology (geognosy) and mineralogy; the teaching of chemistry and the management of the chemical-technical school within the Polytechnic School's were transferred to the up-and-coming Karl Weltzien [Nippert 2016].

Anonymous [1899: 8-9] writes about Walchner in chapter "IX. Chemistry, including the new buildings for the chemical-technical, chemical, and botanical institutes": "*This detailed purpose [note: of the polytechnic school] with only a brief mention of the task of also preparing for 'mechanical factories, such as cotton mills, all kinds of mills, etc.' as well as the fact that, with the exception of two years, the professor of chemistry and mineralogy and later mining councilor **Walchner** headed the school until the "Höhere Gewerbeschule" was divided into a mechanical-technical and a chemical-technical school in 1847, indicate that from the outset it had the distinct character of an institution for the training of technical chemists. After the division of the "Höhere Gewerbeschule," Walchner remained head of the chemical-technical school until 1851.*

Less scientifically productive, he possessed an eminent teaching talent and thus had a stimulating effect on science and practice. According to the latest research, it is thanks to his inspiring lectures that the French chemist Karl Gerhard, born in Strasbourg in 1816, who later became so famous and studied chemistry in Karlsruhe in 1831/32 and 1832/33, switched from engineering, which he had initially chosen, to chemistry.[1]

Walchner's era was marked by the dominant doctrine of the Freiberg geologist **Abraham Gottlob Werner** (*September 25, 1749, Wehrau – †June 30, 1817, Dresden), according to which all rocks were deposited from seawater during the Flood (known as **Neptunism**). "*But Werner had never traveled far; the Alps remained unknown to him, and he had never seen volcanoes*" [von Leonhard 1835: 12]. The widespread doctrine of Neptunism was opposed by, among others, Heidelberg professor **Karl Cäsar von Leonhard** (*September 12, 1779, Rumpenheim – †January 23, 1862, Heidelberg) in his book Geognosie und Geologie (Geognosy and Geology). "*Had he* (note: Werner) *seen how not only young freshwater deposits, but also granite and other rocks he considered to be the oldest had been broken through by basaltic lava, lava that had obviously risen from the depths and spread in unmistakable streams over the surface of those solid masses, he would have had to renounce the untenable belief that such formations were the result of precipitation from water*" [von Leonhard 1835: 13]. Walchner had also already correctly understood the different conditions under which sediments and crystalline, massive rocks are deposited, writing:

"*The distinction between layered and massive mountain formations is quite suitable for supporting our ideas about the formation of mountain masses. In the formation of layers, one cannot fail to recognize the successive deposition of layers from bodies of water, similar to precipitation, and one finds irrefutable proof of the formation of mountain masses under the influence of water, or the existence of Neptunian formations.*

Massive rocks, on the other hand, due to their composition of substances that do not dissolve in water and never crystallized from aqueous liquids, point to conditions where crystallization occurs under the influence of fire, to melting, to fiery flow, from which, as the masses cool and solidify before our eyes, crystallization so often takes place; they lead us to a volcanic mode of formation.

... and if we finally study closely the conditions under which, even today, before our very eyes, further formations are taking place on the Earth's surface, partly under the influence

[1] Considering the quantity and content of Walchner's scientific writings, particularly on geology (geognosy), mineralogy, and mining, the low scientific productivity mentioned by Anonymous [1899] is more attributable to the field of chemistry.

of water and partly under the influence of fire, we must grant the highest degree of certainty to our conclusions that the layered formations (note: sedimentary rocks) owe their formation to Neptunistic, massive volcanic, and plutonic effects, the highest degree of certainty" [Walchner 1839: 578-579].

One of Walchner's students was **Charles Frédéric Gerhardt**, who studied chemistry with him from 1831 to 1833. Gerhardt then went to Leipzig to study with Otto Linné Erdmann and to Giessen to study with Justus Liebig, later becoming a professor in Montpellier. In 1854, Gerhardt declined the chair offered to him at the Zurich Polytechnic School (later ETH Zurich) and became a professor at the École Polytechnique in Strasbourg [Gerhard 1964]. Gerhardt made a name for himself primarily in the field of organic chemistry.

5.1.2 Walchner and the Karlsruhe Natural Science Association

In 1840, Walchner founded the **Association for Scientific Communications Carlsruhe** together with Alexander Braun, director of the Karlsruhe Natural History Museum, and physicist Wilhelm Eisenlohr [Naturwissenschaftlicher Verein 1864: 1]. Other sources suggest that the chemist Weltzien, who was admitted as a lecturer at the Lyceum and the Polytechnic School in 1841, and the director of the Polytechnic Schools's forestry school at the time, Professor Johann Ludwig Joseph Klauprecht, were also involved in founding the association on November 16, 1840, in the main lecture hall of the Karlsruhe Polytechnic School [Trusch 2016]. At monthly meetings of physicist Eisenlohr, geologist Walchner, chemist Weltzien, meteorologist Stiefel, physicians Hochstetter, Schweig, and Voltz, among others, lectures were given in turn until the association's activities came to a standstill during the revolutionary years of 1848/49 [Oberdorfer 1952]. At the suggestion of Grand Duke Friedrich and, above all, at the instigation of physicist Eisenlohr, the association was revived in 1858 as an association for scientific education [Karlsruher Zeitung No. 307 of November 9, 1909], which gave rise to the Natural Science Association Carlsruhe (Naturwissenschaftlicher Verein Karlsruhe) on April 9, 1862, founded by geologist Fridolin von Sandberger and colleagues [Karlsruher Zeitung No. 307 of November 9, 1909, Trusch 2016: 105].

5.1.3 Walchner's deposit discoveries

Walchner was involved in metal ores in the Black Forest and Kraichgau, rock salt, coal, and thermal water. This included not only the exploration and extraction of raw materials but also the processing of ores.

In 1835, Walchner and like-minded individuals founded the **Badischer Bergwerkverein (Baden Mining Association)** with mines in the Kinzig Valley between Schiltach and Offenburg and in the Münstertal Valley between Münstertal and Staufen im Breisgau. "*While the Baden region may be poor in coal, it is all the richer in lead and silver ores, which are mined in Münsterthale at the Teufelsgrund mine and then smelted; fluorspar occurs in the galleries in excellent crystals. ... This mining operation is under the direction of the mining association, which also processes cobalt ore;* ***the new method used by mining councilor Walchner*** *to process cobalt ore, for which he holds several patents, produces an excellent cobalt oxide that is arsenic-free and, with care, can be purified to a very high degree. ... and has recently enjoyed widespread use in French porcelain and faience factories* [Hellmann 1849: 450-451] (note: unlike porcelain, faience remains porous after firing and requires a thicker glaze).

In 1847, Walchner discovered the high **nickel content** in the anatexites in Horbach, southwest of St. Blasien in the Black Forest, whereupon the Friedrich-August mine, named after him, was established and mining was carried out until 1918 [Brill & Falkenstein 2013, Metz 1980: 20]. The St. Anton mine, now the KIT Black Forest Observatory, was also reopened by the Baden Mining Association in 1830 to extract **cobalt** and **silver** from 1834 to 1850. Walchner also investigated the brown ironstone veins in the Kinzig Valley [Walchner in Eisenlohr & Volz 1859: 51-60].

Walchner was also jointly responsible for the resumption of **lead-zinc-silver mining** in the Muschelkalk, which had presumably ended in 1777 near Nussloch between Heidelberg and Walldorf. After an old shaft initiated by Walchner was opened in 1829 but yielded only a small amount of calamine (zinc carbonate) [Hildebrandt 1997: 63], a one-meter-thick mineralization was found in 1845 in a limestone quarry between Wiesloch and Nußloch. Exploration in the region was intensified. In 1851, a discovery was made in a rediscovered medieval tunnel [Herth 1851, Walchner 1851], and mining continued with a few interruptions until 1954 [Hildebrandt 1997: 82]. The Bayrische Volksblatt [1851] reported:

"*Wiesloch, April 18. A few days ago, the mining councilors Walchner and Sommerschu*[2] *, together with Mr. Domänenrath Eberlein, were here and took a closer look at the inventory of a newly discovered calamine (zinc ore) mine. The gentlemen left our town very satisfied; Mr. Walchner stated publicly that what they had encountered and seen exceeded all expectations and previous descriptions. There was a treasure of immeasurable value, he said, and nothing like it could be found anywhere else in Germany. ... and when the Reinhardt brothers from Mannheim, who were building there, recently announced that they had*

[2] Note: Mining councilor Sommerschu is also referred to as Sommerschuh.

struck old workings while sinking a shaft at 100 feet and found a huge calamine deposit covering a large area, ..." the "*... commission, mining councilors Walchner, Bergrath Sommerschu, Domänenrath Eberlein, ... inspected the old mine workings on the 14th of this month ..."* [Bayrisches Volksblatt 1851: 419].

Simply by clearing the old tunnels (an almost horizontal mine shaft in the mine) in 1851, 2,000 tons of calamine were already extracted [Hildebrandt 1997: 67]. Mining inspector Daub from Karlsruhe and Walchner provide further details on the ore deposits in Wiesloch [Walchner 1851, Walchner in Eisenlohr & Volz 1859: 94-96]. Walchner also studied **iron ores** in karstified carbonate rocks [Walchner 1853], but these "*cannot be smelted near Wiesloch because of their arsenic content...*" [Walchner in Eisenlohr & Volz 1859: 97].

While exploring for hard coal, Walchner found the **warm waters** in Rotenfels near Gaggenau in the northern Black Forest, which led to the establishment of the local spa. Since "*... less than 200,000 hundredweight of coal are extracted annually from the small surrounding coal mines, His Highness Margrave Wilhelm von Baden ordered drilling work on the Rothenfels estate in 1839, the management of which was entrusted to me."* While drilling for coal in Rotenfels, he struck mineral springs at a depth of 330 feet in the Rotliegend formation, which initially *poured out "almost 24 Fuder (*note: 1 Fuder = 1500 liters) *in 24 hours"* at a *"temperature of 16°R. (*Note: Reaumur: 80 units between the freezing and boiling points of water, corresponding to 20°C)*"* and then decreased in the outflow. After *"medical experience had proven its healing properties beyond doubt, His Highness had the spring, which was now named Elisabethen-Quelle after his most serene wife"* [Walchner 1843a], developed into an attractive spa resort.

Drilling for **hard coal** near Offenburg in Baden did not encounter any coal, *"so that until now the mines near Gängerbach, not far from Offenburg, are the only ones that supply coal from the Baden Black Forest that is available for trade."* [Hellmann 1849].

5.1.4 Digression: Inefficiency due to government regulations & wood shortage (Hellmann 1849)

The inefficiency of state-run operations was highlighted by Hellmann [1849: 451]: "*In private hands, this mining industry thrives and expands; competition from other locations encourages producers to offer their products at the lowest possible price. This is not the case with the ironworks operated by the government ...".*

Hellmann [1849] also pointed out the unnecessarily high costs of rock salt for citizens and expensive wood fuel from the Black Forest.

The **Black Forest** was almost completely **deforested** by the mid-19th century due to increasing clearing. The numerous forest glassworks in the Black Forest [Maus 2000], the processing and smelting of the extracted ores, and the lime kilns required large amounts of energy from wood. The **energy crisis** caused by deforestation was ended by the advent of coal, the rural exodus from the Black Forest to the cities accompanying industrialization, and the implementation of forestry and thus the redeveloped timber industry [Huss 2014: 481]. There was a lot of mining in **Baden**, and the region is considered **one of the oldest mining regions in the world.** Ulrich Rühlein von Calw (*1465 Calw – †1523 Leipzig), who was born in the northern Black Forest, was probably familiar with the 250-year-old mining industry around Neubulach in the northern Black Forest [Werner & Dennert 2004: 18] and, in addition to his experience in geology, mining, and smelting in the Ore Mountains, also incorporated his knowledge of the Black Forest into his books [von Calw 1518, printed in Worms].

Hellmann [1849] explains how the authorities, through mining engineer Sommerschuh, rejected Walchner and Hellmann's idea of searching for salt in the Baden Upper Country:

"To prove how presumptuous and thoroughly contrary to the welfare of the country civil servants can be, who are driven solely by a certain vanity to want to steer the mining industry in the Baden region and who, with their hollow foreheads and long noses, on which the conceit of civil servants is painted, confront strangers, I cite the following example.

Some time ago, I asked Bergrath Sommerschuh in Carlsruhe whether he believed that the effort to obtain a concession to drill for rock salt in the Upper Country of Baden would not be in vain! To which he replied, with great irony, that it would be madness to establish a third saltworks when the two existing saltworks in Rappenau and Dürrheim could supply far more salt than the state of Baden needed. Furthermore, it would be a disgrace for them (i.e., the civil servants of the factories) if a third saltworks were to be established and wanted to sell salt more cheaply than it is currently sold.

*I then paid a visit to Mr. Sommerschuh himself, who laughed in my face when I brought up the subject of the salt works and said, "Hey, Mr. Bergrath **Walchner** came up with the idea, but I am against it. I am fighting this idea, which will die as quickly as it was born." None of this would strike me as remarkable if there were a more reasonable reason than Mr. Sommerschuh's vanity.*

But what advantage would it be for Baden to have a saltworks, even a private one, in the Rhine Valley? First of all, it would save the transport of salt from Dürrheim, i.e., from the heights of the Black Forest to the lowlands of the Rhine Valley, which is traversed by a railroad; or it would be possible to sell the salt to the farmers more cheaply by avoiding this transport, and then in the Rhine Valley, where coal is readily available, this could be used, while in the Black Forest the increasingly expensive wood could be burned with a

little peat. The main advantage, however, that a salt works in the Rhine Valley would offer is that the rock salt there is only 300 feet deep, so it could be easily mined, which could then be ground and sold as cattle salt or fertilizer, thus saving a large expense for fuel, which the farmer now has to pay unnecessarily." [Hellmann 1849: 451-452].

5.1.5 Walchner's reference books

Walchner's *Handbook of Complete Mineralogy in Technical Relation to Use in his Lectures and for Self-Study* [Walchner 1829, First Volume Oryctognosie, 631 pp., Walchner 1832, Volume Two Geognosie, 1104 pages] is likely to have been the first and oldest textbook by a lecturer at KIT or the Polytechnic School of the time.

His *Handbook of Mineralogy and Geognosy* (1831), included in Oken's *General Natural History for All Classes* as *Volume One: Mineralogy and Geognosy* [Walchner 1839, 860 pages], were reference works of their time [Seubert 1875: 421] and, like his *Handbook of Geognosy for use in his lectures and for self-study* [Walchner 1846, 1120 pages], were widely distributed.

Walchner wrote other textbooks such as his book *Chemistry, adapted for the general public and in relation to trade and civic life* [Walchner 1843a, 1130 pages] and his book *Darstellung der geologischen Verhältnisse der am Nordrande des Schwarzwaldes hervortretenden Mineralquellen mit einer einleitenden Beschreibung der naturhistorischen Verhältnisse des zu Rothenfels bei Baden entdeckten Mineralwassers: mit topographischen Plan und einer Zeichnung* [Walchner 1843b, 71 pages].

His *Handbuch der Geognosie* (Handbook of Geognosy, 1851) is described by von Gümbel [1889] as "*the most important of his writings,*" "*a broad-based, very comprehensive work, written with great care and literary knowledge, which unfortunately remained unfinished after the first volume dealing with alluvial, diluvial, and tertiary formations*."

5.1.6 Walchner and democracy

In 1833, Walchner was elected as representative of constituency S8 to the democratic Second Chamber of the Estates Assembly of the 6th Baden State Parliament of the Grand Duchy of Baden. The First Chamber was reserved for the nobility. The Baden Estates Assembly was established in 1819 and is considered the cradle of democracy in Germany. In 1848, Walchner was a representative of Baden and a member of **the preliminary parliament** that met in Frankfurt's Paulskirche in March and April 1848**.** This parliament convened in Frankfurt on March 31, 1848, to prepare for the election of the constitutional Frankfurt National Assembly in April and May [Jucho 1848 a, b].

More than 500 representatives of the estates and members of the state parliament were invited to the preliminary parliament by the 51 opposition politicians who met in Heidelberg on March 5, 1848. The first all-German, democratically elected national parliament convened for the first time on May 18, 1848. The cause was the German Revolution of 1848/1849, which spread from the Grand Duchy of Baden to all states of the German Confederation and had the goal of creating a German nation state with a democratic constitution. It was bloodily suppressed by the Prussian and Austrian military by July 1849.

5.1.7 Walchner, Rotteck, and Welcker

Walchner wrote an article on polytechnic schools [Walchner 1848: 40-44] and mining [Walchner 1858: 40-44] in *the encyclopedia* published in 1834 by the liberal Freiburg professor **Karl von Rotteck** (*1775 in Freiburg – †1840 in Freiburg, ennobled in 1789) and the Freemason and Freiburg professor **Karl Theodor Welcker** (*1790 Ober-Ofleiden – †1869 Neuheim) – *Encyclopaedia of all political sciences for all classes* [Walchner 1848: 40-44], mining [Walchner 1858: 527-536] and chemistry [Walchner 1859: 510-512]. In it, he highlights, among other things, the contribution of polytechnic schools to industrial development and criticizes their financial resources.

Karl von Rotteck worked with **Nebenius** on the **Baden Constitution** of 1818 and was elected to the First Chamber of the Baden Estates Assembly in 1819 as a representative of the University of Freiburg. The government appointed by Grand Duke Carl disapproved of Rotteck's liberal ideas and attempted to prevent his re-election by influencing and manipulating the vote. Karl von Rotteck stood for election to the Second Chamber of the Baden State Parliament and represented the electoral district of Kenzingen and Endingen from 1831.

5.1.8 Walchner in the Baden Estates Assembly and the Frankfurt Pre-Parliament

Walchner was elected to the **Baden Estates Assembly** in 1833 in the S8 electoral district of the city of Karlsruhe. On March 25, 1846, Walchner was elected alongside senior teacher Sütterlin, master mason Mauck, master gardener Männing, master baker Schweizer, innkeeper Eichhorn, and general staff physician Dr. Meier as electors for the tenth district in Karlsruhe [Karlsruher Zeitung No. 84 of March 27, 1846].

Like Karl Theodor Welcker, Walchner was a member of **the preliminary parliament**, which met in Frankfurt's Paulskirche from March 31 to April 3, 1848. Walchner was probably initially close to the Casino faction in the preliminary parliament, then to the Landsberg faction [Karlsruher Zeitung No. 92 of April 2, 1848]. The largest faction, the Casino

faction, represented the liberals of the right-wing center and favored a nation state with a legislature limited to the legislative branch and an emperor with a hereditary office [Deutsches Historisches Museum 2024]. The Landsberg faction was formed in September 1848 from members of the constitutional-liberal Casino faction and the left-wing, parliamentary-liberal Württemberg-Hof faction. The national-liberal members of the Landsberg faction advocated a stronger position for parliament and a constitutional monarchy.

Since Walchner contributed articles on mining, chemistry, and polytechnic schools to *"Das Staatslexikon: Encyklopädie der sämmtlichen Staatswissenschaften für alle Stände*" (The State Lexicon: Encyclopedia of All Political Sciences for All Classes) by the liberals Rotteck & Welcker's "*Das Staatslexikon: Encyklopädie der sämmtlichen Staatswissenschaften für alle Stände*" (The State Lexicon: Encyclopedia of All Political Sciences for All Classes) as well as in Lorenz Oken's series *Allgemeine Naturgeschichte für alle Stände (General Natural History for All Classes)* and used Bassermann's publishing house, he may have been involved early on in the developments that led to the Baden Revolution of 1848/49 since his time in Freiburg.

Walchner was supported by 62 other members of parliament, including Robert Blum (Cologne), Carl Vogt (Giessen), Karl von Behr (Köthen), Adam Dupré (Mainz), Johann Adam von Itzstein (Mannheim, German Court faction), Johann Jacoby (Königsberg), Emil and Ernst Leisler (Wiesbaden), Georg-Christian Strecker (Mainz), Heinrich Wuttke (Leipzig), supported the Ziß motion, which stated that "*... before proceeding to convene the National Assembly, the Bundestag must renounce those exceptional resolutions and remove from its midst those men who contributed to their enactment and execution"* [Grün 1849: 97]. However, after losing the vote and accepting the motion by **Friedrich Daniel Bassermann** (Casino faction) (*1811 Mannheim – †1855 ibid), they declared, "*The undersigned have voted in favor of Ziß's motion, but consider it their duty to submit to the majority of the voters and not to leave the chamber.*" [Anonymous 1848 : 67, Jucho 1848a: 127-128]. Bassermann was a popular liberal politician who was elected to the Baden Second Chamber, the Pre-Parliament, and in 1848 to the Frankfurt National Assembly. From 1840 onwards, he belonged to the circle of moderate liberal politicians around the well-known **Johann Adam von Itzstein,** the opposition leader in the Second Chamber of the Baden Estates Assembly.

Walchner voted by name in the preliminary parliament on the following resolutions: *"Should the principle of direct elections be expressed in such a way that it must be applied to every state?"* with Yes and was defeated by 197 Yes votes to 317 No votes; "*Should the assembly declare itself permanent?*" with No and was part of the majority with 368 No and 143 Yes votes [Jucho 1848: 162ff].

Friedrich August **Walchner** was nominated for election to the Frankfurt National Parliament: ***"From the Alb**, May 12. Certainly, men who are proven liberal and principled fighters **for the constitutional-monarchical direction** and who also have knowledge of German state affairs, trade, industry, and commerce should be elected to the German parliament, and who, as strong, eloquent men, fight with patriotic fervor for the intellectual freedoms of the people as well as for the achievement of their prosperity. Allow us to name and warmly recommend a man for those constituencies that wish to elect such a patriot as a representative to the parliament in Frankfurt, a man who, by virtue of his public and recognized position in science and life, offers a full guarantee of vigorous, insightful, and principled action. We are referring to **Bergrath Walchner,** professor at the Polytechnic School in Karlsruhe, who not only has knowledge of German conditions, but has also always worked patriotically for their improvement and has an excellent gift of speech. Years ago, he was a member of the Second Chamber of Baden, where he served with distinction, and recently he also participated enthusiastically in the preliminary parliament in Frankfurt in achieving the final versions there*." [Karlsruher Zeitung No. 132 of May 14, 1848]. Walchner was not elected to the German National Assembly in Frankfurt.

5.1.9 Digression: Democratic election to the Frankfurt National Assembly

Following the Frankfurt preliminary parliament, **Carl Theodor Welcker** was elected in **the Pforzheim constituency XIV** as a member of the Frankfurt National Assembly, which sat from May 1848 to May 1849. Welcker was one of the moderates and joined the Casino faction (the political faction of the right-wing liberal center) in the National Assembly and, in December, the Paris Court faction. In contrast to the constitutionally liberal Casino faction, which favored strong central power and a strong emperor, the conservative Paris Court favored federalism with the constitution being agreed upon with the individual states. On May 13, 1848, Welcker received the majority: *"... that in today's election of a representative to the German Parliament in the districts of Durlach and Pforzheim and some places in the district of Bretten, Welcker, the man of integrity and loyalty, Welcker, for whom a given word is as sacred as an oath, and who always demands such sanctity with a powerful voice on all sides, emerged from the ballot box as the winner with 103 votes, while Mr. v. Itzstein, the Republican of our city, Mr. Welcker, received 34 votes"* [Karlsruher Zeitung No. 132 of May 14, 1848].

The liberal **Johann Adam von Itzstein** (Deutscher Hof) (*1775 Mainz – †1855 Hallgarten) from Hallgarten in Rheingau was also a member of the preliminary parliament and was its vice president and subsequently a member of the **Committee of Fifty**. The fifty men of the Committee of Fifty were elected by the preliminary parliament to ensure compliance with the preliminary parliament's election guidelines in the elections to the

constituent national parliament. In the election to the Frankfurt National Assembly, he was elected to the first freely elected German parliament for the **constituency of Bretten**. The newspaper reported: "... *In Bretten-Bruchsal, as we hear, the election has fallen to Itzstein*." [Karlsruher Zeitung No. 135 Wednesday, May 17, 1848], then *"Pforzheim, May 12. Today, A. v. Itzstein was elected by 104 votes to 24 as representative of this district in the parliament in Frankfurt."* [Karlsruher Zeitung No. 137 Friday, May 19, 1848] and corrected the following day: *"Pforzheim, May 18. The information provided by the Oberrheinische Zeitung and the Frankfurter Journal that Adam v. Itzstein had been elected as representative to Frankfurt in this district is incorrect. The election fell to Welcker."* [Karlsruher Zeitung No. 138 Saturday, May 20, 1848]. The **Deutscher Hof** faction led by Robert Blum, with Itzstein, Kolb, Jacoby, and others, wanted a democratic republic with a single chamber and equal suffrage in direct elections.

Karl Zittel, a Protestant pastor elected in Karlsruhe constituency XIII and father of the future geology professor Karl Alfred Ritter von Zittel, was also a member of the Casino faction of the Frankfurt National Assembly from May 1848 to May 1849 as an elected representative of the Karlsruhe constituency. "*Zittel was elected today as representative of the Karlsruhe-Ettlingen district to the German Reichstag*." [Karlsruher Zeitung No. 135, Wednesday, May 17, 1848]. Previously, Pastor Karl Zittel had been a member of the Second Chamber of the Baden Estates Assembly from 1842 to 1851 and, like Walchner, a member of the preliminary parliament in 1848. The liberal Casino faction was the strongest faction in the National Assembly and advocated a nation state with a constitutional monarchy.

5.1.10 Walchner and the German National Association

Walchner later became a member of the **German National Association** (Deutscher Nationalverein). The German National Association was founded in Frankfurt am Main in September 1859 with the aim of uniting the German states into a nation state. The Karlsruhe local association was founded in 1861 and met for the first time on May 5, 1861 [von Rochau 1861: 456]. The assembly of 200 members voted in favor of a *"parliamentary institution, central authority, and transfer of the latter to the Prussian crown*" [von Rochau 1861: 456]. At the monthly meeting of the local group of the National Association on March 6, 1862, of which Walchner was also a member, Walchner pointed out the necessity of a state tax for the German fleet [Karlsruher Zeitung No. 59 of March 11, 1862]. The Imperial Fleet was founded by resolution of the National Assembly on June 14, 1848, in Frankfurt am Main, then built up and sold after the suppression of the revolution in 1852/1853. The National Association of liberal democrats saw the establishment of a German imperial fleet as a national symbol and promoted the formation of a German nation state under Prussian leadership and within the legal possibilities.

In March 1862, at the monthly meeting of the National Association, "*... a petition for the equality of Jews was read aloud and those present were informed that it was available for signature*" [Karlsruher Zeitung No. 59 of March 11, 1862]. On October 15, 1862, the law on civil equality for Israelites in the Grand Duchy of Baden came into force [Stempf 1862, IRG Baden 2024]. The basis for this was "*not only an irrefutable demand for justice from the standpoint of humanity and civilization; it also arises as a logical necessity from the consistent development of the principles of our constitution, in particular the principle that the exercise of civil rights should be independent of religious denomination*" [Stempf 1862: 5].

5.1.11 Digression: August Ludwig von Rochau and Realpolitik

The left-liberal co-founder and editor of the German National Association, **August Ludwig von Rochau** (*August 20, 1810, Harpke, Saxony-Anhalt – †October 15, 1873, Heidelberg), was, like Walchner, active in the March Revolution of 1848 and sat in the Frankfurt Pre-Parliament, but was not elected to the National Assembly. The German National Association, which dissolved in 1867, gave rise to the **National Liberal Party**, which won the 1871 elections to the all-German Reichstag with 30.1% of the vote [Wissenschaftlicher Dienst Bundestag 2021]. Von Rochau was elected to the first Reichstag of the German Empire in 1871 as a representative of the National Liberals; in political debates, he coined the term **Realpolitik** to describe the long-term power politics of the bourgeoisie [von Rochau 1853].

5.1.12 Walchner and his contemporaries in the fraternities

Walchner had been a member of the Corps Rhenania Freiburg, founded in 1812, since 1817. This corps gave rise to the "*Verein zur Bearbeitung wissenschaftlicher Gegenstände*" (Association for the Study of Scientific Subjects) in 1818 and the Alte Freiburger Burschenschaft (Old Freiburg Fraternity) in 1818/1819 [Lönneker 2010]. It remains unclear whether he attended the first **Wartburg Festival** on October 18, 1817, near Eisenach. The date of the Wartburg Festival was chosen in memory of the 300th anniversary of Martin Luther's posting of his theses on October 31, 1517, and the 4th anniversary of the Battle of Leipzig against Napoleon Bonaparte (October 16 to 19, 1813). The Wartburg was chosen because of the protection it offered Martin Luther from 1521 to 1522 after he was excommunicated by the Diet of Worms and the papal bull of excommunication [von Engelhardt 2003]. The Wartburg Festival is considered the beginning of the united German fraternities, which pursued the goal of German unity and the introduction of fundamental rights [von Engelhardt 2003]. Around 500 students and professors, such as the natural scientist and

physician **Lorenz Oken** (then in Jena), took part in the Wartburg Festival [von Engelhardt 2003]. Walchner later wrote the first volume of **Oken's book series General Natural History for All Classes**, suggesting that the two had known each other for some time [Walchner 1839 Mineralogy and Geognosy, 860 pp.].

Invitations from Jena were sent to numerous student fraternities in Germany, including Heidelberg and Tübingen. The Freiburg students were not invited to the Wartburg Festival and held an equivalent festival on October 18, 1818, on the Wartenberg near Geisingen [Lönneker 2010].

At Wartburg Castle, demonstrations were held against petty statism and serfdom, and in favor of freedom of the press, equality before the law, and the election of representatives of the people. Fearing a revolution, the states of the German Confederation passed the **Carlsbad Decrees** in September 1819. This led to censorship of the press and restrictions on freedom of expression, surveillance of universities, the removal of liberal professors, and a ban on student fraternities. The disputes between the Corps, the Swiss Zofingia, and the Old Freiburg Fraternity were to be settled in 1824 with the founding of a general association. However, the application for foundation was rejected by the authorities and the fraternity was dissolved [Lönneker 2010: 19]. After the application was rejected, **Walchner** was one of 217 students who were persecuted and punished in January 1824, like many other members. Among those persecuted was the engineer and physician **Karl Franz Josef Bader.**

5.1.13 Digression: The persecution of students and censorship

Karl Franz Josef Bader (born in 1796 in Freiburg, died in 1874 in Freiburg) was professor of hydraulic engineering, road construction, and geodesy at the Karlsruhe Polytechnic School from 1832. From 1840 to 1845, Bader was director of the Polytechnic School, and during the Baden Revolution he sided with the monarchy. In 1850, he was forced into early retirement. Bader had been a member of the Old Freiburg Fraternity since 1818. With the assistance of Rotteck and Welcker, the new Germania fraternity was founded in Freiburg in 1832. Bader, who played a key role in establishing the Freiburg "*Association for the Study of Scientific Subjects*" and presumably also the Freiburg Wartenfest in 1818, was arrested in 1819 [Lönneker 2010: 15] and in November 1824 he was sentenced to six years in prison for "*fraternity activities*," but was pardoned in March 1825 before he began his sentence [Gundermann 2004: 4].

The Bavarian king's tightening of censorship and ban on freedom of assembly in response to the French July Revolution of 1830 led to the development of a new democratic movement. At the **Hambach Festival near Neustadt an der Weinstraße** (at that time, the

Rhine Palatinate belonged to the Kingdom of Bavaria) from May 27 to 30, 1832, some 20,000 to 30,000 people demanded national unity, freedom of the press and assembly, and the sovereignty of the people. The latter ranged from demands for a constitutional monarchy to the introduction of democracy. The efforts were ultimately suppressed by the Bavarian king.

Karl von Rotteck Jr. (*1806 Freiburg – †1898 Woodstock near St. Louis) was actively involved in the **Baden Revolution** of 1848/1849. After the uprising was crushed, he had to flee to the USA via Switzerland. He was sentenced in absentia to 20 years in prison and his assets were confiscated. Other rebels, such as the Catholic theologian, lawyer, and philosopher **Franz Joseph Richter** (*1801 in Kappel – †1865 in New York), a member of the Old Freiburg Fraternity since 1820, who like Walchner was charged in 1824, also had to flee later. Richter was a member of the Second Baden Chamber from 1842 to 1848 and of the Frankfurt National Assembly in 1848/1849. He favored a model of government based on that of the United States. After the suppression of the German Revolution, he was sentenced in absentia to 15 years in prison for high treason and fled via Switzerland and France to the USA in 1850, where he worked as a lawyer from 1851 onwards.

5.1.14 Walchner and his family

Friedrich August Walchner was the eldest son of **Kasimir Walchner** (*1771 Eichstädt – †1837 in Konstanz). Kasimir Walchner studied law and history at the University of Ingolstadt. Like his father Franz Walchner before him (**Franz Walchner** was a district forester in Wollmatingen, now a district of Konstanz), Kasimir entered the service of the prince-bishop [J. Marmor in von Beech 1875: 420-421]. From 1795, Kasimir Walchner worked as a legal scholar in Meersburg, from 1802 to 1805 as managing director of Bohlingen, from 1805 as bailiff of the formerly free imperial city of Pfullendorf, and in 1811 as district administrator in Radolfzell [Reusch 1896: 777-780]. After repeated requests, Kasimir Walchner was retired in 1834 and then moved to Konstanz [J. Marmor in von Beech 1875: 420-421].

The physician **Franz Hermann Walchner from Bühl** (*May 29, 1807 Pullendorf – †Sept. 30, 1879 Bühl) was the brother of Friedrich August Walchner [Walchner 1835: 167]. Franz Herrmann Walchner initially worked in Gondelsheim, then in Karlsruhe, and finally in Bühl [German National Library 2024]. The two-story Walchner Villa at Eisenbahnstrasse 28 in Bühl, probably designed in 1847, with its Mediterranean style, can be traced back to the Weinbrenner School in Karlsruhe or the Bühl master builder Jacob Paniania and master carpenter Ignatz Götz from Bühl [Coenen 2015]. Franz Herrmann Walchner had overextended himself financially during construction and had to sell the house [Coenen 2019]. A

few years ago, the Walchner Villa was scheduled for demolition, but thanks to active citizens, it was preserved and renovated.

Since at that time, travelers staying at inns and private homes were mentioned by name in the daily newspaper, it can be concluded that the family visited the villa. For example, in the Karlsruher Tagblatt No. 229 of August 22, 1850, under the heading "Strangers in local inns", "Mr. Walchner, doctor from Bühl" is registered at the Zähringer Hof. In July 1855, "Mrs. Walchner from Bühl" stayed at the Rothes Haus Inn [Karlruher Tagblatt No. 199 of July 23, 1855].

Whether **Otto Walchner**, who had to flee to Liège after the revolution was crushed and requested a pardon and return to Baden in 1850/1851 [Rau (archivist) 1851, Petit p. 26], also belongs to the family remains to be clarified. In the Karlsruher Zeitung No. 139 of June 14, 1851, an announcement declares a proceeding "*... against Otto Walchner, formerly in Bühl, now a fugitive, claim concerning the defendant's seized assets with the Grand Ducal auditor Eberle in Meersburg, assigned to the plaintiff in lieu of payment; which is hereby notified to the fugitive defendant."* In the Badischer Beobachter No. 104 of May 3, 1862, under the heading *"Ganterkenntniß"* (forced sale of the fugitive's property), there is an entry *"† Otto Walchner of Mühlhausen (AG. Meersburg), Tagk. May 13, morning at half past eight*" [Badischer Beobachter No. 104 of May 2, 1862]. Meersburg was also the birthplace of Friedrich August Walchner.

On January 8, 1845, Friedrich August Walchner mourned the **death of his wife Auguste** "*On the 25th, Mrs. Auguste Walchner, née Müller, from Freiburg, wife of the Grand Ducal Mining Councilor and Professor Dr. Friedrich August Walchner here, aged 48 years, 6 months, and 27 days*" [Karlsruher Tagblatt 9, January 10, 1845]. On November 12, 1846, Friedrich August Walchner and his second **wife Charlotte,** née Roth, mourned the death of the 75-year-old "*mother and mother-in-law, State Councilor Roth, widow*" [Karlsruher Zeitung No. 313 of November 15, 1846]. In 1855, Friedrich August Walchner mourned the **death of his son** "*On the 11th (note: May) Karl Friedrich Herrmann from here, aged 7 years, 4 months, and 27 days, father Dr. Friedrich August Walchner, Grand Mining Councilor and retired professor here*" [Karlsruher Tageblatt No. 186 dated July 10, 1855]. In the list of conference participants of the Society of German Natural Scientists and Physicians (GDNÄ) in September 1858 in Karlsruhe, Walchner is listed as residing in Zell am Harmersbach, Ortenaukreis in the Kinzig Valley [Eisenlohr & Volz 1859: 315].

In 1863, **tax auditor Friedrich Walchner**, possibly Walchner's son, mourned the death of his wife Elisabeth Friederike Walchner, née Hemberger, who at the age of 38 "*... after happily giving birth to a girl, succumbed to childbed fever last night at 10:30 p.m.* " [Karlsruher Tagblatt 101 of April 14, 1863, Karlsruher Tagblatt No. 143 of May 28, 1863].

Walchner initially lived with his family at Innerer Zirkel 17 [Mall 1832, 1833], later at Akademiestr. 13. In 1865, **Friedrich August Walchner** died at the age of 65 "*Feb. 17, Dr. August Walchner, retired mining engineer, husband, aged 65*" [Karlsruher Tagblatt No. 48 of February 18, 1865] and "*February 17, Friedrich August Walchner, Meersburg, retired mining councilor, husband, aged 65 years, 5 months, 15 days*" [Karlsruher Tagblatt No. 72 of March 14, 1865].

Also in 1865, a **Prof. A. Walchner** from Wesleyan Academy, USA, advertised language courses in the Karlsruher Tagblatt No. 162 of June 16, 1865 "*... that I have the honor of informing the esteemed residents of Karlsruhe that it will be my great pleasure to offer them an opportunity to become fully proficient in both French and English in the shortest possible time and regardless of age, if they would kindly take note of this advertisement*." The courses are offered at Akademiestr. 23, "*One or two participants to form a French and English class*" [Karlsruher Tagblatt No. 301 dated November 2, 1865]. Perhaps this refers to the private Wesleyan University in Middletown, Connecticut, USA, which was founded by Methodists in 1831. Whether A. Walchner and tax auditor F. Walchner were sons of Friedrich Walchner and his first wife has yet to be verified. Perhaps A. Walchner returned to Karlsruhe because of his father's death.

Whether the teacher at the girls' secondary school at Ritterstr. 5, **Miss Walchner** [Reichert & Glaenßer 1865, Address Calendar Karlsruhe 1865: XLI], is a daughter of Walchner from his first marriage has not yet been conclusively clarified.

Walchner's second wife, **Charlotte Walchner**, daughter of State Councilor Roth, died at the age of 71 on April 26, 1874 [Karlsruher Zeitung No. 99 of April 28, 1874, see also Karlsruher Tagblatt 115 of April 28, 1874]. "*It pleased Almighty God to call our dear sister and aunt Charlotte, née Roth, widow of the late mining councilor Walchner, from this earthly existence yesterday morning after a long illness. We commend the soul of the deceased to the prayers of friends and acquaintances*" [Karlsruher Zeitung No. 99 of April 28, 1874]. The Walchners' house was sold: *"The two-story house at No. 13 Akademiestraße, with side building, courtyard, and small garden, belonging to the estate of Mrs. Bergrath Dr. Walchner, widow, valued at 14,500 florins, will be put up for auction again at the request of the heirs on Monday, August 31 of this year at 2 p.m. in the local town hall (commission room) and will be finally sold, even if the highest bid does not reach the estimated price*." [Karlsruher Tagblatt, August 28, 1874]. On August 24, 1874, the house at No. 13 had already been unsuccessfully offered for auction by the grand ducal notary Sevin [Karlsruher Tagblatt No. 224 of August 17, 1874].

5.2 Fridolin Sandberger 1855–1863 (Geology & Mineralogy)

Karl Ludwig Fridolin Ritter von Sandberger (*November 11,11.1826 Dillenburg – †11.4.1898 Würzburg) succeeded Walchner and was appointed full professor of *geology and mineralogy* at the Karlsruhe Polytechnic School, where he taught from 1855 to 1863 before accepting a professorship at the University of Würzburg (Fig. 10) [Beckenkamp 1899, von Voit 1899]. At that time, the reputation and salary at universities were significantly better than the conditions at the Karlsruhe Polytechnic School. Sandberger taught geology, mineralogy, ore mineralogy, and paleontology in Karlsruhe.

Fig. 10. Professor Karl Ludwig Fridolin von Sandberger [Image: from Beckenkamp 1899].

Sandberger became a member of the Bavarian Academy of Sciences in 1870 and an honorary member of the Geological Society in London in 1875. He was elevated to the Order of Knighthood of the Kingdom of Bavaria as "Knight of" and received numerous other awards, such as the Cothenius Medal, the highest award of the Leopoldine-Caroline German Academy of Natural Scientists, in 1876 [Beckenkamp 1899].

Sandberger lived at Innerer Zirkel 10 [Eisenlohr & Voltz 1858: 8]. In 1863, "*... Professor Dr. Fridolin Sandberger at the Polytechnic School was granted the humbly requested dismissal from the Grand Ducal State Service at the end of the current school year*" [Anonymous 1863: Badische Gesetz- und Verordnungsblätter March 1863 No. XII p.75], so that he could accept his appointment to Würzburg.

5.2.1 Sandberger's soil horizons in the Buntsandstein and ore veins in the Black Forest

Sandberger recognized the usefulness of the former **soil horizons in rocks** (carnelian layers) at the boundary between the Middle and Upper Buntsandstein for stratigraphic correlation in fossiliferous rocks. Due to their outstanding work on the structure of the Devonian, he and his brother Guido were awarded a grant from the **Wollaston Foundation** by the Geological Society of London in 1856 to fund further research. In addition to discovering fossil soil horizons and their use for stratigraphic correlation, Sandberger researched the formation of metal deposits in the Black Forest [Sandberger 1869, 1880, 1891].

5.2.2 Sandberger's first geological map in Baden

In 1856, Sandberger was commissioned to carry out a geological survey of Baden on a scale of 1:50,000. He published the **first geological map sheet of Baden**, Müllheim bei Badenweiler, which he had mapped himself, as early as 1858 [Sandberger 1858].

In 1856, Sandberger organized the annual conference of the German Geological Society in Karlsruhe. He was also involved in organizing the 34th Assembly of German Natural Scientists and Physicians in Karlsruhe in 1858. The publication of the first geological map sheet was specially postponed and moved to the 34th meeting [Eisenlohr & Volz 1859: 50].

5.2.3 Sandberger on ore deposits

In addition to his geological and paleontological work on the Rhenish Slate Mountains, the Rhön, the Haardt, the Mainz Basin, and other areas, Sandberger also worked on metallic deposits and mining around Freudenstadt and elsewhere. He was an advocate of **ore formation in veins and fissures through lateral secretion** from the surrounding rock, a model that was developed in the 1850s by Karl Gustav Bischof (*January 18, 1792, Wöhrd near Nuremberg – †November 30, 1870, Bonn), Johann Friedrich August Breithaupt (*May 18, 1791 Probstzella, Thuringia – †Sept. 2, 1873 Freiberg), Carl Bernhard von Cotta (*May 18, 1791, Zillbach, Thuringia – †Sept. 14, 1879, Freiberg) and Johann Georg Forchhammer (*July 26, 1794, Husum – †Dec. 14, 1865, Copenhagen) against the resistance of most geologists of the time.

Sandberger emphasized the importance of ore deposits for mining and the state: "*The importance of the matter for the national economy is immediately apparent. In the first case, a direct or indirect enrichment of the state's assets can be expected, while in the second*

case, the costs that would be incurred by futile attempts, often amounting to hundreds of thousands, *are saved*" [Beckenkamp 1899: 12].

5.2.4 Sandberger, Alexander von Humboldt & the Society of German Natural Scientists and Physicians

In September 1858, physicist Hofrath Professor Dr. Wilhelm Eisenlohr from the Karlsruhe Polytechnic School and Medicinalrath Dr. R. Voltz from the Karlsruhe Clinic organized the 34th Assembly of German Natural Scientists and Physicians for the first time in Karlsruhe as managing directors [Karlsruher Zeitung No. 219 of September 18, 1858, Eisenlohr & Volz 1859]. "*The appointed managing directors sought to surround themselves with a circle of men who, with their advice, would help them to manage the business more effectively. This committee consisted of Messrs. Hofräthen Redtenbacher and Weltzien, Professors M. Seubert,* ***Sandberger****, and Dienger, Medicinalrath Schweig, and Hofphysikus Zollikofer. ... We felt compelled to send the first invitation to* ***Alexander von Humboldt***." [Eisenlohr & Volz 1859: 1].

Alexander von Humboldt (*September 14, 1769 Berlin – †May 6, 1859 ibid.), whom the Grand Duke had previously visited in Berlin, was unable to attend the meeting in Karlsruhe due to his advanced age; Humboldt's words of welcome were printed in the newspaper and he was honored with praise at the beginning of the conference [Karlsruher Zeitung No. 219 of September 18, 1858, Eisenlohr & Volz 1859]. The "committee" with Professors Redtenbacher (mechanical engineering, mathematics, at that time director of the Karlsruhe Polytechnic School), Sandberger (geology), and Weltzien (chemistry), among others, demonstrates the importance of the conference and the interaction between the various disciplines. A total of 909 participants came to Karlsruhe [Eisenlohr & Volz 1859: 7].

The First Section for Mineralogy and Geognosy welcomed Sandberger as its section president at the conference in Karlsruhe: *"Prof. Dr. F. Sandberger welcomed the members of the geological section with a speech in the conference room*." There were 30 presentations in Section I, including two each by Karlsruhe professors Bergrat **Walchner** (Sandberger's predecessor) and **Sandberger,** as well as by Professor Johann Reinhard Blum from Heidelberg (*1802 Hanau - †1883 Heidelberg, professor of mineralogy, co-founder of the Upper Rhine Geological Association in 1871, member of the former Corps Hassia) "*On pseudomorphs of calcite into feldspar and augite*."

"*The meeting room of the second chamber of the state parliament had been prepared for the geologists' section, usually one of the most numerous*" [Eisenlohr & Volz 1859 : 49]. The *"mining and smelting products of the Baden region*" were represented by the *"Staatseisenwerke Albbruck, Kandern, and Hausen, and the Baden and Altenberg Zinc Mining Company*," as were "*the Münsterthal Mining Company, which had all products up*

to fine silver, along with very instructive vein samples, the nickel ores from Willenschwand, the coal from Berghaupten ..." [Eisenlohr & Volz 1859 : 49]. Walchner spoke about baths (thermal water) and ores [Walchner in Eisenlohr & Volz 1859: 51-60 ,88-89], Sandberger about drilling for carbonated brine [Sandberger in Eisenlohr & Volz 1859: 64-66] and *"On the land and freshwater fauna in the Mainz Tertiary Basin*" [Sandberger in Eisenlohr & Volz 1859: 76-79]. In addition to Professors Sandberger and Walchner from Karlsruhe, many other famous geologists also took part in the 1858 conference in Karlsruhe, such as Professors G. Leonhard from Heidelberg, von Carnall, and Beyrich.

The Third Section for Mathematics, Astronomy, and Mechanics welcomed Court Councilor **Redtenbacher**, the Fifth Section for Physics welcomed Professors **Clausis**, **Helmholtz**, and others, including Section President **Eisenlohr**, and the Sixth Section for Chemistry welcomed Court Councilor **Weltzien**. In addition, the Sections for Botany and Plant Physiology met with **Seubert,** Anatomy and Physiology, Medicine, Surgery and Ophthalmology, and Psychiatry [Karlsruher Zeitung No. 219 of September 18, 1858, Eisenlohr & Volz 1858]. Herrmann Helmholtz (*August 31, 1821, Potsdam – †September 8, 1894, Charlottenburg), at that time professor of anatomy in Heidelberg, spoke at the GDNÄ conference in Karlsruhe in 1858 [Eisenlohr & Volz 1859, list of participants: 305] on September 23 as chair of the day, not only on physics but also in Section VIII on Anatomy and Physiology on the movement of the ossicles of the ear [Eisenlohr & Volz 1859: 202] and on September 24 on the propagation speed of stimuli in nerves [Eisenlohr & Volz 1859: 203]. The Karlsruhe professors Weltzien (chemistry), Hofrath and Professor Redtenbacher (mathematics) and other professors from the Karlsruhe Polytechnic School were also involved in the organization and contributed to the proceedings [Eisenlohr & Volz 1859: 299ff].

The Society of German Natural Scientists and Physicians (GDNÄ) is the oldest German scientific association and was founded in 1822 by the natural scientist **Lorenz Oken**.

5.2.5 Sandberger and the Polytechnic School

At the time of Sandberger, the teachers of the Polytechnic School were located at Langestraße 14[3] and Carl-Friedrichstraße 15, covering the fields of mathematics, natural sciences, architecture, water and road construction, mechanical engineering, forestry, commercial science, and general education courses [Reichert & Naumann 1862: XXXIV]. In 1862, in addition to Sandberger, the Polytechnic School, headed by Director Ferdinand

[3] Langestraße was renamed Kaiserstraße in 1879 on the occasion of the golden wedding anniversary of Emperor Wilhelm I and Empress Augusta.

Redtenbacher, included professors Dr. Wilhelm Eisenlohr, Dr. Moritz Seubert, Dr. Carl Weltzien, Dr. August Clemm, Franz Müller, Carl Engler, Julius Fehres, Dr. Ernst Voit, Alexander Wasum, and assistants in the natural sciences [Reichert & Naumann 1862: XXXIV].

5.3 Karl Alfred Zittel 1863–186 5 (Geology & Mineralogy)

From 1863 to 1865, **Karl Alfred Ritter von Zittel** (*1839 in Bahlingen – †1904 in Munich), a well-known paleontologist of his time, succeeded to the chair *of geology and mineralogy* (Fig. 11). In 1866, he was appointed to the only chair of paleontology in Germany at the University of Munich. Zittel's father, the Protestant pastor **Karl Zittel** (*1802 in Schmieheim – †1871 in Karlsruhe), was a leading representative of liberalism in Baden and, like Walchner, was a member of the Frankfurt Pre-Parliament.

In 1863, Karl Alfred von Zittel was appointed professor of geology, mineralogy, and paleontology at the Polytechnic School in Karlsruhe [Mayr 1898: 13ff]. In 1865, he married Ida Schirmer, a native of Karlsruhe. In Karlsruhe, Zittel became a member of the Karlsruhe Natural Science Association and succeeded his predecessor Sandberger, who had moved to Würzburg. Zittel writes: *"The collections are quite good, especially the mineral deposits, which are sufficient for my teaching purposes. Of course, there is much to be done in the geological collection, as there is not a single piece related to Alpine geology. The premises are magnificent, and my lecture hall in particular is a true model of beauty and practicality* ...", but he criticizes the *"somewhat small and limited economy ..."* [Mayr 1898: 13ff].

The death of paleontologist Professor Albert Oppel in Munich left his position vacant. The famous Alpine geologist Eduard Suess, Vienna, wrote to the mining master and leading geologist of Bavaria at the time, C.W. von Gümbel: *"If you want to find a good replacement for poor Oppel, you should do everything you can to secure Zittel in Carlsruhe, a hard-working and capable paleontologist and, almost as importantly, a kind-hearted comrade. He has left us with fond memories*" [Mayr 1989: 14]. In the fall of 1866, Zittel was appointed full professor of paleontology at the University of Munich by decree of Ludwig II on September 1, 1866, and developed Munich into a leading international center for paleontology.

Fig. 11. Professor Karl Alfred Ritter von Zittel [Image: WikimediaCommons from Palaeontolographica, 1904].

Zittel received numerous awards, such as the Wollaston Medal from the Geological Society in 1894. Zittel was a member and later president of the Bavarian Academy of Sciences since 1869, a member of the Geological Society of London since 1889, a member of the Russian Academy of Sciences since 1896, and a member of the United States National Academy of Sciences since 1898. Zittel was elevated to the Order of Knighthood of the Kingdom of Bavaria.

Karl Alfred Ritter von Zittel is considered the co-founder of paleontology. His *Handbook of Paleontology* (volumes published between 1876 and 1891) set the standard for its time and was translated into French, Russian, and English [Zittel 1876-1880]. Zittel, who received numerous national and international awards, was president of the German and Austrian Alpine Club from 1886 to 1889.

After the death of his son-in-law, lawyer Schmitt, in a fall from the Zugspitze, "... *his heart was broken and his state of mind very depressed since that time. He passed away peacefully on Tuesday night from heart failure*" [Mayr 1989: 36]. Obituaries were published in Nature magazine [W. 1904], among others.

5.4 Adolph Knop 1866–1893 (Geology & Mineralogy)

Privy Councilor Adolf Knop (*January 12, 1828, Altenau, Harz – †1893, Karlsruhe) was appointed full professor of *geology and mineralogy* at the Technical University of Karlsruhe in 1866 (Fig. 12). In addition to his research on rock analysis and mineral chemistry, he was the founding father of the Upper Rhine Geological Association (OGV) in 1871 and established the Baden Geological Survey.

Fig. 12. Professor Adolph Knop [Image: from Kluth 1972].

Knop was director of the Karlsruhe Technical University from 1874 to 1875. He was awarded the title of Hofrat (court councilor) in 1877 and was appointed Geheimer Hofrat (privy councilor) in 1884. After the death of Moritz August Seubert (1818 to 1878) in 1878, he also headed the Grand Ducal Natural History Cabinet of the Karlsruhe Natural History Museum, built between 1866 and 1872, and directed the geological survey of Baden. In 1872, he received the Order of the Zähringer Lion, and in 1881, he was admitted to the Leopoldina [Kluth 1972]. In 1894, the calcium-titanium-rich perovskite Knopit ($(Ca,Ti,Ce)_2O_3$) was named after him. Adolph Knop discovered cherry-red pyrochlore minerals rich in the rare element niobium in the Kaiserstuhl region, which he named **Koppit** after the Heidelberg chemist Prof. Dr. Kopp [Hoenes 1950].

On July 28, 1856, Knop married Agnes Emilie Rompano, the daughter of a merchant from Chemnitz, with whom he had three children [Kluth 1972].

5.4.1 Digression: The Carlsruhe Natural Science Association and earthquakes in and around Karlsruhe

The Association for Scientific Communications in Carlsruhe, founded in 1840, was continued as the Carlsruhe Scientific Association from April 9, 1862 [Karlsruher Zeitung No. 307 of November 9, 1909, Trusch 2016: 105]. In addition to intensive scientific exchange, an earthquake commission was established at the instigation of Grand Duke Friedrich and the chairman, Professor Franz Grashof, following an **earthquake in Baden** on January 24, 1880.

At the 233rd meeting of the Natural Science Association on February 6, 1880, "... *Professor Dr. Sohncke spoke about the observation of earthquakes, which occur much more frequently than is commonly believed. For example, last December and January, three earthquakes occurred in Baden within seven weeks: a stronger one on December 5 in the southern Black Forest, Switzerland, and southern France; on December 22, a more local one in Höchenschwand and St. Blasien, and on January 24, the one in Karlsruhe, which is still fresh in everyone's memory and was particularly strongly felt in the north and west of the city*." [Naturwissenschaftlicher Verein 1881: 183]. "*Mr. Hofrath Dr. Knop follows up with information about the relationship between earthquakes and the geognostic structure of the earth; how they have been shaking it since time immemorial and will probably continue to do so in the future, insofar as earthquakes are to be understood here as the result of dislocations caused by successive subsidence ...*" [Natural Science Association 1881: 164]. "*Following the discussions of the two previous speakers, the chairman of the association, Privy Councilor Dr. Grashof, proposed that the association set up an earthquake commission to investigate the earthquakes occurring in Baden ...*" [Natural Science Association 1881: 165].

Further earthquakes shook the region: "*At the meeting of the Natural Science Association on December 16, 1881, Director Dr. Schröder first presented the association's earthquake commission with some printed materials from the Seismological Society of Japan, which he had received for this purpose. This was followed by a report from Mr. Hofrath Dr. Sohncke that of the two earthquakes observed in southern Baden in November 1881, the one on November 16 had been felt throughout Italy as far as Calabria, and the one on November 18 had been noticeable in Zurich, among other places, by the clouding of a spring*." [Karlsruhe Tagblatt 1882].

To determine ground vibrations, horizontal pendulum analyses were carried out by the astronomer and **geophysicist Ernst Ludwig August von Reuber-Paschwitz** (*August 9, 1861, Frankfurt an der Oder – †October 1, 1895, Merseburg) [von Reuber-Paschwitz 1888]. From 1884, von Reuber-Paschwitz worked at the Karlsruhe Observatory as "first

assistant" to Professor Carl Wilhelm Friedrich Johannes Valentiner (born February 22, 1845, in Eckernförde – died April 1, 1931, in Berlebeck) [Eisenhagen 1895]. Von Reuber-Paschwitz continued to develop the horizontal pendulum in the basement of the Karlsruhe Polytechnic School until he had to give up his work in 1888 due to tuberculosis [Eschenhagen 1895]. He is considered a pioneer of seismology and was able to measure the earthquake of April 18, 1889, in Tokyo, Japan, with his horizontal pendulums in Potsdam and Wilhelmshaven [von Reuber-Paschwitz 1889]. The German Geophysical Society awards the **Ernst von Reuber-Paschwitz Medal** in memory of his achievements.

5.4.2 Knop's tectonic analysis of the Rhine Rift Valley

Knop recognized "*that the Rhine Valley owes its formation to the subsidence of vertically split mountain masses, which is strongly supported by the occurrence of thermal springs...*" [Knop 1879: 10], which took place along tectonic faults in the Rhine Valley (Knop called them fissures). In 1872, Professor Platz gave a lecture at the proceedings of the Natural Science Association in Karlsruhe [Naturwissenschaftlicher Verein 1873: 34]:

"Professor Platz speaks about the history of the geology of the Upper Rhine. The lecture, about which the speaker himself promises to provide a report for our proceedings, is to be concluded at the next meeting.

The lecture was followed by a discussion in which the first question asked was about the source of the sand masses that cover a large part of our Baden region in the form of red sandstone. No information could be provided in this regard. The discussion then turned to the question of how the Rhine Valley was formed. There is no doubt that ***this resulted in the formation of fissures that border the Rhine Valley on both sides****. Contrary to the speaker's view that the banks rose and the valley remained in its former position,* ***Prof. Knop argues that the middle part sank, but the banks of the valley remained unchanged.*** *Knop points out the great geological importance of these fissures, which border the Rhine Valley on both sides in lines that intersect in the Belfort area.* ***These fissures are very deep, and the thermal springs*** *on both sides of the Rhine Valley lie on top of them****.*** *They may be the cause of the* ***earthquakes*** *that frequently afflict our region*."

5.4.3 Digression: The further development of the Carlsruhe Natural Science Association

Heinrich Hertz, professor of physics at the Technical University of Karlsruhe from 1885 to 1889, and Fritz Haber, later Nobel Prize winner and professor of technical chemistry at the Technical University of Karlsruhe, also gave presentations at the Karlsruhe Natural

Science Association on "*Relationships between Light and Electricity*" (Hertz 1889) and the *catalytic production of ammonia* (Haber), respectively.

In the 19th and early 20th centuries, the chairmen of the Karlsruhe Natural Science Association fostered close ties between the natural sciences and engineering sciences at the Karlsruhe Polytechnic School/Technical University and the Natural History Museum in Karlsruhe. The chairmen were also professors at the Polytechnic School and Technical University, such as the botanist and zoologist Prof. Alexander Braun from 1840 to 1846, the physicist Prof. Dr. h.c. Wilhelm Eisenlohr from 1846 to 1869, mechanical engineer Prof. Franz Grashof from 1869 to 1893, mathematician Prof. Christian Wiener from 1893 to 1896, chemist Prof. Dr. Carl Engler from 1896 to 1910, and physicist Prof. Dr. Otto Lehmann from 1910 to 1920 [Oberdorfer 1952]. After World War I and due to the economic crisis, the association's activities declined under the chairmanship of R. Burger (1920 to 1922) and P. Eitner (1922 to 1935). Dr. Max Auerbach (chairman from 1935 to 1945), associate professor of zoology and anthropology at the Technical University of Karlsruhe and Lake Constance researcher, separated the Natural History Museum and the association from the Technical University of Karlsruhe [Kiefer 1964, Trusch 2016: 107]. Other chairmen were senior director of studies Professor Josef Dolland (1946 to 1958), botanist and honorary professor Dr. Dr. h.c. Erich Oberdorfer (1958 to 1970) [Wirth 2003], E. Jörg (1972 to 1977), botanist and curator Prof. Dr. Georg Philippi (1977 to 2006), and, since 2006, biologist and curator of the Natural History Museum Dr. Robert Trusch [Trusch 2016: 112-113]. The Karlsruhe Natural Science Association (Naturwissenschaftlicher Verein Karlsruhe e.V.) is still active today.

5.4.4 Knop's investigations into the Danube seepage

In 1877, Knop demonstrated that the Aachtopf near Aach, in the district of Konstanz, Germany's largest spring, is fed by seepage from the Danube. He proved this with a tracer experiment using 10 kg of green sodium fluorescein, 20 t of salt, and 1200 kg of shale oil.

5.4.5 Knop's investigations into oil deposits in the Rhine Rift Valley

In 1873, Knop reported on petroleum seeping from cracks in the cellar of the master baker in Reichartshausen in the Odenwald region and *"...* being channeled *through a closed canal into the stream where laundry was washed. The washerwomen complained about the petroleum contaminating their laundry*." [Knop 1873: 2]. Knop analyzed the petroleum and concluded that it did not come from coal, but rather that "*petroleum is a decomposition product of organic matter in shell limestone*." [Knop 1873: 3]. "*Only near Sulz in Alsace*

has petroleum occurred in such quantities that it can be technically exploited..." [Knop 1873: 3].

On June 7, 1879, Knop wrote to the Grand Ducal Ministry of Trade in Karlsruhe about his discovery of petroleum in the Arieten limestone of the Black Jurassic (Lias) near Niedereggenen am Kaiserstuhl during his excursion with his "geology students":

*"However, these occurrences are also of considerable technical interest. It is well known that **bitumen** is extracted with great advantage in Alsace, near **Bechelbronn**, and since the geognostic conditions of Alsace are continuously related to those of Baden, the question has been raised several times as to whether such bitumen deposits also exist on the Baden side, without this question having been definitively answered to date.*

I also remember that an industrialist from Mannheim once asked me whether there were any bituminous rocks within the borders of Baden that would be suitable for a newly constructed apparatus for producing coal gas. At the time, I could only refer him to the bituminous shales (also in the Lias) in the Bruchsal and Langenbrück area.

In Klettgau (according to Würtenberger), as in the neighboring Kingdom of Württemberg, above the aforementioned Arieten limestone, there are deposits of so-called oil shale, which is Lias shale very rich in bituminous substances, which has been and perhaps still is being processed technically in Württemberg. It would not be impossible that the Lias formation in the Niedereggenen area in the Baden Oberland, which appears to be rich in bitumen, would also be suitable for technical enterprises, and in this sense I believe that this area should be recommended to the Grand Ducal Ministry of Trade for preliminary consideration." [Kirchheimer 1958].

The bitumen from Bechelbronn, Northern Vosges, now Pechelbronn, is natural oil seeping to the earth's surface (**earth pitch springs**), which has been documented since 1498 [Reinhold 2020]. The oil was initially used for medical purposes and to lubricate cart axles [Reinhold 2022]. Around Pechelbronn, the petroleum was initially extracted by mining and later by drilling until 1964 [Reinhold 2016]. The petroleum was stored in cleaned **herring barrels with a volume of 159 liters**, which are still used today as **a unit of measurement** (from the French baril, German Fass). What is believed to be **the world's first oil well** was also sunk at Pechelbronn in 1813, at a depth of 42 m. On September 5, 1927, the **world's first geophysical measurement** was carried out **in a borehole** near Pechelbronn-Merkwiller by the Schlumberger brothers, which developed into today's **Schlumberger service company** with around 100,000 employees and annual sales of more than US$30 billion.

5.4.6 Knop in the Alps

In August 1883, Adolph Knop documented his excursion to the Alps. It took him to the Zugspitze, the Großglockner, Finstermünz, Großer Geiger, and other places (Fig. 13).

Next page:

Fig. 13. Photos from Adolph Knop's geological excursion through the Alps in August 1883. a) Großglockner from Kals-Matreier Thörl (Image 2). b) Geological measurements at Hochfinstermünz, Austria (Image 9). c) Woman and two men (Knop?) at the tunnel, Finstermünz (Image 7) [Images: State Museum of Natural History, Karlsruhe].


a)
b)
c)

5.4.7 Knop founded the Upper Rhine Geological Association (OGV) in 1871

After the Upper Rhine Geological Association was founded in Bad Rothenfels on August 17, 1871, the second meeting took place on March 25, 1872, in the mineralogical auditorium of the Friedrichsbau building at Heidelberg University. With Adolph Knop as secretary, the association's statutes, drafted by Prof. Rosenbusch from Freiburg and Prof. Fischer, were approved during the second meeting [Karlsruher Zeitung No. 76 of March 29, 1872]:

"*Heidelberg, March 27. The second meeting of the Upper Rhine Geological Association on March 25 of this year gave us the joyful experience of seeing how the need for periodic gatherings of mineralogists and geologists from the Upper Rhine region has grown out of healthy soil. For although at the first meeting on August 17, 1871, in Rothenfels, there may have been fears that two meetings a year might be too many, it became clear in Heidelberg how enormous the task ahead of us was and how unjustified those fears were. The second meeting of the association took place at 10 a.m. in the mineralogical auditorium of the Friedrichbau. After an introductory speech by Mr. Hofrath Blum, who was elected chairman of the association, while Prof. Knop from Karlsruhe took on the role of secretary, Professor Rosenbusch from Freiburg presented the association's statutes, which he and Professor Fischer, also from Freiburg, had formulated on the basis of earlier drafts ...*". The third meeting was held in Gernsbach in the Murg Valley on September 17, 1872.

5.4.8 Knop invites Maria Countess von Linden to give a lecture at the OGV

As chairman of the Upper Rhine Geological Association (OGV), Adolf Knop invited the natural scientist **Maria Countess von Linden** (*1869 Burgberg Castle near Heidenheim – †1936 in Schaan, Liechtenstein) to give a lecture on Indusian limestones at the OGV's annual meeting in Sigmaringen in 1890. In 1891, she became the first female member of the OGV. Since von Linden's father forbade his twenty-year-old daughter from giving the lecture ("*the bold appearance...*"), Knop read it aloud and ensured its publication [Villinger 2021].

Maria Gräfin von Linden (Fig. 14) attended the Victoria-Pensionat boarding school for girls in Karlsruhe (formerly located at Kaiserstr. 241 in Karlsruhe). Since the school did not qualify her for the Abitur, she applied to attend a Realgymnasium in order to obtain her Abitur and gain admission to university. She was denied admission, so she continued her education privately and, through the mediation of her uncle Joseph Franz Peter Freiherr von Linden (*June 7, 1804, Wetzlar – †May 31, 1895, Hebsack near Freiburg), former

Minister of the Interior and Foreign Minister of Württemberg (and an opponent of the Baden Revolution), she was finally able to successfully pass her Abitur in Stuttgart. Maria Countess von Linden was thus the **first female high school graduate in Württemberg (**with special permission) and a pioneer for equal education and equal access to university studies for women.

Maria Countess von Linden was (with special permission from the king) the **first female student from Württemberg** at the University of Tübingen. There she studied natural sciences and was the **first female scientist in Germany to receive a doctorate** in Tübingen in 1895. Her dissertation dealt with "*The Development of Sculpture and Drawing in Marine Snails*" [von der Linden 1896]. In her acknowledgments, she thanks her teacher, zoologist Prof. Dr. Theodor Eimer, for inspiring her work, as well as private lecturers Dr. Hesse and Dr. Josef Felix Pompeckj for their kind support. The paleontologist and geologist Pompeckj later qualified as a professor (1894) under Karl von Zittel in Munich and became a full professor at the Friedrich Wilhelm University (now Humboldt University) in Berlin in 1917 [Humboldt University 2024].

Fig. 14. Countess Maria von Linden [Image: University Archive Tübingen S 35,1/182,3].

Maria Countess von Linden became an assistant at the Zoological and Comparative Anatomical Institute of the University of Bonn in 1899. In 1902, she was elected to the Leopoldina. In 1906, the University of Bonn denied her habilitation and venia legendi, but in 1910 she was appointed **titular professor** and head of the Department of Parasitology at the University of Bonn. The Badischer Beobachter No. 27 reported on July 3, 1910:

"*Countess Dr. Maria von Linden. The appointment of the first female university professor in Germany has caused a sensation. It is Countess Dr. Maria von Linden who is the first of her sex to attain this dignity. After the talented lady had pursued her scientific studies with great diligence, she worked for a long time as an assistant at the Anatomical Institute of the University of Bonn in the Rhineland, where she now works as a professor of zoology*."

From 1912, Maria Countess von Linden headed the spatially independent Parasitological Institute at the University of Bonn and in 1914 declined the position of head of the Bacteriological Department in Rostock [Bruchhausen 2019: 29].

Maria Countess von Linden was an opponent of National Socialism [conversation in 1923 with Wladimir Lindenberg in Klens 2024]. She was forcibly retired in October 1933 under the "Law for the Restoration of the Professional Civil Service" [Dumschat 2024] [University of Bonn 2024]. The law, enacted by the National Socialists when they came to power in April 1933, was intended to dismiss politically undesirable persons and people of Jewish origin from public service or force them into retirement [Dumschat 2024]. In Bonn, von Linden lived for many decades with the family of Heinrich Hertz, whom she helped flee to Norway in 1935. Heinrich Hertz (1857 Hamburg – †1894 Bonn) was a professor at the Technical University of Karlsruhe until 1889, when he accepted a position in Bonn. Maria Countess von Linden had to sell her castle in Burgberg and emigrated to Lichtenstein, where she died in poverty in 1936 [Villinger 2021].

5.4.9 Digression: Women's rights & education

Through role models such as Maria Countess von Linden and activities such as the "Frauenverein Reform" (Women's Reform Association) founded in Weimar in 1888 by **Hedwig Kettler** (*September 19, 1851 in Harburg – †January 5,1.1937 in Berlin), which campaigned for the establishment of girls' high schools and comprehensive access to university studies in all subjects, the **first German girls' high school in Karlsruhe** was opened in September 1893 in the more liberal state of Baden.

In 1899, the first four students graduated from high school [Hochstrasser 1994 60-64, Karlsruhe City Archives 2018]. Of these, **Rahel Goiteins** (later Rahel Straus, born March 21, 1880, in Karlsruhe – died May 15, 1963, in Jerusalem), the daughter of a rabbi, was the first woman to study at the medical faculty in Heidelberg and became a doctor. **Magdalena Meub** (later Magdalena Neff, born February 9, 1881, in Karlsruhe, died July 19, 1966, in Ettlingen), daughter of a master baker, was the first female student to enroll at the Karlsruhe Technical University for Pharmacy in 1904 and later worked as Germany's first licensed pharmacist [Karlsruhe City Archives 2018]. In 1913, chemist **Else Reinfurth** (born in 1899 in Karlsruhe, high school diploma in 1908) was the first woman to graduate from the Karlsruhe Technical University. Her performance was rated *with distinction* [Ascher et al. 1992:

204]. In 1915, chemist **Irene Rosenberg** (*December 2, 1890, high school diploma in 1909, †September 30, 1986 in Hollywood) became the first woman to earn a doctorate at the Karlsruhe Institute of Technology under Prof. Carl Engler and Prof. Georg Bredig, making her the second female chemist in Germany to earn a doctorate; Both women also came from Karlsruhe and were former students of the girls' high school [Hochstrasser 1994: 63].

5.4.10 Knop's geological mapping

Geological mapping was promoted in all countries in the 19th century, as it serves as the basis for deposit exploration. In 1879, Knop organized the 26th annual conference of the German Geological Society in Baden-Baden from September 26 to 29. He also presented his geological map sheet *"Overview of the geological conditions of Baden-Baden*" [Knop 1879].

5.4.11 Digression: The founding of the Prussian Geological Survey and the mapping of Europe

In Berlin, **Prof. Dr. Ernst Beyrich** (*1815 Berlin – †1896 ibid.) pushed the Prussian ministries to carry out geological surveys on a scale of 1:25,000 as a necessary basis for mining. Beyrich was supported in this endeavor by **Prof. Dr. Wilhelm Hauchecorne** (*1828 Aachen – †1900 Berlin), director of the Mining Academy in Berlin since 1866. Ernst Beyrich was a member of the Leopoldina since 1845, a founding member of the German Geological Society in 1848, a member of the Royal Prussian Academy of Sciences since 1853, a full professor at the Mining Academy Berlin (now TU Berlin) in 1865, the first director of the Natural History Museum in 1873, and a privy mining councilor in 1876.

After the Franco-Prussian War of 1870/71, Beyrich and Hauchecorne were commissioned to establish the **Prussian Geological Survey** in Berlin. An office building was erected at Invalidenstr. 44, and Hauchecorne, who was also director of the Mining Academy in Berlin, was appointed its first director in 1873 [Eberhardt 1997]. Beyrich became the second director of the Prussian Geological Survey and was professor of geology and paleontology at the Mining Academy in Berlin. The front page of the Karlsruher Zeitung No. 5 of January 6, 1882 reported on the "*International Congress of Geology in Bologna*," at which it was decided to create a "***complete geological map of Europe*** *... on a scale* of *1:1,500,000*," *to which "all the geological authorities of all European states—except Turkey and Greece, which do not have such authorities—have agreed to contribute. Berlin was chosen as the central point, and overall management ... was entrusted to Privy Councilors Beyrich and Hauchecorne*" [Karlsruher Zeitung 1882].

The **Prussian Geological Survey** in Berlin, with its branch office for oil exploration in Hanover established in 1934, became the Reich Office for Soil Research in 1939 [Maier 2017], to which the previously independent state geological offices were assigned in March 1939 [Kölbl-Ebert 2018: 399]. In 1941, it was renamed the Reich Office for Soil Research, which, after the division of Germany following World War II, was re-established in Hanover in 1950 as the Office for Soil Research and renamed **the Federal Institute for Geosciences and Natural Resources (BGR)** in 1975 [Maier 2017: 29]. The BGR is subordinate to the German Ministry of Economics.

Privy Councilor Dr. Adolph Knop died in Karlsruhe on December 27, 1893 *"Karlsruhe, December 28. Yesterday, after a long illness, Privy Councilor Dr. Adolf Knop passed away here. His passing means the loss of one of our technical university's most outstanding teachers..."* [Badische Landes-Zeitung 306, December 29, 1893].

5.5 Reinhard Anton Brauns 1894–1895 (Geology & Mineralogy)

The mineralogist **Reinhard Anton Brauns** (*1861 in Eiterfeld – †1937 in Bonn), one of the leading mineralogists of his time, took over as full professor of *geology and mineralogy* at the Technical University of Karlsruhe in March 1894, but only remained for one year. In March 1894, he took over as head of the geological-mineralogical department of Knop's natural history collection [Mayer 1983: 143]. A dispute arose between Braun and the Natural History Museum over which items in the collection were the property of the museum's natural history cabinet and which were the property of the Karlsruhe Technical University [Mayer 1983: 143ff].

In 1895, Braun moved to the University of Giessen, then to Kiel in 1904 and Bonn in 1907. Reinhard Brauns was one of the founders of the German Mineralogical Society in 1908. His books *Chemische Mineralogie* (Chemical Mineralogy, 1899, 482 pages) and *Mineralogie* (Mineralogy, 1893), continued in the 8th edition by Karl F. Chudora from 1943 and from 1955 to 1979 as two volumes*, Allgemeine Mineralogie (General Mineralogy)* and *Spezielle Mineralogie (Special Mineralogy), Das Mineralreich* (*The Mineral Kingdom*, 1903, 440 pages), translated into English in 1912 as *The Mineral Kingdom,* were standard works of their time.

5.6 Carl Futterer 1895–1904 (Geology & Mineralogy)

Carl Josef Xaver Futterer (born in 1866 in Stockach, Baden – died on February 19, 1906, in Illenau) served from 1895 to 1904, initially as an associate professor and, from 1897, as a full professor of *geology and mineralogy* at the Technical University of Karlsruhe (Fig. 15). From May 8, 1899, he also headed the geological-mineralogical department of the Grand Ducal Natural History Museum [Mayer 1983: 146].

After obtaining his doctorate in geology in 1889 in Heidelberg under the world-renowned petrographer Karl Heinrich Rosenbusch, he became a student of the geologist Ferdinand Freiherr von Richthofen (*1833 in Carlsruhe, Silesia – †1905 Berlin) in Berlin, where he habilitated in geology and paleontology in 1892 [Leopoldina 1906: 68].

Fig. 15. Professor Carl Futterer, ca. 1901 [see Schreiber 2007, image: GLA Baden Collection F I /218].

At the turn of the century, Futterer established the Geological-Mineralogical Institute in Karlsruhe on the third floor of the east wing of the main building of what is now KIT [Hoenes 1950: 160]. *"The other natural science institutes also experienced rapid growth: the mineralogical-geological institute, headed successively by two scholars of the first rank, F. Sandberger and E. Zittel, followed later by A. Knop and Brauns, who were also outstanding experts, not only expanded its collections, but also its teaching and laboratory facilities. Last year, thanks to the efforts of its current director, K. Futterer, it was able to*

move into the beautiful new rooms on the third floor of the main building, which had been vacated by the architecture department's move to the auditorium building. It is now a fully-fledged institute equipped with modern facilities for scientific and teaching purposes." [Anonymous 1899: 60].

5.6.1 Futterer's expeditions to the Alps, the Urals, and East Africa

Futterer led major international expeditions from Karlsruhe. In addition to his work in Baden, his expedition-based geology and paleontology took him to the Alps, the Urals, and East Africa.

5.6.2 Futterer's expedition from Russia to Shanghai

Futterer's extensive two-year expedition began on August 1, 1897, together with the Baden lawyer and magistrate Dr. Julius Holderer (*1866 in Muckenschopf, Baden – †1950 Schriesheim, Baden) from Russia through Central Asia, over the Pamir Mountains and along the Yellow River through Tibet **to Shanghai** (Figs. 16, 17). Futterer is considered the best geological researcher of Asia of his time.

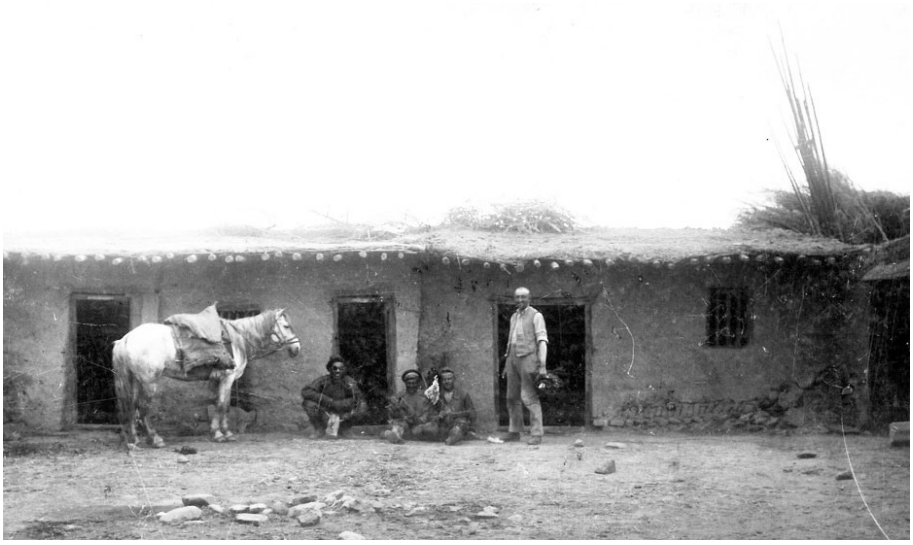

Fig. 16. Group photo, camp on July 4, 1898, in Wu-Ascheng-Ye, Konsu Province, from left to right: Mehmed, Nikolai, Bock, Dr. Holderer in Asia [Image: State Museum of Natural History Karlsruhe, photo presumably by Futterer].

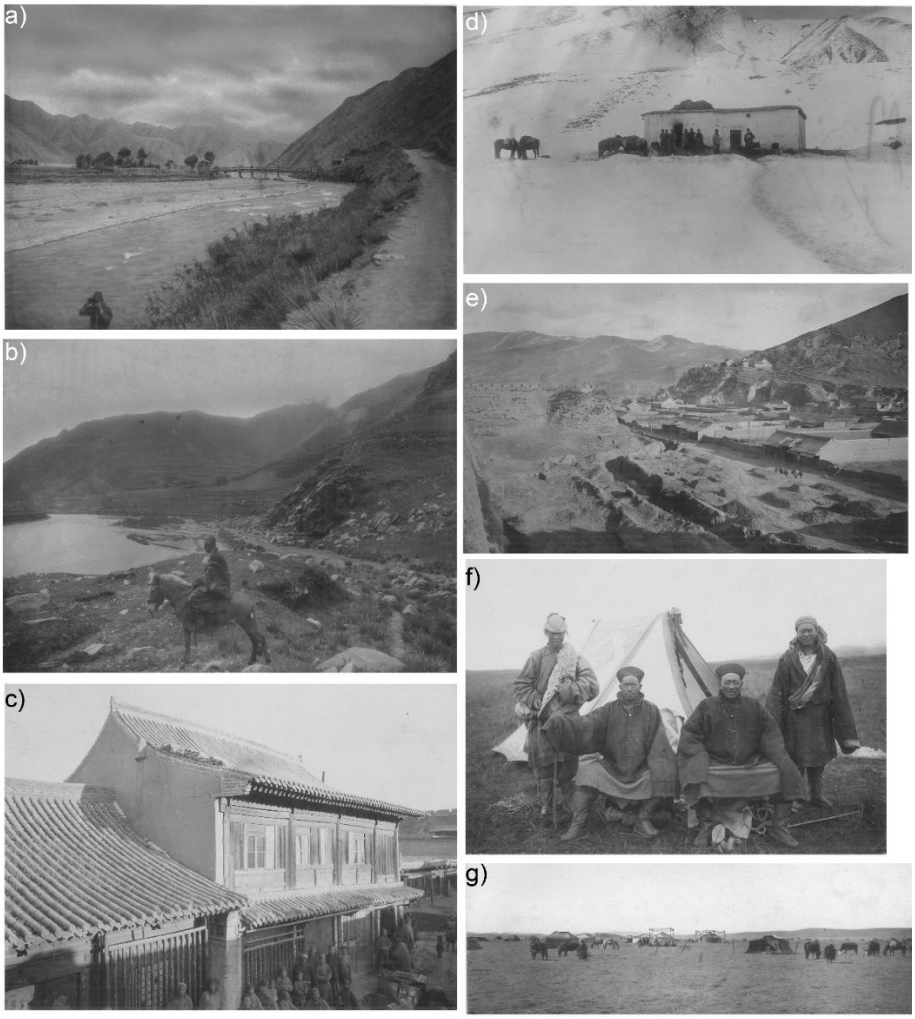

Fig. 17. Photos from Futterer's expedition to Asia. a) River bridge below Wu-schong-fou, Nan-schan Mountains, Gansu Province, July 4, 1898. b) Valley of the Sining-ho, just below Tau-ka'r-thing, July 1898. c) Christian mission house in Tao-Asch, June 25, 1898. d) Rest house in the snow-covered mountains, January 26, 1898. e) City of Min-chou and temple on the mountain southeast of the city, viewed from the city wall, June 30, 1898. f) The Chinese leaders of the expedition at Camp XXIV east of the Hoangho crossing, September 19, 1898 and sourrounding area (g) [images and image descriptions from the State Museum of Natural History in Karlsruhe].

Futterer published the geological and geographical results of his expeditions in 1895 in *Africa in its significance for gold production* [Futterer 1895] and in preparation for his planned two-year expedition *The general geological results of recent research in Central Asia and China* [Futterer 1896]. After his expedition, Futterer published the work *Geographical Sketch of the Gobi Desert* [Futterer 1902], *Geographical Sketch of Northeast Tibet* [Futterer 1903], and, from 1901 to 1911, his important three-volume work *Through Asia* [Futterer 1901 Volume 1, Futterer & Noelting 1905 Volume 2 Part I].

Due to an incurable nervous disorder, Futterer was unable to complete the first part of the second volume, which he had almost finished, and the unfinished volume and the writings of the expedition were handed over to Fritz Noelting in Karlsruhe by Futterer's nurse, the pharmacist Albiker, for completion [Futterer & Noelting 1905: VI]. Part II of Volume 2 and Volume 3 were written by various authors.

During his illness and until the chair was filled again, Carl Futterer was represented by Maximilian Helmut Siegfried Hartmann (*September 18, 1871, Karlsruhe – †September 3, 1948, ibid.), curator at the Natural History Museum, who worked in higher education and as an adjunct professor at the Technical University of Karlsruhe from 1904 [Hoenes 1950: 158]. Futterer died on February 19, 1906, at the Illenau sanatorium at the early age of only 40 [Leopoldina 1906: 68].

5.7 Wilhelm Paulcke 1905–1935 (Geology & Mineralogy)

Wilhelm Paulcke, born in Leipzig in 1873, died in Karlsruhe in 1949) held the chair of *geology and mineralogy* from 1905 as an associate professor and from 1911 as a full professor, becoming rector of the Karlsruhe Institute of Technology in 1919/20 [Paulcke 1919] (Fig. 18). Paulcke was a member of the Heidelberg Academy of Sciences from 1924 [BArch_R_4901_13273_0297].

After graduating from high school in Lörrach in 1893, he volunteered for a year of military service in the 8th Jäger Battalion in Schlettstadt (Alsace). From 1894 to 1899, Paulcke studied zoology with a minor in geology and mineralogy in Freiburg and at the University of Zürich [UZH 2024]. In 1899, he received his doctorate from the Zoological Institute in Freiburg under Weissmann. Professor August Weismann (*1834 in Frankfurt – †1914 in Freiburg) is considered, after Charles Darwin, to be the most important evolutionary researcher of his time and founded neo-Darwinism. Paulcke qualified as a professor in 1901 under geologist Professor Gustav Steinmann (*1856 in Braunschweig – †1929 in Bonn) in Freiburg, where he worked as a private lecturer until 1905 [Leo BW 2021].

Fig. 18. Wilhelm Paulcke 1912/1913 [Image: Signature Generallandesarchiv Karlsruhe F-S Paulcke No. 10870].

5.7.1.1 Other lecturers at the Institute of Geology and Mineralogy

Martin Henglein (*1882 Sonderriet – †1963 Karlsruhe) became an associate professor in 1917 and later an adjunct professor of mineralogy and economic geology under Paulcke at the Technical University of Karlsruhe after completing his habilitation in Freiberg in 1911 [Hoenes 1950]. Among other things, he worked on the deposits of the Black Forest, such as the lead-zinc mineralization of Schauinsland near Freiburg (*Ore and Mineral Deposits of the Black Forest, 1924, 196 pp., Schweizerbart)*. In 1961, he was made an honorary member of the Upper Rhine Geological Association. The full-time curator of the Natural History Museum, **Dr. Kurt Frentzen,** gave lectures on paleontology between 1931 and 1936 [Hoenes 1950]. In 1922**, Dr. August Göhringer** joined the teaching staff for practical geology, such as mapping courses and hydrology, as well as for lectures and exercises on the geology of southwestern Germany; he continued to run the institute after Paulcke's retirement in 1935/36 [Hoenes 1950].

5.7.2 Paulcke and World War I

During World War I, Paulcke introduced **military skiing** and served as **an officer and mountain infantry instructor** in the Vosges, Dolomites, Carpathians, and Turkey. He received several war decorations, such as the Iron Cross II and I Class, the Turkish Iron

Crescent, the Wound Badge, and the Front Fighter's Cross [BArch R 4901_13_273_0297-0298]. Paulcke also received other honors (Fig. 20). He received the Royal Prussian Crown Order IV Class, the Grand Duke Friedrich Jubilee Medal, the Russian St. Anna Order - Knight's Cross [KIT Archive – Paulcke personnel file] and the Zähringer Lion Order I Class [BArch R 4901_13_273_0297-0298]. During his Christmas vacation in 1917, he fell ill with war nephritis (Hanta virus) with bloody kidney inflammation and had to spend six months in a military hospital. After that, Paulcke was no longer fit for duty at the front. He took over as garrison commander in Karlsruhe until the end of the war in late 1918 and then returned to work as a professor [Paulcke 1936: 236].

Fig. 19. Wilhelm Paulcke at a parade in Predazzo on June 27, 1915, in front of Archduke Karl of Austria, General Konrad Krafft von Delmensingen, and Colonel Otto von Below [Image: Signature Generallandesarchiv Karlsruhe F-S Paulcke No. 11247].

5.7.3 Paulcke establishes university sports

Paulcke introduced **university sports** in Karlsruhe after he was able to expand the university grounds in 1918 through the transfer of the Grand Ducal Pheasant Garden following difficult negotiations. In 1919, he was able to begin **construction of the first large German university sports facility** [Paulcke 1936: 238]. Paulcke initiated the construction of the university stadium, which is now a listed building, with a sports hall (completed in 1927) and a covered grandstand (completed in 1930), and hired **Germany's first university sports teacher, August Twele** [Twele 1950, Scharenberger et al. 2017]. The foundation stone was laid and the first sports festival took place in 1928. He was a representative

of the professors and sponsors on the national academic committee of the German University of Physical Education (DHfL), which trained sports teachers between 1920 and 1935 and was then closed down by the National Socialists.

The understanding of sports and nature among Paulcke's generation around 1900 was shaped by a fascination with nature and the mountains, a social Darwinist view of the world and humanity (Darwin's *"survival of the fittest*" or *"struggle for existence*"), but also by experiences on the front lines of World War I. Accordingly, this generation had a "*... strict, combative understanding of sport, characterized by discipline and military toughness*." [Krüger 2024]. Paulcke's speech *on the laws of development on the occasion of the hand-over of the rectorate* in 1919 reflects this different view of the world and humanity [Paulcke 1919].

When the National Socialists came to power in 1933, the SA University Office took over university sports. Track and field competitions were discontinued and cross-country sports were made compulsory for students from 1934 onwards and introduced as a requirement for admission to the diploma examination. In the same year, university sports were transferred from university self-administration to the Office for Physical Education in the Reich Ministry of Education, which was created in 1934.

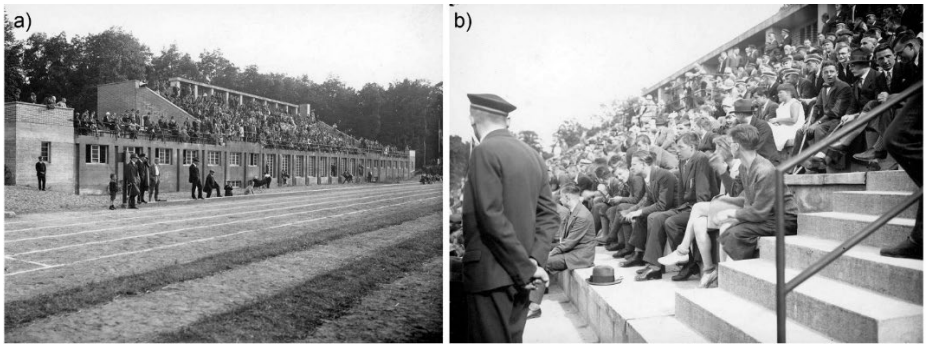

Fig. 20. a) Sports festival at the Karlsruhe Technical University in 1928. b) Spectator stands [Images: a) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 11905; Image source b) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 11908].

5.7.4 Paulcke and alpinism

Paulcke was one of the first German mountaineers. Numerous first ascents in the Alps and the first ascent of the Battert near Baden-Baden in the Black Forest in 1885 are associated with Paulcke [AlpinWiki 2023, Schmitt 1983]. In 1898, Paulcke made the first successful solo ascent of the Matterhorn via the northeast and northwest ridges, and in 1906 he made

the first ascent of the Heidelberger Spitze in the Silvretta, among many other achievements [AlpinWiki 2023]. The **Paulcketurm in the Silvretta** (3078 m, difficulty level 4+), named after him, the **Paulcketurm in the Höllental in the Black Forest**, and the Paulcke Route on the Battert, named after him in 1890, demonstrate his importance and achievements in alpinism. In Antarctica, a mountain on the west coast of Graham Land was named after Paulcke in 1959.

Due to his war injury to his leg, which caused him discomfort until his death, he was no longer able to climb mountains and walking became difficult for him. He planned geological excursions with his students so that he could reach the outcrops by car whenever possible. "*After the war, because of my severe war injury, mountain climbing and long hikes were no longer possible for me... I was grateful that my eyes, above all, had remained healthy! I could see and work! But I had to find ways and means to get out! First, Daimler-Benz generously provided me with a spacious open 8/38 car; then my brother-in-law Hans Ringier and loyal university friends donated a car of the same type, and I was able to express my gratitude with oil paintings for this great kindness, which was almost beyond my comprehension at first*." [Paulcke 1936: 239].

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Fig. 21. a) Group of mountaineers at the inauguration of the Heidelberg Hut around August 1889. b) Presumably Wilhelm Paulcke with his wife Marie, also an alpinist, climbing the Battertfelsen near Baden-Baden. c) Wilhelm Paulcke, Marie Paulcke, and Max von Baden in the Sciora Hut, Bergell, Switzerland, 2118 m above sea level, ca. 1912 [Images: a) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 1912. b) F-S Paulcke No. 4340. c) F-S Paulcke No. 10382].

a)

b)

c)

5.7.5 Paulcke and skiing

Paulcke's parents moved to Davos in 1880 with their sickly son Wilhelm Paulcke and his sister Else (later Else Dietrich). In 1883, he received his first skis from Norway from his Norwegian governess and was one of the first skiers in Central Europe [Zinnecker 2023, Ski-Club Freiburg 2023]. He published an article on the Norwegian method with two poles as early as 1898, gave ski lessons as early as 1902 [Zinnecker 2023], and promoted skiing as an outstanding skier. On November 29, 1895, he **co-founded the Freiburg Ski Club section** of the DSV [Ski Club Freiburg 2023] (Fig. 22a). He then **co-founded the German Ski Association** on November 5, 1905, as well as the **Austrian Ski Association**, which was founded at the same time in Munich [Zinnecker 2023].

Paulcke made the first alpine ski ascent of a mountain over 3000 m high in 1886 with the Oberalpstock (3328 m) in the Glarus Alps, and the first crossing of the Bernese Oberland from the Grimsel Pass to the Rhone Valley in 1887 [AlpinWiki 2023]. Paulcke published a widely read book on skiing entitled *"Skiing, its learning and use in the service of transport, as well as for tourist, alpine, and military purposes*" [2nd edition 1903, 3rd edition 1905, Paulcke 1905]. He initiated **military skiing** in Germany (Fig. 22b) and Turkey and led snowshoe hunter battalions as a captain during World War I [Zinnecker 2023]. Paulcke was also involved in the 1936 Winter Olympics in Garmisch-Partenkirchen [Krüger 2024].

Fig. 22. a) Women skiing on the Feldberg in 1896. b) Resting in the Vosges at the Hochbrück farmstead, snowshoe command in the Vosges in 1898 [Images: a) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 8084. b) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 8099].

5.7.6 Paulcke and avalanche research

One of Paulcke's main areas of research was snow and avalanche science. Paulcke's books *Praktische Schnee- und Lawinenkunde (Practical Snow and Avalanche Science, 1938)*, *Gefahrenbuch des Bergsteigers und Skiläufers (Danger Book for Mountaineers and Skiers, 1942)*, and *Die Gefahren der Alpen (The Dangers of the Alps, continued until 1987 by Helmut Dumler for the German Alpine Club DAV)* were widely read and testify to his importance for alpinism. The book *Die Gefahren der Alpen* (The Dangers of the Alps), first published by Dr. Emil Zsigmondy in 1881, was taken over and further developed by Paulcke from the 4th edition onwards, following a 2nd and 3rd edition by Ludwig Purtscheller [Paulcke 1908, 1922]. Bayerischer Rundfunk published an obituary on Paulcke's achievements as the first German **avalanche researcher** on the 150th anniversary of his death in 2023 [Zinnecker 2023].

5.7.7 Paulcke's geological research

Paulcke's broad academic interests included avalanche research, alpine tectonics, correlations in Swiss flysch using paleontology, and experimental structural geology (book *Das Experiment in der Geologie*, 1912, 108 pages) [Paulcke 1912]. Paulcke correlated experiments with rock analogues that had been laterally confined with geological structures in the Alps (Fig. 23). Paulcke researched the Engadin region with Gustav Steinmann in Freiburg and confirmed that it was a tectonic window (**Engadin window)**, above which the gneisses of the eastern Alpine Silvretta nappe joined to the north. He published the first profiles of **geological nappes with extensive thrust faults**.

During an excursion to the **Tauern Window,** he recognized the correlation with the Western Alps and thus established the **Lower Eastern Alps**. In his book *Berge als Schicksal (Mountains as Destiny, 1936),* he once again emphasized the importance of field geology and experimental geology. Paulcke also worked in other regions of the Alps, such as Finstermünz, Austria (1903) and other regions, following in the footsteps of his predecessor Adolph Knop. His excursions also took him to other regions such as Sicily (1899), Tenerife (1907), Argentina/Patagonia/Peruvian Alps, North America Quebec (1903) and the Rocky Mountains (1903, 1913) (Fig. 24).

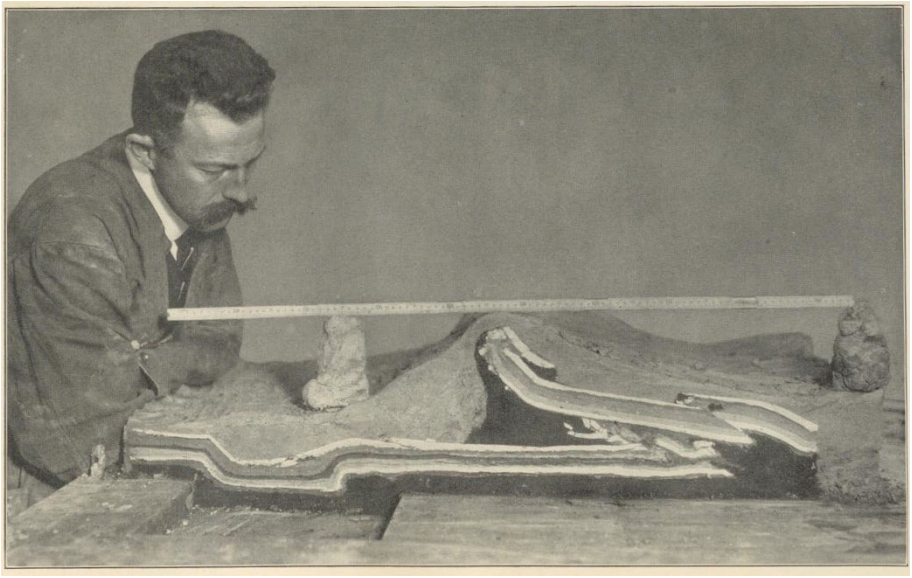


Fig. 23. Wilhelm Paulcke analyzes a geological experiment in which lateral constriction caused the colored ghost rock analogues to shift and form folds. He correlates the experiments with the formation of the Alps [Image: from Paulcke 1912].

Paulcke's journey to Canada probably took him by carriage and train to Bremerhaven, then by steamship (the George Washington, owned by Norddeutsche Loyd) from Bremerhaven to New York, and finally by train to Toronto (Fig. 25). After attending the **Geological Congress in Toronto** in 1913, he spent several weeks traveling through Canada and the USA from the Atlantic to the Rocky Mountains [Paulcke 1936: 164 ff]. Paulcke probably traveled with Canadian geologist Reginald Aldworth Daly (*1871 – †1957), professor of geology at Harvard University from 1912 to 1942, by train from Toronto to the Rocky Mountains to Kamloops in British Columbia in 1913.

Reginald Aldworth Daly, one of the few supporters of Alfred Wegener's theory of continental drift (1912, 1915), developed a model in the mid-1920s that explained how mountains were formed by gravitational forces pulling them downwards (*"downstream folds and* thrusts") and how continents broke apart due to gravitational sliding of solid bodies (*"upstream tension gaps*") [Letsch 2015]. In 1946, he also developed the model, which is still valid today, that an asteroid impact on Earth hurled parts of the Earth into space, which today forms the Moon.

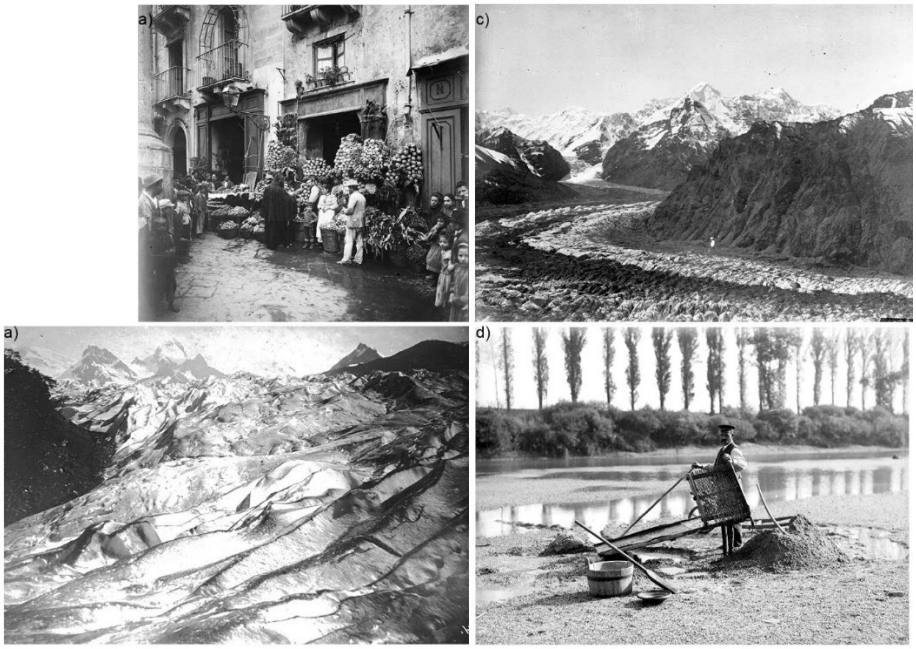
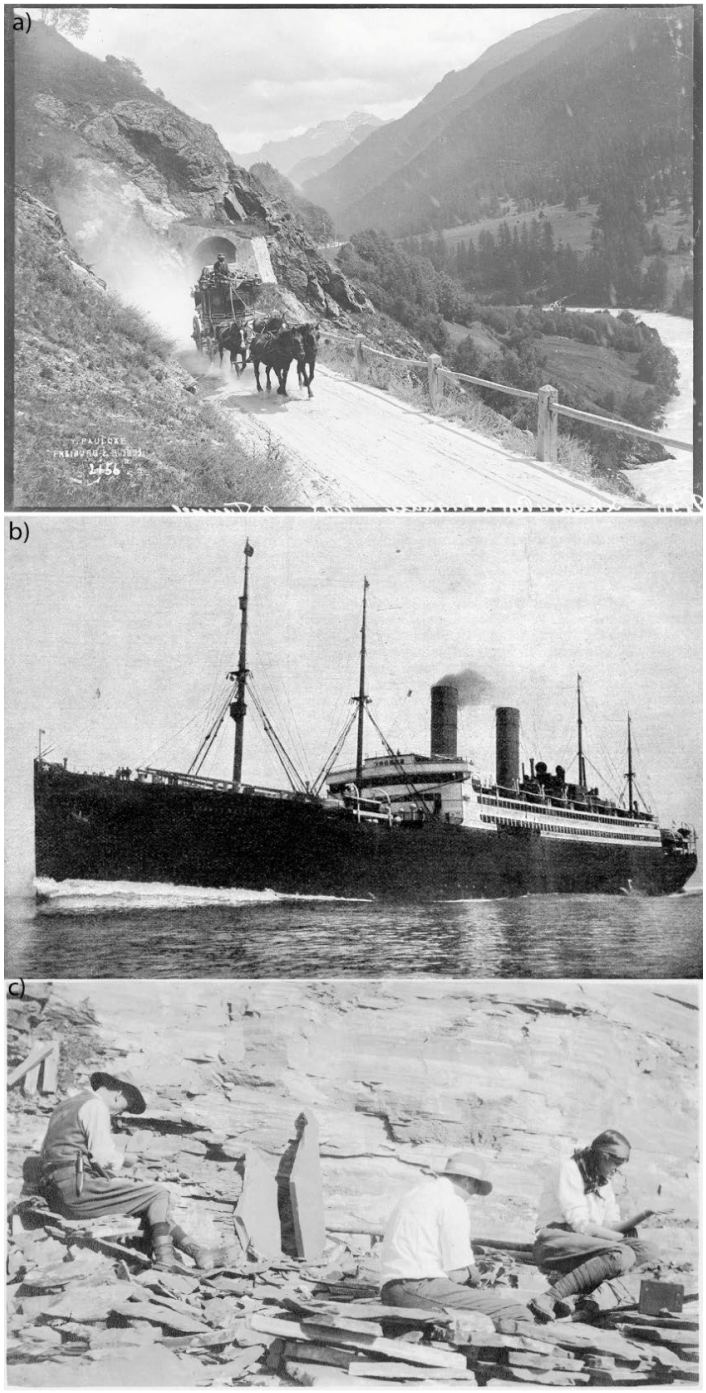


Fig. 24. a) Messina, Sicily, 1899. b) Argentina, Bismark Glacier (Glaciar Moreno). c) Rocky Mountains, 1903, glacier tongue. d) Gold panners on the Rhine near Philippsburg in 1911 [Images: a) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 7783. b) No. 869 Image 1. c) No. 939 d) No. 4384].

Paulcke rode on to **Charles Doolitte Walcott** (*1850 New York Mills – †1927 Washington D.C.) and his daughter and son, who were living in a tent camp in the Canadian Rocky Mountains that summer, searching for fossils together in the famous **Burgess Shale** (Fig. 25 c). Walcott first discovered the numerous shell-less fossils in the sediments of the Cambrian period, the time of the explosion of life in the world's oceans, in 1909 and returned there regularly to conduct research. The area is now listed as a World Heritage Site.

Next page:

Fig. 25. a) Stagecoach at the tunnel in the Engadin in 1903. b) The steamship George Washington, built in 1909 by Norddeutsche Lloyd. c) Charles Walcott around 1913 with his daughter Helen Breese Walcott (*1894– †1965) and his son Sidney Stevens (*1892 – †1977) at work in the Burgess Shale, which Paulcke visited in North America. Photo possibly taken at the time by W. Paulcke [Images: a) Generallandesarchiv F-S Paulcke No. 3595. b) WikimediaCommons, Anonymous c) WikimediaCommons, Author Smithonian Institution, Signature SIA 2008-1906].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In 1929, Paulcke organized the annual conference of the German Geological Society in Karlsruhe, focusing on geology and technology [supplement to the Volksfreund, August 7, 1929]. After welcoming the 150 participants in the auditorium of the Karlsruhe Technical University on August 4, 1929, scientific sessions followed until August 7, 1929, followed by a full-day excursion to the northern Black Forest and the Murg and Schwarzenbach valleys with the Murg- (built between 1914 and 1918) and the Schwarzenbachwerk (1922 to 1924) near Forbach (Baden). At the time, the **Schwarzenbachwerk** was the largest power plant in Europe. Connected to other reservoirs by tunnels, it still serves as a pumped storage power plant for electricity generation today. From August 9 to 11, 1929, he took part in a multi-day excursion to southern Baden, the University of Freiburg, and the Baden Geological Survey [supplement to the Volksfreund, August 7, 1929]. Paulcke was also active in the Karlsruhe Natural Science Association [Henninger 1950].

5.7.8 Paulcke and art

Paulcke published the book ***Steinzeitkunst und moderne Kunst*** *(Stone Age Art and Modern Art) (1923)* and devoted his free time to painting. His nature paintings were exhibited in Karlsruhe, Freiburg, Mannheim, Vienna, and Budapest [Vogeley 1988] (Fig. 26).

Fig. 26. a) Paulcke painting with Max von Baden and his son Prince Berthold in the garden of Kirchberg Palace in 1912/1913. b) Painting by Paulcke, view of Frauenalb in the upper Albtal valley near Karlsruhe [Images: a) Reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 10813 Image 1. b) No. 7877].

There are also numerous landscape photographs by Wilhelm Paulcke [e.g., Landesarchiv BW 2023c]. His father Rudolf, a pharmacist by profession, also devoted himself to painting.

5.7.9 Paulcke under National Socialism

After the National Socialists seized power in March 1933, *"Gleichschaltung" (enforced conformity)* took place in the federal states. By decree of the *Minister of Culture, Education, and Justice* on April 7, 1933, **Hans Kluge** (rector from 1933 to 1935) prematurely replaced the previous rector **Karl Holl** (rector from 1931 to 1933, now vice-rector) [see Kluge 1933: 9]. Wilhelm Paulcke was appointed representative of the Grand Council during this period [Engehausen 2019, KIT Archive 1933].

On November 6, 1934, Paulcke, like all public servants, was sworn in to the Führer [BArch_R_4901_13273_0297]. Paulcke took early retirement in 1935 and lived at Ammersee until the end of World War II. He cited his complaints as a result of his war injury as the reason and pointed to the disputes with the SA University Sports Office; after World War II, he wrote about his early retirement: "*I myself soon voluntarily took early retirement in order to gain my personal freedom and because I had been relieved of the responsibility for the physical and athletic education of the students, which I had established and held at the university until then*."

Kluge's successor as rector, Wittmann, professor of water management and soil science, wrote [Wittmann 1936: 7-8]: "*Since the National Socialists came to power, the Technical University has undergone an exceptionally radical change in its teaching staff, with the result that today about half of the chairs have been newly filled or are still to be filled: The following were relieved of their duties as a result of reaching the age limit or on the basis of the law on the restructuring of the German university system:*

The full professor of geology and mineralogy, Dr. Wilhelm Paulcke

Full professor of architecture, senior civil engineer Dr. h.c. Herrmann Billing

... Retired in accordance with the Reich Citizenship Law: Full Professor of Organic Geochemistry Dr. Stephan Goldschmidt."[4] [KIT 2024a].

[4] Goldschmidt, who was appointed full professor at the Technical University of Karlsruhe in 1929, was Jewish and emigrated to Nijmegen, Netherlands, in 1938. After the end of

Rudolf Weigel, a NSDAP party activist who had been appointed shortly before but failed in the 1935 rector election, took over the rectorship from Kluge in 1937 [Engehausen 2019].

Paulcke's contributions to skiing, university sports, and alpinism, as well as his good networking, resulted in his participation in the opening ceremony of the IV Olympic Winter Games in Garmisch-Partenkirchen on February 6, 1936, where he stood below the tribune of Nazi dignitaries with Adolf Hitler, Joseph Goebbels, and Hermann Göring [Krüger 2024].

In 1942, Paulcke was "*... in recognition of his outstanding services to the physical training of academic youth, which he rendered, especially during Germany's deepest humiliation, primarily through the introduction of compulsory sports at the Technical University and the creation of the university stadium, as well as in appreciation of his pioneering promotion of skiing in Central Europe*" [Weigel 1942: 11].

On April 8, 1943, on his 70th birthday, Paulcke received the Goethe Medal for Art and Science, donated by Hindenburg in 1932, from Reich Minister of the Interior Dr. Wilhelm Frick (*1877 Alsenz – †1946 Nuremberg) presented Paulcke with the Goethe Medal for Art and Science, donated by Hindenburg in 1932 [e.g. in Der Führer 1943 dated April 9, 1943], as well as the Grand Letter of Honor from the National Socialist Reich Association for Physical Exercise. Paulcke knew Frick from earlier days as a mountaineer and skier. The presentation of the award by Reich Minister Frick at Paulcke's private home on Lake Ammersee caused great irritation in the rector's office of the Technical University of Karlsruhe, as the university had planned a grand ceremony. Whether political topics were also discussed, also with regard to Paulcke's family situation and Frick's imminent replacement by Heinrich Himmler, remains to be clarified.

In addition to Paulcke's poems about everyday life and his family, he also wrote poems in support of the war [Landesarchiv BW 2023a]. Paulcke's estate also includes a portrait of Adolf Hitler painted by him [Landesarchiv BW 2023b: F-S Paulcke No. 7511].

Wilhelm Paulcke's wife, **Marie Paulcke**, née Ringier, was probably "quarter Jewish" [Falkner 2008: 88]. Children of non-Jewish faith who had only one Jewish grandparent were designated as "*second-degree Mischlinge"* under the Nuremberg Laws passed in 1935, colloquially known as "quarter Jews" [see also Yad Vashem 2024]. Quarter Jews also suffered under Nazi repression. "Mischlinge" of all degrees were dismissed from civil

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World War II, he accepted a chair in organic chemistry at the Technical University of Munich in 1947.

service in 1937, while "*second-degree Mischlinge*" were allowed to continue working as employees [Prez 2013: 233]. The professions of doctor and lawyer were restricted and membership in the Reich Chamber of Culture, headed by Josef Goebbels, was prohibited [Perz 2013: 233]. The fact that Wilhelm Paulcke hardly mentions his wife and daughters Randi and Heidi in his 1936 biography *Berge als Schicksal (Mountains as Destiny)* is associated with his desire to protect his family.

In April 1942, Paulcke asked the rector Rudolf Weigel (rector from 1935 to 1945) for help in obtaining the ancestry certificate that Paulcke had to submit to the ministry for himself and his wife. "*I have been a member of the Reich Chamber of Fine Arts as a 'painter and graphic artist' since 1934, and now they have found out in Berlin that, according to a certain paragraph, I cannot be 'listed in the chamber' because I only practice this profession 'part-time'. ... Now, at least, I will be able to continue to "publicly display and sell" my work in the future, provided I have a new ID card. But now, after this has happened repeatedly, I am once again required to provide the Reich Chamber of Fine Arts with proof of my and my wife's Aryan ancestry*." The Reich Chamber of Fine Arts was part of the Reich Chamber of Culture. Founded in 1933 and headed by Joseph Goebbels, the Reich Chamber of Culture brought art and culture into line with Nazi ideology and excluded non-Aryan and critical composers, painters, presenters, writers, and actors. In his letter to Rector Weigel, Paulcke also refers to his daughter in Pforzheim, who *"has obtained an 'ancestry passport,' which I now also want to have copied and issued*." Rector Rudolf Weigel replied in April 1942 that the TH Karlsruhe did not have the documents and the university could not help, but "*If for any reason you do not want to or cannot take this route, I ask you to send the above-mentioned documents here. I would be happy to try to have the desired proof issued by the Baden Ministry of Education*." Whether Weigel was aware of Paulcke's family situation remains to be determined.

During questioning after World War II, Paulcke stated that he had been a member of the NSDAP from 1938 to 1944 [KIT Archive – Paulcke personnel file]. The ministry's files [BArch R 4901_13_273_0297-0298] do not document any "*political activity*" or membership in the NSDAP, but they do document his membership in the National Socialist Teachers' League (NSLB) and the National Socialist German Front Fighters' League (NSdFrB Stahlhelm). The Stahlhelm Association of Frontline Soldiers was founded by veterans shortly after the end of World War I in 1918. In 1933/1934, it was placed under the control of the Sturmabteilung (SA). In 1934, the old members were transferred to the renamed NSdFrB Stahlhelm, which was dissolved by the National Socialists in 1935. In the files of the Reich Security Main Office, Paulcke is listed as "*Former professor at the Technical University, Karlsruhe. Unemployed. Ref.: List of professors removed from office (Emergency Measures for German Scientists Abroad - 1936)*" [BArch R 58_9617_0101].

5.7.9.1 Digression: Reich Minister Dr. Wilhelm Frick

Reich Minister Dr. Wilhelm Frick was replaced by Heinrich Himmler on August 26, 1943, and transferred to Prague as Reich Protector of Bohemia and Moravia in 1943. Since Frick, as Minister of the Interior, was also responsible for the preparation of the 1936 Olympic Games, Paulcke's acquaintance with Frick may also have led to Paulcke's contribution to the Olympic Committee. As Minister of the Interior since 1933, Frick, a lawyer, ensured the abolition of the constitutional order with the dissolution of the state parliaments in 1933. With the introduction of the Reich Citizenship Law in 1935 ("Nuremberg Laws") [BPB 2020], he deprived Jewish citizens as well as Sinti and Roma of their fundamental rights. This meant that Jewish citizens and "Mischlinge" (half-breeds), classified according to degree [Yad Vashem 2024], were also prohibited from attending secondary school and university under National Socialism. Until 1936, Reich Minister Frick was in charge of the police, the Schutzstaffel (SS), the secret state police (Gestapo), and the security service (SD), which were then transferred to Heinrich Himmler. In 1945, Wilhelm Frick was arrested and executed by hanging on October 16, 1946, by the International Military Tribunal in Nuremberg for his crimes against peace, against humanity, and for war crimes.

5.7.10 Paulcke and his family

Wilhelm Paulcke, son of pharmacist Rudolf Herrmann Paulcke and Johanna Maria Paulcke, née Becker, from Dresden, grew up first in Leipzig and then, from 1879, in Davos, Switzerland. After the death of his mother around 1876, Wilhelm's father married Anna Schmalfuß from Dresden in 1877, who died in 1885. Wilhelm and his sister moved with their father to Munich. After Rudolf Herrmann Paulcke's sudden death from heart failure on April 1, 1887, Wilhelm and his sister became orphans (Falkner 2008). Paulcke was taken in by a friend of the family, Dr. Max Lange from Baden-Baden.

Wilhelm Paulcke was married to **Marie Ringier** (*1875 Zofingen, Switzerland) since 1900 (Fig. 27), and they had two daughters, Randi (*1901) and Heidi (*1905). Both Protestant parents Wilhelm and Marie later left the church [BArch R 4901_13_273_0297-0298]. Marie Ringier, like Paulcke also an alpinist, was the daughter of the liberal Swiss politician (FDP) and member of the cantonal government of Aargau, Karl Arnold Ringier (born October 16, 1845, in Zofingen; died May 11, 1923, in Zofingen).

Fig. 27. Wilhelm applies cream to his wife Marie Paulcke's face (left). Marie Paulcke taking a break (right). Both in the Engadin and Bergell mountain landscapes, 1912-1913 [Images: left, reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 10979; right, reference number Generallandesarchiv Karlsruhe F-S Paulcke No. 10960].

In 1909, Paulcke met the married Prince Maximilian of Baden (*1867 in Baden-Baden – †1929 in Constance). Max von Baden married Maria-Louise of Hanover-Cumberland in 1900, and they had a daughter, Marie Alexandra (*1902), and a son, Berthold (*1906). The Paulcke family went on excursions and vacations with Prince Max von Baden, his wife Princess Maria Louise von Baden, and their children (Fig. 28). The friendship between Max von Baden and Wilhelm Paulcke was interpreted by Machtan [2013: 233-239] as a homoerotic relationship.

During the Nazi era, Paulcke had disagreements with the SA university office because of university sports. His wife Marie was probably a quarter Jewish (Falkner 2008: 88), and Paulcke had reason to fear problems.

In July 1920, his daughter Randi Paulcke passed the examination at the conservatory in the state capital of Karlsruhe with an aria by Handel [Der Volksfreund 157, July 10, 1920]. She married Herbert Hafner from the Buckenberg estate in Pforzheim. They announced the birth of their daughter Renate on October 28, 1926 [Karlsruher Tagblatt No. 342 of November 1, 1929]. Their daughter Heidi Paulcke, who had numerous appearances as a contralto in Karlsruhe [Karlsruher Tagblatt No. 100 of April 10, 1933], married Dr. Albert Wieland from Ulm on August 10, 1933 [Karlsruher Tagblatt No. 228 of August 19, 1933, Der Führer 228 dated August 19, 1933]. Their daughter Karin Jlse Monika Wieland was born on July 25, 1934, at the Landesfrauenklinik Karlsruhe [Der Führer 204 dated July 7, 1934].

Fig. 28. a) Prince Max von Baden (left) and Paulcke (right) in front of Kirchberg Palace (ca. 1912/13). b) Marie Paulcke (right) and Princess Maria Louise von Baden (left) in front of Kirchberg Palace in 1912/1913. c) Photo of Marie Paulcke, Prince Max von Baden, Wilhelm Paulcke, and Princess Marie Alexandra, ca. 1912/1913. d) Marie Paulcke and Prince Max von Baden in a carriage, ca. 1912/1913 [Images: Generallandesarchiv Karlsruhe F-S Paulcke].

Wilhelm Paulcke dies after a fall in his library [Vogeley 1988] on October 5, 1949, at the age of 76. He is cremated [Badische Neueste Nachrichten 198, October 7, 1949]. Marie Paulcke died at the age of 75 after a short illness on September 27, 1950. Her daughters Randi Hafner from Pforzheim Buckenberg and Heidi Wieland with Dr. Albert Wieland from Ulm mourned her death with four grandchildren [Badische Neueste Nachrichten 195 of September 30, 1950].

5.8 Karl Georg Schmidt 1937–1945 (Geology & Mineralogy)

From April 1, 1937, to 1945, Karl Georg Robert Schmidt (*1902 Karlsruhe – †1976 Bonn) held the *Chair of Geology and Mineralogy* at the Technical University of Karlsruhe [BArch R_4901_13275_0787] (Fig. 29). He first studied at the Technical University of Karlsruhe and then, after completing his preliminary degree, in Freiburg.

Schmidt received his doctorate in 1925 under Johannes Ernst Wilhelm Deecke (*1862 Lübeck – †1934 Freiburg) in Freiburg. Schmidt, an engineering geologist who worked as an assistant in Freiburg until 1926, then worked as an independent consultant and completed another degree in mining engineering at the Freiberg Mining Academy in 1930. He worked in the Dutch East Indies on Java until the end of 1934 and, from April 1, 1935, as an assistant with a teaching assignment at the Freiberg Mining Academy. Schmidt became a lecturer on April 1, 1936, and was appointed full professor at the Technical University of Karlsruhe on April 1, 1937.

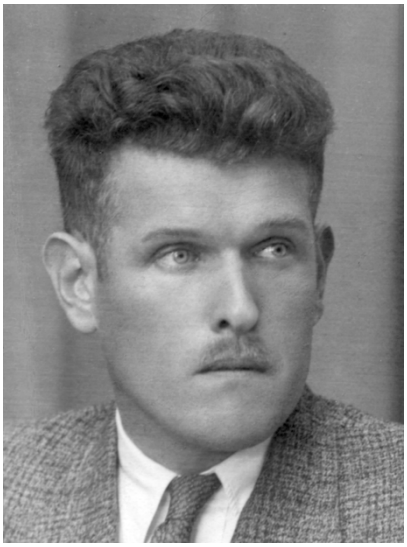

Fig. 29. Professor Karl Georg Schmidt around 1937 [Image: KIT Archive, inventory number: 10002_ 2496].

During the same period as Schmidt, **Julius Wilser** (*1888 Wehr – †1949 Heidelberg) habilitated under Deecke in 1921 and became an adjunct professor there in 1924. The National Socialist Wilser was appointed chancellor in 1933 by Martin Heidegger (*1889 Meßkirch – †1976 Freiburg, member of the NSDAP from 1933 to 1945), who had been

appointed rector of the University of Freiburg in 1933. In 1934, Wilser was appointed to the professorship of geology and paleontology in Heidelberg, where the local **professor Wilhelm Salomon-Calvi** (*1868 Berlin – †1941 Ankara) was "advised" in 1933 to relinquish his professorship. In 1934, Salamon-Calvi emigrated to Turkey, where he established the water supply for Ankara for Kemal Atatürk (*1881 in Selânik / today Thessaloniki – †1938 Istanbul). After Salamon-Calvi's death in Ankara, Atatürk honored his achievements with a state funeral. Wilser worked as a military geologist in various countries, but was denied a return to his chair in Heidelberg after the end of the war.

The Geological-Mineralogical Institute, established by geologist Professor Carl Futterer at the turn of the century on the third floor of the east wing of the main building, was completely destroyed during World War II by bombing raids on September 3, 1942, and September 27, 1944. Part of the collection had been relocated, "*... the objects moved to central Germany in February 1945 fell victim to a fire there*" [Hoenes 1950: 160]. Due to the damage, the collection was moved to the west wing of the main building [Hoenes 1950].

5.8.1 Schmidt under National Socialism

In 1928, Schmidt joined the NSDAP, membership number 108325. From February to March 1936, Schmidt was trained as a marksman. On August 4, 1937, he swore the oath of allegiance to Adolf Hitler before the vice-rector of the Technical University of Karlsruhe: *"... today took the oath of office in the prescribed manner, placing his left hand on his heart, raising his right hand, and reciting the following oath aloud: 'I swear: I will be loyal and obedient to the Führer of the German Reich and people, Adolf Hitler, observe the laws, and conscientiously fulfill my official duties. So help me God!'" (*from his personal file).

On December 18, 1937, Schmidt received his draft notice for a two-month Ufa training course with the army in Heilbronn from January 26, 1938, to March 25, 1938. Successful completion of this non-commissioned officer candidate course (Ufa) qualified graduates to become non-commissioned officers in the Wehrmacht or Unterscharführer in the SS. Accordingly, Schmidt was already involved in the military before the outbreak of World War II. From July 11 to August 22, 1939, Schmidt, who was already vice-rector of the Technical University of Karlsruhe at the time, was called up for military training with Infantry Regiment 109, 7th Company. At the start of the war, Schmidt worked as a military geologist. In order to conduct examinations of students in Karlsruhe, Rector Weigel had to ask the district military command for leave for Schmidt.

On September 24, 1941, Rector Weigel was asked by the Karlsruhe District Military Command, Air Force Division, "*... to provide the following information as accurately as possible about his* [note: Schmidt's] *personality, outlook on life, public reputation, his economic*

and family circumstances, possibly his military activities, as well as his activities in public life, the state, the party, and organizations," because Schmidt had volunteered to join the civil service corps. The rector replied on September 24, 1941, "*... Sch. has been a member of the NSDAP since 1929 and is one of the trusted representatives of the National Socialist movement within our university*." The 1946 registration form states that Schmidt was a member of the NSDAP from 1928 to 1945 and received the NSDAP's bronze award. The file records his membership in the NSDAP as well as his "*political activity*" as "*political leader of the Baden Gauleitung Office for Technology*," his "*military status*" as "*rifleman*," and no war medals or decorations [BArch R_4901_13275_0787].

5.8.2 Schmidt as a military geologist in World War II

In 1938, Schmidt was responsible for the **Siegfried Line** at the *Trier VIII Fortress Inspection* and thus entered military service even before the outbreak of World War II. After the outbreak of war in 1939, Schmidt was initially transferred to Baden-Baden to join the *military geology group of* ***the Wehrmacht's*** *Upper Rhine Fortifications Command* [Rose 2020: 167]. In August 1940, he was then assigned to *Military Geologist Reconnaissance Unit 2* in Dijon and, from at least December 1940, was one of Germany's leading military geologists [Rose 2020: 167,168]. Schmidt became head of *Military Geology Office 2* of the 2nd Army (Army High Command 2, AOK2), which was assigned to the **Luftwaffe** in western France in June 1941. When *Military Geology Office 2* was relocated to Prague in October 1942, Schmidt remained with the Air Force Command in western France until 1943 [Rose 2020: 169]. As one of the geologists in charge, he was responsible for the Luftwaffe's water supply to airports in France and for **fortifying the Western Front** with tunnels, initially as a government building officer (equivalent to major [Rose 2020: 96]), later as a senior government building officer (equivalent to lieutenant colonel [Rose 2020: 96]).

During World War II, the Wehrmacht had *military geologist positions*, which in November 1943 comprised 40 teams and were deployed from North Africa to Northern Norway and from France to Russia [Rose et al. 2019: 16]. In addition, geologists worked for the *Luftwaffe,* the paramilitary *Organisation Todt*, and the *Waffen-SS*. After the invasion of Denmark and Norway in April 1940, the German occupiers built the so-called Atlantic Wall there with the assistance of geologists from the Wehrmacht, the Organisation Todt, and the Luftwaffe [Rose et al. 2019: 16].

In 1942, Schmidt, as a geologist with the Luftgaukommando Westfrankreich (Western France Air Command)**,** inspected the fortifications of the **Channel Islands of Alderney, Guernsey, Jersey, and in the cities of St. Malo and Cherbourg,** where, as of July 21, 1942, 4,957 German and 24,233 foreign workers and **forced laborers** from Russia,

Ukraine, France, and other countries were housed in labor camps [Ginns 1994 from Rose & Willig 2020: 100]. In January 1942, labor camps for volunteer French workers were set up by the Organisation Todt for the fortification of the Channel Islands. In July, these camps were expanded for forced laborers under SS Construction Brigade 1 [Rose 2020: 290]. About a week after his 1942 inspection of the tunnels built on the Channel Islands, Schmidt drew up a "*Geological Report No. 146. Principles for the preliminary geological exploration of tunnel systems on the Channel Islands. Rapporteur: Reg. Building Officer Prof. Dr. K.G. Schmidt, Dipl. Berging*."[5] He must therefore have been aware of the forced labor. In March 1943, the I. *SS Construction Brigade*, consisting of prisoners from the Ruhr area, a branch of the Neuengamme concentration camp, was stationed on Alderney and a concentration camp was established. Many prisoners died on the Channel Islands.

Until the liberation of France in the summer of 1944, Schmidt worked there as a geologist for the Luftwaffe. In the winter of 1944, Schmidt, like many geologists, was transferred to the Organisation Todt, as the Allies now had air superiority and were decimating the German Luftwaffe. Schmidt was transferred to **Task Force IV (Kyffhäuser) "Organisation Todt"** in Weimar.

During World War II, Schmidt was one of 22 experts responsible for approving all geological projects [Rose 2020] (Table 2). His assignment in Stuttgart is associated with his close connection to Wilser.

On March 1, 1945, Schmidt was appointed rector of KIT, but he did not take up the post due to illness during the war. He had previously been prepared for the position as vice-rector by the then rector and *"leader of the university*" Rudolf Georg Weigel (*1899 in Bretten – †1955). "*The rector is the leader of the university and has all the powers of the former ... senate. He is appointed by the Minister of Culture, Education, and Justice from among the full professors and is sworn in by him*" [Engehausen 2019].

[5] Air District Command Western France—Administration—Ref.: 63 c 26 A 87—Adm. III/7—Br. B. No. 5122/42 confidential, May 11, 1942. [Federal Archives Military Archives RH32v.3041] [Source from Rose 2020: 169].

Table 2. List of geologists responsible for approvals during World War II, who were appointed directly by the Reich Ministry of Science, Education, and National Education, as well as by the High Command of the Wehrmacht [districts and names from Rose 2020: 168-169, (A) see also Kölbl-Ebert in Figueirôa et al. 2019].

Berlin	Mühlen, Leo von zur, professor in Aachen, then TH Berlin until '45, then labor camp in Siberia, †1953 in Moscow	Cissarz, Arnold, later head of department at the Federal Institute for Research in Geosciences and Natural Resources (BGR), †1973 in Hanover	Kraus, Ernst, professor at LMU Munich until 1945
Bonn	Rode, Karl, professor in Aachen, †1980 in Bonn	Päckelmann, Werner(A) †1952 in prison in East Germany	Schuh
Halle	Weigelt, Johannes, professor in Halle until 1945, †1948 in Klein-Gerau	Deubel, Fritz, later professor in Jena, †1966 in Ilmenau	Seidlitz, Wilfried von, professor in Jena until 1945, †1945 during the war in Eisenach
Munich	Beurlen, Karl, professor in Munich until 1945, died in 1953 in Tübingen	Schuster, Matthäus, senior mining director in Munich, †1966 in Munich	Kraus, Ernst, professor †1970, at LMU until 1945, later associate professor at LMU
Stuttgart	Wilser, Julius, professor in Heidelberg until 1945, died in Heidelberg in 1949	Frank, Manfred, head of the State Geological Office in Stuttgart until 1970, †1976 in Waiblingen	Schmidt, Karl Georg, professor in Karlsruhe until 1945, died in Bonn in 1976
Vienna	Leuchs, Kurt, later associate professor at the University of Vienna, †1949 in Vienna	Lotze, Franz, later professor in Münster, †1971 in Münster	Gallwitz, Hans, later professor in Halle, †1958 in Halle

5.8.3 Digression: The historical development of military geology

Military geology dates back to Napoleon Bonaparte, who first took four geologists with him on the French invasion of Egypt in 1798, whom he called "*minéralogistes*" [Rose et

al. 2019: 1]. Military geology deals, for example, with the nature of the terrain, the construction of defensive structures (ramparts, tunnels, roads, airports, etc.) and the nature of the ground, for example, with regard to its accessibility and navigability. The Swiss Johann Samuel Gruner (*1766 – †1824), a student of Abraham Gottlob Werner (then professor at the Freiberg Mining Academy), is considered the first military geologist in the German-speaking world. He took part in the Wars of Liberation in 1813/14 on the side of Prussia against Napoleon and posthumously published the book *Verhältnis der Geognosie zur Kriegs-Wissenschaft (The Relationship of Geognosy to the Science of War)* [Häusler 2012, Häusler 2020]. Today, military geology in the German Armed Forces is coordinated by the Center for Geoinformation in Euskirchen.

5.8.4 Digression: Schmidt, Hoenes, Müller, and the Organisation Todt (OT)

The Organisation Todt (OT), named after the Reich Minister for Armament and Munitions Dr.-Ing. Fritz Todt (*1891 Pforzheim – †1942 at Rastenburg Airport) (after his death in 1942, Albert Speer (*1905 Mannheim – †1981 London)), was established in 1938 as a militarily organized construction unit and, at the instigation of Minister Speer, was placed directly under the Führer in 1943. At the end of 1944, the Organisation Todt had 60,000 employees and 1.3 million forced laborers, who were also deployed in Baden-Württemberg [BArch R 50-I, Steinbach et al. 2016]. Fritz Todt completed his studies in civil engineering in Karlsruhe after participating in World War I; The then rector of the Technical University of Karlsruhe commemorated him in his speech: "*We commemorate the fallen and, in particular, we also remember the great student of our Fridericiana, the Reich Minister for Arms and Munitions and leader of German technology, Major General Prof. Dr. Fritz Todt, who was tragically taken from us a few days ago while serving the Führer and the people*." [Weigel 1942: 3].

Initially, the **Organisation Todt** was responsible for the construction of the Autobahn and the Siegfried Line, then for infrastructure, telecommunications networks, bunkers, barracks, raw material extraction, and the reconstruction of factories in occupied foreign countries. From 1940 onwards, it also built war fortifications and submarine bases in France, and from 1941 onwards, it built the Atlantic Wall and rebuilt war damage in Germany, such as factories and destroyed dams. From 1943 onwards, the Organisation Todt built the launch pads for the V1, V2, and V3 "retaliatory weapons" in northern France. Task Force IV ("Kyffhäuser") was responsible for the underground relocation (**U-Verlagerung)** of industrial facilities and the provision of **forced laborers**.

In addition to Karl Georg Schmidt and Dieter Hoenes (military geologist in the Wehrmacht, professor of geology and mineralogy at the Technical University of Karlsruhe after World

War II), **Leopold Müller** (*9.1.1908 Salzburg – 1.8.1988 Salzburg, after World War II professor of rock mechanics at the Technical University of Karlsruhe from 1966 to 1976) also worked for the Organisation Todt. He held a senior position in the construction of motorways in Germany and was deployed in Belgium, the Netherlands, and the Channel Islands [Rose & Willig 2020: 101]. Leopold Müller is considered one of the pioneers in the field of rock mechanics.

From 1944 onwards, in addition to prisoners of war, prisoners from labor education camps and concentration camps, "*first-degree Mischlinge*" (people of mixed German-Jewish ancestry) and "*Jüdisch Versippte*" ("Aryan" spouses) were also conscripted as forced laborers [see also International Center on Nazi Persecution, Arolsen Archives 2024]. **Task Force IV** "Kyffhäuser," for which Schmidt held a leading position, was responsible, among other things, for the U-Verlagerung (underground relocation) [see also Wikipedia 2024, Minehunter 2012].

- Code Anke, expansion of a slate quarry for the construction and storage of torpedoes from November 1944, Saalfeld-Rudolfstadt district, Thuringia
- Code Meerschaum, construction of a tunnel in red sandstone for the construction of torpedoes from October 1944 near Schwarza, Saalfeld-Rudolfstadt district, Thuringia
- Code Jacob II and IV, for a distillation plant for fuels, Görlitz district, Saxony
- Code Lachs, for the assembly of the Me 262 with more than 12,000 forced laborers (more than 10,000 foreigners, more than 2,000 Germans), construction from April 1944, near Bredelar in the Hochsauerland district
- Code Schneehase, with up to 4,000 forced laborers for the construction of the Me 262 and turbine engines near Kahla, Saale-Holzland district, Thuringia
- Code Porphyr, for crankshaft production, construction from May 1944 [Baranowski 2024].

5.8.5 Digression: Studying during World War II

Schmidt employed Eugen Schlager (*September 9, 1908 – ?) and Reinhold Pharion (*May 10, 1910 – ? in Pforzheim?, NSDAP since May 1, 1935, SS until summer 1932, see also Landesarchiv BW 2024) at the Technical University of Karlsruhe, for whom he submitted a DFG application for research grants on the topic of "*Compiling a collection of mineral raw materials and technically important rocks*." The application was rejected in 1937 because the candidates did not have doctorates [BArch R 73/14382]. On January 31, 1942, a request was made for Schmidt to be granted leave of absence for the "*... student Wehrmacht soldiers on leave*" because "*even the last assistant at the Geological Institute has now received his draft notice*." Schmidt was granted recreational leave from July 3 to July 16, 1942, and "*... subsequently, three days of work leave are approved for implementation at*

the Technical University." The Geological-Mineralogical Institute in the east wing of the main building was completely destroyed by bombing raids in 1942 and 1944 [Hoenes 1950].

5.8.6 Schmidt after National Socialism

At the end of April 1945, Schmidt's salary from the Technical University of Karlsruhe was suspended. His request to be allowed to work at the institute was rejected by the military government. On April 24, 1948, the proceedings against Schmidt were discontinued and it was decided that Schmidt did not fall into category I or II of denazification. Nevertheless, he was not reinstated at the Technical University of Karlsruhe.

Schmidt was unable to present any significant academic publications or scientific achievements for his appointment. His early involvement in the NSDAP since 1928, even before the seizure of power on January 30, 1933, was probably decisive for his appointment. His role in the war on the Western Front and in tunnel construction during the underground relocation in Germany, using numerous forced laborers, as well as his preparation for the office of rector of the Karlsruhe Technical University, also demonstrate his active support of National Socialism.

Schmidt worked as a scientist at the University of Bonn from 1949, researching dust, as evidenced by his publications *Der Mondbericht (The Moon Report, 1949), Comparison of the Effects of Quartz, Cristobalite, and Tridymite Dust in Intratracheal Animal Experiments with Rats (1955)*, and *Dust Control in the Foundry Industry* (*1957, 244 pp.)*.

5.8.7 Digression: Studying under Rector Weigel during National Socialism

The rector of the Technical University of Karlsruhe, Prof. Dr.-Ing. Rudolf Georg Weigel (*November 2, 1899 in Bretten – †January 19, 1955 in Karlsruhe), a member of the NSDAP since 1930, became a professor at the Lighting Technology Institute at the Karlsruhe Institute of Technology in 1934 and its rector in 1937 [Gilbert 2017]. As early as 1935, German universities lost their independence, democratic bodies at universities were abolished, and the *Führer principle* was transferred to universities with a *student leader* appointed by the ministry, a *lecturer leader*, and a superior *rector* with absolute power [Kölbl-Ebert 2017: 64].

On January 23, 1942, Weigel wrote to the Reich Minister of Science, Education, and National Education about the "*half-breed Z.*" regarding Z.'s application for a doctorate, which Weigel rejected: "*I have not gained a favorable impression of Z., who already holds a*

degree in engineering and is currently working on his doctoral thesis. Even his outward appearance, posture, and gaze are typically Jewish. Insofar as conclusions about his inner values can be drawn from his behavior as I have observed it, the Jewish bloodline has clearly prevailed there as well. I therefore do not consider a German doctorate to be appropriate" [Werner 1990: 139].

German citizens of the Jewish faith were already **prohibited from** studying after the National Socialists seized power in 1933, and with the pogrom of November 9, 1938, they were even **prohibited from entering the university** [von Olenhusen 1966: 190]. Children of non-Jewish faith whose grandparents were half Jewish were designated as "first-degree Mischlinge" (half-breeds) under the Nuremberg Laws passed in 1935, colloquially referred to as "Halbjuden" (half-Jews). Children whose three or four grandparents were Jewish were considered full Jews, those with one Jewish grandparent were called "second-degree Mischlinge" and colloquially "quarter Jews." However, if the children were Jewish, they were referred to as "Geltungsjuden" and equated with "full Jews." Most "first-degree Mischlinge" were **no longer enrolled** after the pogrom of November 1938 [von Olenhusen 1966: 190]. German Jews had not been allowed to obtain **doctorates** since 1937, and in Baden, "doctorates for German non-Aryans" had already been suspended in 1934, unless their fathers had "*... fought for Germany or its allies on the front lines in World War I*" or if they were "*Mischlinge*" [von Olenhusen 1966: 191]. As early as 1940, "first-degree Mischlinge" had to submit **proof of ancestry, a curriculum vitae going back to their grandparents, and a statement from the rector** on *"... personal impression of the applicant's personality and appearance"* and "*whether and to what extent the characteristics of the Jewish race are outwardly recognizable*." From 1942 onwards, "second-degree Mischlinge" required the approval of the rector and the Reich Ministry to be admitted to university, and they were generally excluded from studying medicine, pharmacy, and agriculture [Perz 2013: 232].

Professor Dr. Theodor Pöschl, who was married to a Jewish woman, was dismissed from the Technical University of Karlsruhe in 1937 [KIT 2024]. The headmaster of the Goethe Gymnasium in Karlsruhe recommended the following for their son: *"In Pöschl's outward appearance, the Jewish element is becoming increasingly apparent and is now unmistakable. It would be contrary to all experience if, in this case too, the Jew did not come to the fore in terms of character and soul: time and again, he tried to come up with sophistical objections in a typically intellectual manner*." Accordingly, Rector Weigel rejected the application for enrollment [Werner 1990: 138-139].

Dr. Joachim Teichmüller, full professor of electrical engineering and lighting technology, had already left the university early due to disagreements with Weigel, who was employed at his institute: *"The following were relieved of their duties at their own request: Dr. E.*

*Zschimmer, associate professor of silicate metallurgy, and Dr. Joachim Teichmüller, professor of electrical engineering and lighting technology" [*Kluge 1934: 6].

Weigel appointed Karl Georg Schmidt, professor of geology and mineralogy, as vice-rector in order to prepare him for the office of rector. Schmidt became rector in 1945, but did not take up the post. Weigel and Schmidt were subjected to denazification proceedings in 1945 and dismissed from university service [Gilbert 2017].

5.9 Alfred Bilharz 1946 – ?

After World War II, civil engineer Alfred Emil Bernhard Bilharz (*October 24, 1884 in Baden-Baden – †October 2, 1968 ibid.) represented the chair in 1946 with a teaching assignment in technical geology. Since the 1920s, he had also been working on geological topics at the Baden-Baden building authority, such as monitoring thermal springs and mapping the Baden-Baden sheet [Hoenes 1950].

In 1933, Billharz was suspended from his duties as city planning officer in the civil service and placed on temporary retirement. Since "*Prof. Schmidt ... was indispensable due to urgent official duties*," the rector asked the Baden Minister of Culture and Education in Strasbourg on November 22, 1943, to give city planning officer Bilharz from Baden-Baden a teaching position. Building officer Bilharz advertised his geological excursions in the press as "*guided walks*" [Der Führer Kreisausgabe Rastatt 15, June 7, 1944].

Bilharz was appointed honorary professor at the Technical University of Karlsruhe in 1952. In 1964, he became an honorary member of the Upper Rhine Geological Association.

5.10 Dieter Hoenes 1950–1955 University of Frankfurt (Geology & Mineralogy)

Dieter Hoenes (born May 8, 1912 in Frankfurt am Main – †1955 in Egersund, Norway) took over the *Chair of Geology and Mineralogy* as a lecturer from Freiburg on January 31, 1950, as an associate professor of geology and mineralogy [Badisches Volksecho 41 of February 17, 1950]. In 1953, he was appointed full professor at the *Institute of Geology and Mineralogy* (Fig. 30).

Hoenes was a military geologist from 1940 to 1945. Hoenes studied in Bonn and Freiburg and received his doctorate in Freiburg in 1936. His doctoral thesis dealt with the mineralization in the Münstertal valley in the southern Black Forest [Tröger 1956: 172]. He habilitated in Berlin in 1943 under Paul Ramdohr on the structural geological and mineralogical

development history of the southern Black Forest. Hoenes held a chair in Kiel in 1947 and became a lecturer in Freiburg in 1948. In 1937, he published an article on ore deposits in the Black Forest, followed in 1949 by a guide to petrographic-geological excursions in the Black Forest and Kaiserstuhl (1949) and a publication on the metallurgical behavior of chromium ores (1954). Dieter Hoenes died on an excursion of the International Association for the Study of Crystalline Rocks [Tröger 1956: 175] in southern Norway near Stavanger on August 10, 1955 [Rose 2007].

Fig. 30. Professor Dieter Hoenes in 1940 [Image: KIT Archive, inventory number: 28010_I/2392].

5.10.1 Hoenes as a military geologist in World War II

During World War II, Hoenes initially served as a soldier in Poland, then from November 1940 for *Geological Office 4* in Jarosław, Poland, and from July 1941 for *Military Geological Office 7* in France, reporting to its head Walter E. Tröger [Rose 2020: 217]. In his obituary for Dieter Hoenes, Walter Tröger writes: *"After six months of military training, he was fortunately transferred to military geology at the end of 1940, where he remained mainly in France until the end of the war, initially as an assistant geologist and later as head of a geological office."* [Tröger 1956]. In March 1942, Hoenes was assigned to the Wehrmacht's *Military Geology Office 4* in France, which was responsible for fortifying the western front on the Channel Islands of Guernsey and Alderney. From May to December

1942, Hoenes headed the *Wehrgeologenstelle 4* on the Channel Island of Guernsey alongside his older superior Bernhard Beschoren, initially as Fortification Engineer Command No. 14 of the *Wehrgeologenstelle 4* (WG4 FestPiKdr XIV), and in December as Fortification Engineer Staff 19 of the *Wehrgeologenstelle 4* (WG4 FestPiStab 19) [Rose 2007, Rose 2020: 199].

Military geologist Hoenes, then *TKVR Technical War Administration Council* (equivalent to the rank of major, Rose 2020: 217], accompanied the senior military geologist **Professor Karl Georg Schmidt** on his inspection of the tunnel construction on Alderney on April 23, 1942 [Rose 2020: 170]. Accordingly, Hoenes, who took over Schmidt's chair after World War II, must have known his predecessor at the Technical University of Karlsruhe, Professor Karl Georg Schmidt. Likewise, Hoenes and Schmidt should have been familiar with the forced laborers employed by SS Construction Brigade I for tunnel construction and fortification of the Channel Islands.

In 1943, Hoenes was active in the Wehrmacht's Fortress Engineer Corps 24 of the *Military Geology Office 4* (WG4 FestPiStab 24). From March 1944, he was assigned to the Wehrgeologenstelle 19 (WG19 branch office at FestPiStab 14) in southern France under **Walter E. Tröger**, and from July 1944 to the Wehrgeologenstelle 26 (WG26 FestPiKdr IV). Hoenes was arrested as a British prisoner of war in southwestern France in the winter of 1944/45 and released after two months [Rose 2020: 248, 249]. Walter Ehrenreich Tröger (born January 18, 1901, in Dresden – died January 13, 1963, in Freiburg) was dismissed from the Technical University of Berlin after World War II because of his membership in the NSDAP. In 1952, he was appointed to the Chair of Mineralogy at the Technical University of Darmstadt and in 1956 to the Chair of Mineralogy and Crystallography at the University of Freiburg, becoming a renowned mineralogist and petrographer.

After Hoenes, the Chair of Geology & Mineralogy was divided into two parts: the Geological Institute (Professor Illies) and the Institute of Mineralogy (Professor Jagodzinski).

5.10.2 Digression: Studying geology at the Karlsruhe Institute of Technology after World War II

After the war, in the summer semester of 1949, three temporary classrooms were set up by R. Eigenfeld in the west wing of the main building of the Technical University of Karlsruhein order to offer technical applications of geology, petrology, and mineralogy to students of civil engineering, inorganic chemistry, chemical technology, geography, and natural sciences [Hoenes 1950: 160]. Hoenes [1950: 160] wrote: "*Once the rooms on the second floor of the main building, which are intended to be the permanent home of the institute, have been completed*, *research activities will also be revived*."

5.11 Henning Illies 1958–1982 (Geology)

Jürgen Henning Illies (born in Hamburg in 1924, died in Karlsruhe in 1982) joined the *Geological Institute* at the Technical University of Karlsruhe as an associate professor in 1958. There, he was appointed full professor and director of the *Geological Institute* (General & Historical Geology) at the Technical University of Karlsruhe in 1963, which he headed until 1982 [LeoBW 2024].

Illies graduated from high school in 1942, after which he did labor service and then frontline service. He was wounded on the Eastern Front in 1943 and studied geology in Hamburg from 1943 to 1948, where he received his doctorate in 1948 and his habilitation in 1951. In 1951, he became a lecturer at the University of Freiburg and from 1956 to 1957 he and his wife Gisela (*18.12.2024 – †29.12.2008) were at the University of Austral in Valdivia, Chile [Fuchs 1983, Nairn 1985].

Illies was on the board of the German Quaternary Association from 1960 to 1965, chairman of the Upper Rhine Geological Association from 1964 to 1971, and its vice-chairman from 1971 to 1977. From 1974 to 1977, Illies was on the board of the Geological Association and has been its vice-president since 1978. Henning Illies was elected to the Leopoldina in 1973, appointed Fellow of the Geological Society of America (GSA) in 1978, and was editor of the journal Tectonophysics from 1978. In 1981, he received the Hans Stille Medal from the German Geological Society [Fuchs 1983, Nairn 1985].

Illies' structural geological and regional geological work on rift and graben structures, such as "Mechanisms of Graben Formation" [Illies, 1981], gained international significance. More than 100 publications demonstrated his academic achievements. Together with geophysicist Stephan Müller, who was appointed in 1964, he laid the foundation for the "**Karlsruhe spirit**", a long-lasting, trusting scientific collaboration between geophysics, geodesy, and geology. Illies organized three annual conferences of the Geological Association in Karlsruhe, founded by Hans Cloos and colleagues in 1910: in 1958 with the title *"Permian volcanism and related issues*," in 1969 with the title "*Fracture tectonics,"* and in 1975 with the title "*Tectonics of kratonized areas*."

Together with colleagues from other departments, Henning Illies pushed for the **expansion of geology at the Technical University of Karlsruhe** with additional professorships. Together with the Institute of Mineralogy, which was established in 1959, geologists could now be trained in the main subject. Furthermore, a Geophysical Institute was established in 1964, and chairs for petrography and applied geology were created in 1965.

Illies died after a long and serious illness and was buried in Hamburg's Olsdorf Cemetery [Fuchs 1983].

5.11.1 Rolf Stellrecht & Eberhard Sittig (Historical Geology & Paleontology)

Rolf Stellrecht (born in Stuttgart in 1928, died in Karlsruhe in 2017) taught historical and regional geology as an academic senior lecturer. Prof. Dr. Eberhard Sittig represented the teaching and research area of paleontology under Illies. Stellrecht worked at the Geological Institute from 1959 to 1993. Rudolf Metz (*1923 – †1991) worked at the Geological Institute as a research assistant from 1958, where he habilitated in 1971 and was appointed adjunct professor in 1983.

5.11.2 Viktor Maurin 1965–1982 (Department of Applied Geology)

In 1965, Prof. Viktor Maurin (*1922 Kapellen an der Mürz – †January 22, 2011 Graz) was appointed to the new professorship in the *Department of Applied Geology* at the Geological Institute under Illies. Maurin, an Austrian, grew up in Graz, where he was drafted into the German Wehrmacht at the age of 18 in 1940. Due to a serious injury, Maurin was discharged from military service in October 1943 and was able to complete his schooling. After studying geology at the Karl-Franzens-University in Graz, he received his doctorate there in 1953 with a dissertation on the catchment area of the Lurhöhlen cave system. Immediately afterwards, he began his scientific career at the Institute of Technical Mineralogy and Geology at Graz University of Technology. He habilitated in 1960 [Benischke & Weissensteiner 2011] and worked there as a university lecturer until his appointment in 1965.

Maurin's research focused on karst hydrogeology, where he was able to draw directly on his experiences as a young cave explorer. In 1958, he co-founded the Association for Hydrogeological Research, which still publishes the authoritative journal *"Beiträge zur Hydrogeologie" (Contributions to Hydrogeology)* in German-speaking countries. In 1966, he co-organized the first symposium on the use of tracers to track underground water. This event led to the founding of the International Working Group on Tracer Hydrology.

With his appointment to the University of Karlsruhe (TH), the establishment and expansion of the Chair of Applied Geology was purposefully advanced in a form that combined the natural sciences and engineering. For the first time in Karlsruhe, the subjects of hydrogeology and engineering geology, which had previously been part of the subject of general geology, were established as independent examination subjects in the diploma examination regulations.

Under Maurin's leadership and scientific supervision, various karst hydrogeological studies were carried out as part of diploma and doctoral theses in southern Germany, Austria, and

the former Yugoslavia. The results of both methodological and regional objectives have contributed significantly to today's modern understanding of karst hydrogeology. In addition to this focus, however, the other diverse tasks of applied geology were also taken into account. These range from general hydrogeological issues, such as groundwater management, to engineering geological tasks in the context of road, tunnel, and dam construction, for example.

In 1982, Viktor Maurin was relieved of his duties at the university at his own request for health reasons.

5.12 Heinz Jagodzinski 1959–1963 (Mineralogy)

The *Institute of Mineralogy* was founded in 1959 and headed by Heinz Jagodzinski (born April 20, 1916, in Aschersleben; died November 22, 2012, in Munich). He studied physics in Greifswald and Göttingen and received his doctorate in Göttingen in 1941. The crystallographer Jagodzinski qualified as a professor in Marburg in 1944, was an adjunct professor at the Max Planck Institute for Silicate Research in Würzburg from 1955, and a full professor at the Technical University of Karlsruhe from 1959. In 1963, he accepted a position as professor of mineralogy and crystallography at LMU Munich.

5.13 Hans Wondratscheck 1964–1991 (Mineralogy)

Hans Wondratscheck (born in Bonn in 1925, died in Karlsruhe in 2014) succeeded Jagodzinski as chair of the *Institute of Mineralogy and Crystallography*. The crystallographer Wondratscheck studied physics in Bonn, where he received his doctorate in 1953. Wondratscheck conducted research at the Max Planck Institute for Silicate Research in Würzburg until 1958. After a year at the Institute of Crystallography at ETH Zurich, he moved to the Institute of Mineralogy at the University of Bonn, where he qualified as a professor in 1961. Until his appointment at the Technical University of Karlsruhe, he was a lecturer at the Institute of Mineralogy at the University of Freiburg.

Wondratscheck was a member of the Leopoldina Academy of Sciences since 1989 and received the Viktor Moritz Goldschmidt Prize of the German Mineralogical Society in 1981, the Friedrich Becke Medal of the Austrian Mineralogical Society in 1987, and the Carl Hermann Medal of the DGK in 2001 [Hahn 2012, 2015]. He published several books, including *Symmetry of Crystals* with Theo Hahn in 1994. Prof. Dr. Theo Hahn (*1928 Duisburg – †2016 in Aachen) taught crystallography. The author of this book still fondly

remembers attending Hahn's lectures at RWTH Aachen University as a student several decades ago.

With the restructuring of the faculties in 1969, Wondratscheck transferred his institute, the **Institute of Crystallography,** from the Faculty of Mathematics and Natural Sciences to the Faculty of Physics. Professor Illies' Geological Institute and Professor Rein's Institute of Mineralogy and Petrography became part of the Faculty of Biological and Earth Sciences.

Hans Wondratscheck retired in 1991. He was succeeded by Kurt Hümmer. Following Hümmer's early retirement and the retirement of adjunct professor Dr. Wilfrid Edgar Klee (*1935 in Union City, USA), the institute was closed.

5.13.1 Gerhard Rein 1965–1972 (Petrography)

Mineralogist Gerhard Rein (*1913 – †June 29, 1972) headed the teaching and research area of petrography from 1965. With the restructuring of the faculties in 1969, *petrography* became part of the Faculty of Biological and Geosciences.

5.14 Harald Puchelt 1973–1995 (Geochemistry)

Harald Puchelt (*May 15, 1929 in Gera – †December 27, 2004) was appointed head of *the Institute of Petrography and Geochemistry* at the University of Karlsruhe (TH) in 1973. In addition to training as a chemical laboratory assistant, which he completed in 1951, Puchelt studied chemistry at the Technical University of Hannover from 1950 to 1955. He earned his doctorate with a thesis on the genesis of the ore deposits at Meggen and Rammelsberg. In 1961, he joined the University of Tübingen as an assistant and worked closely with the first German laboratory for isotope geochemistry in Göttingen. After completing his habilitation at the University of Tübingen in 1967, he spent a year conducting research at the Carnegie Institution in Washington. He then returned to Tübingen as a scientific advisor.

After being appointed to the University of Karlsruhe (TH), Puchelt established geochemical analysis. Between 1977 and 1993, Puchelt led several voyages with research vessels to areas including Hawaii, the Galapagos Islands, the Tyrrhenian Sea, and the Red Sea. Puchelt researched ocean floor basalts and ore genesis, such as the formation of massive sulfides. Puchelt also conducted research on environmental geochemistry, such as with the newly developed analysis of platinum group elements or the analysis of mine water, and on geochemical prospecting, such as with the energy-dispersive X-ray fluorescence method developed by Utz Kramar [Hubberten 2005: XLI].

Puchelt was dean of the Faculty of Biological and Geosciences. He supported the establishment of geochemistry at the University of Nuevo Leon in Linares, Mexico, and was instrumental in setting up the new geoecology degree program and the new Environmental Research Center at the University of Karlsruhe.

The *Institute of Petrography and Geochemistry* emerged from the Institute of Petrography, which was created during the 1969 restructuring under Gerd Rein. Petrography and geochemistry were located on the 5th floor of Chemistry Tower II. Engineering geology and hydrogeology were located on the 4th floor, geology and paleontology on the 3rd floor, and mineralogy on the 2nd floor. The transition from Puchelt to his successor Doris Stüben, who was appointed in 1994, was planned to overlap; Puchelt moved to the West Campus in 1994.

Harald Puchelt had been married to his wife Barbara since 1959 and had four children [Hubberten 2005]. He retired in 1995.

5.14.1 Rolf Emmermann 1974–1981 (Petrography)

Geoscientist Rolf Emmermann (*January 12, 1940, in Wolfenbüttel) headed the teaching and research area of petrography from 1974 onwards. Emmermann studied mineralogy, crystallography, geochemistry, and geology in Braunschweig, Frankfurt, and Munich from 1959 to 1960. He received his doctorate from the Technical University of Karlsruhe in 1967 and habilitated in mineralogy in 1973. In 1974, he became professor of petrography at the University of Karlsruhe (TH). In 1981, he accepted a position at Justus Liebig University Giessen as full professor of mineralogy and petrology. His successor at the University of Karlsruhe (TH) was Egon Althaus.

Rolf Emmermann was a co-initiator and, from 1986, scientific coordinator of the DFG Priority Program **Continental Deep Drilling Program KTB** near Windischeschenbach, Oberfalz, Bavaria. After a 4 km deep preliminary drilling from 1987 to 1989, one of the deepest drillings worldwide was achieved between 1990 and 1994 with a depth of 9.1 km, which was accompanied by numerous new scientific findings and the development of new processes and technologies. Emmermann also headed the **ICDP** (International Continental Drilling Program) for 15 years [Marquardt 2013]. In 1991, Emmermann became the founding director of the Helmholtz Centre **German Research Centre for Geosciences GFZ in Potsdam,** which he headed as scientific director from 1992 to 2007. Emmermann also remained a full professor in Giessen until his retirement in 2007.

Rolf Emmermann received the Federal Cross of Merit 1st Class (1999), the Order of Merit of the State of Brandenburg (2005), the Grand Cross of Merit (2008), the Walter Kertz Medal of the German Geophysical Society (2002), and was awarded an honorary doctorate

from the University of Braunschweig (2001). He is a founding member of the Brandenburg Academy of Sciences, a member of Acatech, the Academia Europaea, and the Heidelberg Academy of Sciences.

5.14.2 Rainer Altherr 1982–1994 (Petrography)

Rainer Altherr (*August 6, 1947, Freiburg) studied mineralogy in Freiburg after graduating from high school there in 1967, graduating with a degree in 1973. He received his doctorate there in 1975. From 1975, Altherr worked as a research assistant in Clausthal and, from 1976, at the Technical University of Braunschweig. In 1981, he became a university assistant at the Technical University of Braunschweig, where he qualified as a professor in 1982. In 1982, Rainer Altherr was appointed to the Institute of Mineralogy to teach and conduct research in the field of petrography. In 1994, he moved to Heidelberg University, where he took over the professorship for mineralogy. Altherr received the Albert Maucher Prize from the DFG in 1981 and has been a member of the Heidelberg Academy of Sciences since 2003.

5.15 Egon Althaus 1971–2001 (Mineralogy)

Egon Althaus (*February 15, 1933, in Hagen – †June 16, 2022, in Malsch-Völkersbach) was appointed head of the Institute of *Mineralogy and Experimental Petrology* in 1971. Althaus completed his studies in mineralogy in Marburg in 1959 and received his doctorate there in 1961. He habilitated in 1967 under Helmut G.F. Winkler in Göttingen, where he later became an academic advisor [Stosch & Franz 2002]. Before his appointment at the University of Karlsruhe (TH), he conducted research at Yale University. Althaus was Dean of the Faculty of Biological and Earth Sciences from 1972 to 1974 and Vice-Rector of the University of Karlsruhe (TH) from 1981 to 1988 [Stosch & Franz 2002].

From 1998 to 1995, Althaus was one of the coordinators of the DFG's **Continental Deep Drilling Program (KTB)**. He is considered one of the initiators of **the GFZ German Research Centre for Geosciences in Potsdam**, which was newly founded in 1992, and chaired its scientific advisory board from 1992 to 1998. Althaus was chairman of the German Mineralogical Society (DMG) from 1977 to 1978. He retired at the end of the 2000/2001 winter semester.

In 1990, Egon Althaus was elected to the Heidelberg Academy of Sciences and the Academia Europea. The Faculty of Civil Engineering at the Budapest University of Technology awarded him an honorary doctorate in 1995. Althaus's work on the mineralogy of building materials and fluids in rocks was honored with the Hans Stille Medal of the

German Geological Society (DGG) in 1998. In 1972, Althaus organized the annual conference of the DMG in Karlsruhe, and in 2004 he was made an honorary member at a second DMG conference in Karlsruhe. As early as 1975, the rare magnesium phosphate mineral althausite was named after him.

5.15.1 Werner Smykatz-Kloss 1980–2004 (Sedimentary Petrography)

Werner Smykatz-Kloss (born in 1938 in Hannover) was appointed to the C3 professorship for sedimentary petrography in mineralogy in Karlsruhe in 1980. After graduating from high school in Wunstorf in 1958, he studied mineralogy in Göttingen. There he earned his doctorate in mineralogy under Professor Carl Wilhelm Correns, with minors in geology under Professor Erich Bederke and inorganic chemistry under Professor Oskar Glemser. From 1969, he was an assistant at the University of Karlsruhe (TH) in the Faculty of Bio-Geosciences, where he also habilitated.

From 1976 to 1979, Werner Smykatz-Kloss was a full professor of applied geochemistry at the University of Al-Fateh (Tripoli, Libya). In 1980, he accepted the C-3 professorship for sedimentary petrography in mineralogy in Karlsruhe. There, he founded his own research group and supervised more than twenty doctoral students. His research focused on silcretes and clay minerals, desertification, and thermal analysis. He published his methodological work on differential thermal analysis in 1974 in a book entitled *Differential Thermal Analysis—Application and Results in Mineralogy.* He also co-edited *Thermal Analysis in the Geosciences* (1991, Springer Verlag) with Slade St. J. Warne and *Palaeoecology of Quaternary Drylands* (2004, Springer Verlag) with Peter Felix-Henningsen. By raising public funds and third-party funding, he was able to invite the most renowned thermal analysts to Karlsruhe, including Professors MacKenzie, Leszek Stoch (Poland), Klaus Heide (Jena), and Hans-Joachim Seifert (Kassel). Werner Smykatz-Kloss traveled to Baltimore, Breslau, Budapest, Gorakpur, Graz, Helsinki, Innsbruck, Jena, Cairo, Khanpur (India), Oulu, Perth (Australia), Pretoria, Rome, Trondheim, Turku, and Vienna to give lectures. Mostly together with Professor Eberhard Sittig (geologist, Karlsruhe), Rolf Stellrecht (geologist, Karlsruhe) or Udo Haack (Göttingen), he led mineralogical excursions to Brittany, Finland, Italy, Norway, and Poland.

Werner Smykatz-Kloss helped establish the geoecology program at the University of Karlsruhe (TH) and taught in the new program. He was dean of the Faculty of Biological and Earth Sciences in 1996 and 1997. Werner Smykatz-Kloss retired in 2003/2004.

5.15.2 Heinz-Günter Stosch 1995–2015 (Petrography)

Heinz-Günter Stosch (*1950) completed his studies in mineralogy at the University of Cologne in 1976. In December 1992, Heinz-Günter Stosch was appointed to the professorship for petrography. Initially based at Puchelt's Institute of Petrography and Geochemistry, Stosch moved to Althaus's institute after a few years. Many German students knew Stosch from his online books, which are freely available on the web: Introduction to Isotope Geology, Crystal Optics I and Crystal Optics II, Exercises in Mineral and Rock Identification, and Introduction to Rock and Deposit Science. After Althaus's retirement and Altherr's departure, Stosch continued to teach the course at the University of Karlsruhe (TH). Heinz Stosch retired in 2015.

Armin Zeh succeeded Stosch as professor in the Chair of Petrology in 2015.

5.16 Gerhard Eisbacher 1984–2005 (Geology)

Gerhard H. Eisbacher (*March 22, 1940, in Graz, Austria) headed the Geological Institute together with Prof. Kurt Czurda from 1984 to 2005. Eisbacher studied in Graz and then in Innsbruck, where he graduated in 1964 with a dissertation on sedimentary petrography. Before completing his doctorate, he accepted an invitation to Princeton University (Master of Arts in 1966, PhD in 1967), where he completed his second degree in 1967 with a thesis on structural geology funded by the Geological Survey of Canada. After returning to Austria, Eisbacher obtained his doctorate in Innsbruck (Ph.Phil. in 1967) with the dissertation that had already been accepted in 1964.

From 1968 to 1984, Eisbacher worked as a research scientist at the Geological Survey of Canada in Vancouver, focusing on basin analysis, tectonics, and mass movements in the Skeena, St. Elias, and McKenzie Mountains of the western Cordillera. In addition, Eisbacher and J. Clague published the reference book *Destructive mass movement in high mountains: Hazards and management* in 1984. The authors were honored with the Edward Burwell Jr. Award from the Geological Society of America in 1988 for their publication.

In 1984, Gerhard Eisbacher took over the Chair of Regional & Historical Geology and moved with his wife Mary from Vancouver to Karlsruhe. Eisbacher took over teaching and field training in structural geology as well as ongoing cooperative research projects with the Geophysical Institute. With the two chairs of the Geological Institute, Regional & Historical Geology (Eisbacher) and Engineering Geology (Czurda), with the teaching and research area of Hydrogeology (Hötzl), supported by Professors Stellrecht, Sittig, Metz, and Stinnesbeck, a joint, professionally qualifying degree with oral preliminary and diploma examinations was established. This included examinations in mineralogical-petrographic

and geophysical subjects and a field-based diploma thesis (diploma mapping). Eisbacher was supported in this by his assistants, of whom Claus-Dieter Reuther, Manfred Strecker, Jonas Kley, and Bettina Reichenbacher qualified for professorships at other universities with their own research projects.

For more than 12 years, the tectonic field exercises financed by Eisbacher and a group of students themselves, in cooperation with Prof. R. Brandner from the University of Innsbruck, took place in the high mountains of the Tyrolean Limestone Alps. The establishment of a geoscience library at the geoscience institutes, supervised by student assistants, provided students with space for learning and intensive seminar work until the library had to be closed due to the centralization of libraries at the University of Karlsruhe (TH).

Eisbacher published articles on aspects of the Canadian Cordillera, the Appalachians and the Arctic, the Limestone Alps and the Black Forest. He also wrote the textbook *Introduction to Tectonics* (2nd edition, 1996). Eisbacher published the booklet *North America* (1988) in the series Geology of the Earth. Together with university assistant Jonas Kley, he wrote the book *Umwelt- & Rohstoffgeologie* (Environmental & Raw Materials Geology) (2001) and, with his research assistant Dr. Werner Fielitz, the geological guide *Karlsruhe und seine Umgebung* (Karlsruhe and its Surroundings) (2010). Eisbacher retired in 2005.

5.16.1 Rudolf Metz 1983–1988 (Regional Geology)

Prof. Dr. Rudolf Metz (*June 4, 1923 in Karlsruhe – †October 18, 1991 in the same city) worked at the Geological Institute from 1958, where he habilitated in 1971 and was appointed adjunct professor in 1983. Metz worked in particular on the regional geology of the Black Forest and the history of mining. He retired in 1988. In 1990, Metz was made an honorary member of the Upper Rhine Geological Association.

5.16.2 Rolf Stellrecht 1959–1993 (Historical Geology)

Prof. Dr. Rolf Stellrecht (*1928 in Stuttgart – †2017 in Karlsruhe) joined the Geological Institute of Illies, later Eisbacher, as an academic senior advisor in 1959 and represented local geology, in particular regional and historical geology, until 1993.

5.16.3 Eberhard Sittig (Paleontology)

Prof. Dr. Eberhard Sittig (*September 28, 1930 – †August 16, 2022 Mörsch) represented the teaching and research area of paleontology. He received his doctorate from the University of Freiburg in 1960 and would have retired in 1994.

5.16.4 Wolfgang Stinnesbeck 1994–2007 (Paleontology)

Eberhard Sittig was succeeded by Wolfgang Stinnesbeck, who headed the teaching and research area of paleontology at the Geological Institute from 1994 to 2007. After Eisbacher's retirement in 2005, Stinnesbeck continued to teach the fundamentals and managed the institute's affairs. In 2007, Stinnesbeck moved from Karlsruhe to Heidelberg University as part of the state evaluation of geosciences in Baden-Württemberg.

5.17 Kurt Czurda 1985–2005 (Engineering geology)

Kurt Czurda (born June 4, 1940 in Bregenz – died February 16, 2023 in Bregenz) succeeded Maurin and was a full professor and *Chair of Applied Geology* from 1985 to 2005, focusing on engineering geology. He received his doctorate in geology in Innsbruck in 1970, in civil engineering in Budapest in 1979, and habilitated in Innsbruck in 1979. From 1987 to 1990, he was dean of the Faculty of Biological and Earth Sciences. In 1991, Czurda founded the engineering firm ICP Ingenieurgesellschaft Prof. Czudra und Partner mbH (KIT 2023) in Karlsruhe. His work included landfill sealing and swelling pressure of clays, tunnel construction, slope movements, and designation of hazard zones (geohazards). After his retirement, Czudra studied and earned his doctorate in art history in 2014 (KIT 2023).

The Chair of Engineering Geology has been headed by **Philipp Blum** since 2010.

5.17.1 Heinz Hötzl 1974–2007 (Hydrogeology)

Heinz Hötzl (*August 29, 1941, Schirmdorf (Črnci), present-day Slovenia) received his doctorate in 1965 from the University of Graz with a microfacial thesis on the type locality of the Tressenstein limestones. After a short DFG research-stay at the Technical University of Darmstadt, he became an assistant to Prof. Viktor Maurin at the Chair of Applied Geology at the Technical University of Karlsruhe. In 1972, he habilitated there on the hydrogeology of the upper Danube catchment area.

Heinz Hötzl became an adjunct professor in 1974 and a professor of hydrogeology in 1978. His scientific work and publications focused on karst hydrogeological studies within the framework of international working groups in Germany, Switzerland, Slovenia, and Greece, as well as methodological investigations into the exploration and remediation of groundwater contamination. His long-term work in the Arab region is particularly noteworthy: from 1978 to 1988 as part of a project by the Austrian Academy of Sciences on the hydrogeology and climate development of the Arabian Peninsula, from 1987 to 1991 as part of the DFG Collaborative Research Center 108 "Stress and Stress Transformation

in the Lithosphere" on the tectonic development of the Red Sea, and from 1996 to 2010 as part of a German-Israeli-Palestinian and Jordanian joint project on water management in the Jordan River basin. For the latter, he was awarded the Order of Merit 1st Class of the Federal Republic of Germany in 2007 for his successful work in promoting international understanding.

Heinz Hötzl supervised over 60 dissertations. Many of the graduates went on to hold prominent positions in industry, government agencies, and consulting firms. His colleagues Stefan Wohnlich, Ingo Sass, Thomas Himmelsbach, and Barbara Reichert were appointed professors at universities. Hötzl was president of the International Association of Tracerhydrology (1986 to 1992), the German section of the International Association of Hydrogeologists (1990 to 1994), and the International Association of Hydrogeologists Karst Commission (1993 to 2006). In 1997, he was awarded the President's Award of the International Association of Hydrogeologists. Hötzl retired in 2007.

In 2011, **Nico Goldscheider** was appointed to the Chair of Hydrogeology.

5.18 Doris Stüben 1994–2012 (Geochemistry & Mineral Deposits)

Doris Stüben (born in 1955 in Wattenscheid) was appointed to the Chair *of Geochemistry and Mineral Deposits* in 1994, which had previously been held by Harald Puchelt. In 2001, she merged the Institute of *Mineralogy and Experimental Petrology*, headed by Egon Althaus, who had retired and whose position was not filled, with her Institute of Geochemistry and Mineral Resources to form a new Institute of *Mineralogy and Geochemistry* [KaNews 2001].

After graduating from high school in 1974 and training as a medical-technical assistant, she began studying geology at the University of Göttingen, graduating after 10 semesters [KaNews 2001]. She received her doctorate in 1986 from the Technical University of Clausthal on the geology and geochemistry of manganese ore crusts on submarine mountains in the Central Pacific. In 1991, she received a Feodor Lynen Research Fellowship from the Humboldt Foundation and spent a year working at the Oceanographic Institute in New Zealand. In 1993, she qualified as a professor at the University of Kiel. In the early 2000s, Doris Stüben was Dean of Studies at the Faculty of Biological and Earth Sciences [KaNews 2001].

Due to renovation work on the Chemistry Tower II, the geosciences moved to their current location at Adenauerring 20, where, in addition to offices, the necessary laboratory space

was also available. The groups led by Professor Eisbacher and Stinnesbeck moved into premises at the West Campus.

Due to Doris Stüben's illness, **Thomas Neumann** was appointed acting professor and headed the institute from 2008 to 2016 before being appointed to the Chair of Applied Geochemistry at the Technical University of Berlin in 2017.

Jochen Kolb was appointed to the Chair of Geochemistry and Mineral Deposits in 2016.

5.19 Reinhard Greiling 2007–2014 (Geology)

The *Geological Institute,* headed by Gerhard Eisbacher, was taken over by Reinhard O. Greiling (*1949). Prof. Dr. Reinhard Greiling moved from Heidelberg University to Karlsruhe University of Technology (TH) in 2007 as a full professor with his chair in *Structural Geology & Tectonophysics* and the Rock Magnetics Laboratory. In 2008, the Geological Institute became part of the Institute of Applied Geosciences (IAG).

The **state evaluation** of geosciences at universities in Baden-Württemberg in 2005/2006 led to a very positive assessment of Karlsruhe as a location. To raise the profile of the locations, Wolfgang Stinnesbeck moved with his paleontology department to Heidelberg University, which was to focus more on the human-environment relationship. In return, Professor Greiling moved from Heidelberg to Karlsruhe University of Technology (TH), which was to expand its applied profile in the geosciences.

Greiling, who spoke fluent Swedish, focused on field-based structural and regional geological studies and mapping of Africa and the Scandinavian Caledonides as a basis for the evaluation of deposits, especially natural stone and industrial minerals. In recognition of his regional and structural geological work on the Scandinavian Caledonides, the new trilobite species *Cotalagnostus greilingi* was named after Greiling in 2023 [Weidner et al. 2023]. Reinhard Greiling was elected to the Leibniz Society in Berlin and honored with the Daniel Ernst Jablonski Medal in 2024 in recognition of his extraordinary commitment to promoting the society's purpose and work.

In 2015, the Institute of Applied Geosciences (IAG) merged with the Institute of Mineralogy and Geochemistry (IMG) to form the Institute of Applied Geosciences (AGW). Until his retirement in October 2014, Greiling's structural geology and tectonophysics department was located in Building 6.36, Hertzstr. 16, in the old barracks at the Campus West, and then moved to Building 50.41 at Adenauerring 20.

In 2016, **Christoph Hilgers** was appointed to the Chair of *Structural Geology & Tectonics*.

5.19.1 Agnes Kontny (since 2007)

In 2007, **Agnes Kontny** (*June 26, 1962, Donaueschingen) came to the Karlsruhe Institute of Technology from Heidelberg with Greiling. She established the rock magnetism laboratory in Karlsruhe and has been in charge of it ever since. After Greiling's retirement in 2014, Agnes Kontny continued teaching from October 2014 to March 2016, managed the institute's affairs, and served as interim head of Structural Geology & Tectonophysics. Since 2016, she has been deputy head of the Chair of Structural Geology & Tectonics.

Agnes Kontny earned her degree in mineralogy from RWTH Aachen University in 1989. During her subsequent doctoral studies there, which she completed in 1994, and as a researcher at Justus Liebig University Giessen until 1995, she conducted research at the KTB continental deep drilling site in Windischeschenbach. In 1996, she moved to the Geological-Paleontological Institute at Heidelberg University to work with Greiling, where she completed her habilitation in 2003 and received her venia legendi in mineralogy and geology. After moving to University of Karlsruhe (TH) in 2007, she qualified as an adjunct professor in 2017. Her research on magnetic minerals makes a significant contribution to the identification of these phases in volcanic and impact rocks. Agnes Kontny was associate editor of the journal Studia Geophysica et Geodaetica from 2011 to 2020 and has been associate editor of the Journal of Geophysical Research - Solid Earth since 2021.

5.20 Geothermal Energy, Technical Petrophysics

The Applied Geosciences department at KIT was able to broaden its scope with two endowed professorships, initiated by civil engineer Prof. Dr. Gerd Gudehus from the Institute for Rock Mechanics and his successor Prof. Dr. Theodoros Triantafyllidis. **Frank Schilling** was appointed to the endowed professorship in Technical Petrophysics (funded by Herrenknecht) in 2009. **Thomas Kohl** was appointed to the endowed professorship in Geothermal Energy (funded by EnBW) in 2010.

5.21 General Geology

Nevena Tomašević has been a junior professor of general geology since 2021.

6 The spirit of Karlsruhe

6.1 The Black Forest Observatory

Heinz Draheim (born in Schönfeld in 1915, died in 2012) was a professor at the Institute of Geodesy from 1960 to 1983 and rector of the University of Karlsruhe (TH) from 1968 to 1983. Together with **Karl Fuchs** and **Henning Illies,** he founded the **Black Forest Observatory** in 1971**,** which is still jointly managed by the Institute of Geodesy and the Institute of Geophysics. During this time, close cooperation developed between the Institutes of Geology, Geophysics, and Geodesy.

6.2 Joint research projects

The close cooperation between geophysics, geology, and geodesy resulted in successful research projects that gained significance beyond the boundaries of the faculty. This successful collaboration was known as the "Spirit of Karlsruhe": research work on the Continental Deep Drilling Program (KTB), the Collaborative Research Center (SFB) Rock Mechanics, the Priority Program (SPP) Uplift of the Rhenish Shield, the SFB Stress and Stress Conversion in the Lithosphere, and the SFB Strong Earthquakes resulted in internationally renowned research groups. The results of the research project *Stress and Stress Release in the Lithosphere* are now known as the *World Stress Map*.

7 Geophysics at KIT since 1964

Geophysics was founded in 1964 at the University of Karlsruhe (TH) and, following the division of the Faculty of Mathematics and Natural Sciences, has been part of the Faculty of Physics since 1969.

7.1 Stephan Müller 1964–1971 (Geophysics)

Stephan Müller (born July 30, 1930, in Marktredwitz – died February 17, 1997, in Zurich) was appointed the first chair of the Geophysical Institute (GPI) at the University of Karlsruhe (TH), which he headed from 1964 to 1971. The founding of the *Geophysical Institute* in 1964 was initiated by civil engineer Prof. Hans Leussink (born 1912, died 2008) from the Institute for Rock Mechanics, who was rector of the University of Karlsruhe (TH) from 1958 to 1961 and later Minister of Education and Research in Baden-Württemberg from 1969 to 1972. When the faculty was divided into mathematics and natural sciences in 1969, the Geophysical Institute became part of the Faculty of Physics through Leussink's mediation. Stephan Müller was dean of the Faculty of Mathematics and Natural Sciences in 1968 and 1969. In 1971, he moved to ETH Zurich with most of his staff.

7.2 Karl Fuchs 1971–1997 (General Geophysics)

Karl Fuchs (born January 21, 1932 in Stettin, died March 22, 2021 in Karlsruhe) succeeded Stephan Müller as director of the Geophysical Institute at the University of Karlsruhe (TH), which was founded in 1964, and held the chair of geophysics from 1971 to 1997 [Wenzel & Ritter 2021]. After studying geophysics in Hamburg, at Imperial College London, and in Clausthal, he worked for two years as a geophysicist for the exploration industry in South America and North Africa. Fuchs received his doctorate in 1963 in seismic wave propagation in Clausthal. He then conducted research in Saint-Louis and Dallas, USA, and from 1965 onwards with Stephan Müller at the University of Karlsruhe (TH), where he habilitated in 1968. Karl Fuchs shaped geophysics in Karlsruhe for a total of 26 years and intensified the research areas of deep seismic exploration with active and passive sources as well as tectonic stress analysis. Fuchs was the initiator and spokesperson of SFB 108 (1981 to 1995), president of the International Lithosphere Project (1985 to 1990), and initiator of the ESF program EUROPROBE.

Karl Fuchs was a Fellow of the American Geophysical Union (class of 1986), a Fellow of the Geological Society of London (1989), honorary fellow of the Royal Astronomical Society, member of Academia Europaea (Earth and Cosmic Sciences, 1990), chairman (1977 to 1979) and honorary member (1992) of the German Geophysical Society, member of the Heidelberg Academy of Sciences (Math.-Nat. Class, 1990) and vice president of the European Union of Geosciences.

In 1984/1985, Karl Fuchs was a visiting scholar at the Australian National University in Canberra, in 1990 and 1994 he was a visiting Cox-Professor at Stanford University, and in 1956 and 2001 to 2004 he was a visiting scholar at the US Geological Survey in Menlo Park, California [Wenzel & Ritter 2021]. In 2002, he received an honorary professorship from the University of Bucharest (2002) and the Karl Heinrich Heitfeld Prize from the GeoUnion Alfred Wegener Foundation (2002).

Before graduating from Clausthal, he married his wife Cornelia-Almuth Winkels, with whom he lived until her death in 2019 [Wenzel & Ritter 2021].

7.2.1 Helmut Wilhelm

Helmut Wilhelm (born June 2, 1939) was a professor at the Chair of General Geophysics from 1980 and conducted research on Earth tides and geothermal energy. From 1990 to 1992, Wilhelm was chairman of the German Geophysical Society.

7.3 Friedemann Wenzel 1994–2016 (General Geophysics)

In 1994, **Friedemann Wenzel** (born January 17, 1951, in Immenstadt) was appointed to the Chair of *General Geophysics* and continued to lead the internationally renowned research team. The Fiebiger Program enabled a smooth transition from Fuchs, who held the chair until 1997, to Wenzel. After studying geophysics at the University of Karlsruhe (TH) in 1979, Wenzel spent a year conducting research at the Lamont-Doherty Geological Observatory of Columbia University, New York. Wenzel received his doctorate in 1985 and his habilitation in 1990 at the University of Karlsruhe (TH). This was followed by several years of research at Columbia University, USA, at CSIRO in Sydney, and later as director at GFZ in Potsdam. At the University of Karlsruhe (TH), he was, among other things, spokesperson for the SFB Starkbeben (Strong Earthquakes). Wenzel retired in 2016.

Andreas Rietbrock was appointed to the Chair of *General Geophysics* in October 2017.

7.4 Peter Hubral 1986–2007 (Applied Geophysics)

A second chair at the *Geophysical Institute* was established in 1986 for *Applied Geophysics*. **Peter Hubral** (*16.10.1940) was appointed to the chair and retired in 2007. After completing his degree in geophysics in Clausthal, Hubral received his doctorate from Imperial College London in 1970. He then began his professional career at Burmah Oil in Australia. From 1974, Peter Hubral worked at the Federal Institute for Geosciences and Natural Resources (BGR) in Hanover.

Peter Hubral was awarded the Conrad Schlumberger Award by the European Association of Geologists & Engineers (EAGE) in 1977 and the Reginald Fessenden Award (formerly Medal Award) by the Society of Exploration Geophysicists (SEG) in 1979. He has been an honorary member of the SEG since 1997 and was awarded the Maurice Ewing Medal by the SEG in 2013 for his work in exploration geophysics.

Thomas Bohlen was appointed to the Chair of *Applied Geophysics* in 2009.

7.5 Seismo-Geodesy

Henriette Sudhaus was appointed to the new professorship for *Seismo-Geodesy* in 2024.

8 Future Applied Geology

Applied geological research will continue to secure livelihoods and prosperity in the future. A global population that will continue to grow in the coming decades, accompanied by rising prosperity, will require more raw materials, groundwater, metals, and energy. Environmental interactions will increase and require more sustainable use of the environment and better environmental and climate protection. The demand for safe building land will rise and geohazards such as flooding and droughts will increase.

The globally increasing demand for raw materials, raw material purity, and energy can only be met by increasing extraction. Additional deposits are needed to expand low-carbon alternative energy production, such as wind power and photovoltaic systems, and to expand the grid infrastructure. Some of this demand can be met through better recycling and reuse. The use of raw materials for energy and materials often go hand in hand: water (dams and drinking water), natural gas (energy source and source of hydrogen and sulfur), petroleum (fuel and raw material for the chemical industry), geothermal energy (geothermal heat and source of lithium from thermal water), coal (fuel and reducing agent in the steel industry), uranium (nuclear fuel and medical technology) or copper and rare earth metals (energy technology and technological products).

New technologies for the exploration and responsible extraction of geoenergy and raw materials, new concepts for groundwater management, new models of deposit formation, large underground storage facilities for alternative energy sources, new sensor technology for building ground and slope stability, new analytics for environmental remediation and protection, and georesource management with improved recycling will continue to ensure our basic needs are met with a smaller footprint in the future, provided that applied geological research, teaching, and innovation continue to advance on the basis of knowledge and creativity.

In addition to basic scientific research, the engineering approach of applied geology/geosciences will gain in importance in order to continue to meet human needs for geoenergy, groundwater, raw materials, resource management with recycling, and safe building ground in the future. Knowledge, creativity, and progress will further improve environmental use and protection in an environment worth living in.

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10 About the author

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