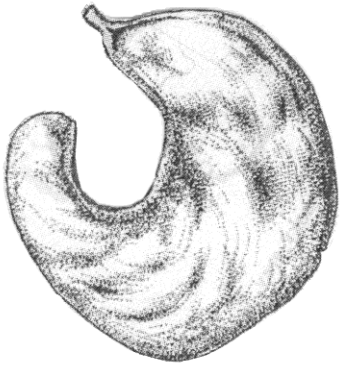

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Circulations: Colonial geology, the Prussian State Geological Institute and the South West African copper (1850–1919)

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Abstract

Science and technology were crucial for colonial expansion during the era of European imperialism. With the colony and motherland being so closely interconnected a circulation of knowledge began. Production of colonial knowledge and economic interpenetration had a massive influence on geological science. Although colonial history saw Africa as a mining continent, geology was never looked upon as a decisive scientific discipline in the colonial knowledge system. Copper ore was already being mined in South West Africa (SWA) in precolonial times while the first commercial mining only started in the middle of the 19th century. From the 1880s onwards, copper became a strategic resource in the second industrial revolution. The expectation of copper imports from SWA to supply German industry became a key argument for colonialists legitimizing German colonial expansion. From the mid-1880s onwards, a growing number of German geologists visited SWA. Their field research founded the tradition of what was known at the time as colonial geology ("Kolonialgeologie"). The Prussian State Geological Institute, founded in 1873, became the pivotal centre for research on colonial geo-resources. The exploration of the deposits up to 1919 culminated in the development of a new geological theory of the genesis of ore deposits.

Introduction

The copper ore resources of the Otavi mountains and other regions in Namibia had been exploited for centuries.[1] Archaeologists have excavated furnace sites up to 400 years old.[2] As early as 1685 "rumours of rich copper deposits in the north", led the

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[1] Eugenia W. Herbert, *Red Gold of Africa. Copper in Precolonial History and Culture*, Madison, University of Wisconsin Press, 1984.

[2] For the Drierivier site furnaces (mid 17th century), Rehobot District, see Beatrice Sandelowsky, *Archaeologically yours. A personal journey into the prehistory of Southern Africa, in particular Namibia*,

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Cape Governor to initiate an expedition to Namaqualand.[3] Early missionaries and others reported on Herero and Ovambo trading ore for metallic copper. In the early 1760s, the first known mining expedition to South West Africa (SWA) was organized by miners from South Africa while during "the copper mining mania of the 1850s"[4] South Africans opened the first commercial copper mine there (Matchless Mine).[5] Expectations of lavish copper occurrences – and even native copper[6] – in SWA attracted adventurers, but also geologists and mining engineers. With the rise of the electrical industry from the 1880s onwards, copper became a strategic resource worldwide. Germany – with no significant domestic copper ore deposits – increased copper imports from 12,300 t in 1880 to 225,400 t in 1913.[7] In the legitimization of German colonial expansion, the expectation of copper imports from SWA for the supply of German industry became a key argument for colonial protagonists.[8] From the mid-1880s onwards, a growing number of German geologists visited SWA, founding a tradition of colonial geology ("Kolonialgeologie").

Following the English example of 1835, the Prussian State Geological Institute ("Preußische Geologische Landesanstalt", PGLA) was founded in Berlin in 1873. By 1919, it had become the pivotal German centre for research on colonial geo-resources. In 1902, the PGLA began to build up a collection of geological-mineralogical material from the colonies ("geologisch-mineralogische Kolonial-Sammlung"). In the political arena, PGLA president Karl Schmeißer (1855-1924) became an important advocate of colonial exploration. In 1912, the PGLA inaugurated the Geological Centre for the German Protectorates ("Geologische Centralstelle für die deutschen Schutzgebiete").[9]

However, due to the disappointing results of exploration and mining activities in SWA, German companies involved in the metallurgical and electrical industries were reluctant to invest there. Only after 1900, when the rich deposits of copper in the Otavi mountains (Tsumeb) promised generous profits, did German industrialists and bankers along with South African and English enterprises, become heavily involved. From 1907 up to 1914, the "Otavi Minen- und Eisenbahngesellschaft" (OMEG) paid exceptionally high dividends.

Windhoek, Namibia Scientific Society, 2004: 73; Brigitte Lau, (ed.), *The Matchless Copper Mine in 1857. Correspondence of Manager C. J. Andersson,* Windhoek, National Archives of Namibia, 1987: viii.

[3] Olga Levinson, *South West Africa*, Cape Town, Tafelberg Publishers, 1976: 14.

[4] John M. Smalberger, *Aspects of the History of Copper mining in Namaqualand 1846-1931*, Cape Town, Struik, 1975: 9.

[5] Dag Henrichsen, *Herrschaft und Alltag im vorkolonialen Zentralnamibia: Das Herero- und Damaraland im 19. Jahrhundert*, Basel, Basler Afrika Bibliographien, 2011: 2, 61, 70 f., 89-91.

[6] Bruce Cairncross mentioned the discovery of a 400 kg pure copper piece at the Oganja mine, north-east of Windhoek, and other mining sites; Bruce Cairncross, *Field Guide to Rocks & Minerals of Southern Africa*, Cape Town, Struik Nature, 2004: 79.

[7] Max Warnack, *Unsere Kolonialwirtschaft in ihrer Bedeutung für Industrie, Handel und Landwirtschaft*, Berlin, Kolonial-Wirtschaftliches Komitee, 1914: 81.

[8] Udo Kaulich, *Die Geschichte der ehemaligen Kolonie Deutsch-Südwestafrika (1884-1914). Eine Gesamtdarstellung*, 2nd edition, Frankfurt a. M., Lang, 2003: 383.

[9] Hans Udluft, *Die Preußische Geologische Landesanstalt 1873-1939*, Hannover, Bundesanstalt für Bodenforschung, 1968: 20.

Beside the extraordinary quality of the copper, for geologists and mineralogists, the mine was a scientific singularity: "Tsumeb ranks as one of the highest grade base metal deposits in the world. It is geologically and mineralogically famous for 41 copper, lead, zinc, vanadium, and germanium ore minerals."[10]

In 1914, the OMEG hired the young geologist Hans Schneiderhöhn (1887-1962)[11] to explore further the ore deposits of Tsumeb and the Otavi mountains. The outbreak of the Great War forced him to stay until 1919. During this period, the Union Defence Force took over the region (1915). In 1916, the South African geologist Percy Albert Wagner (1885-1929)[12] published "a most thorough monograph on the South West African geology and mining industry".[13] Up to 1919, Schneiderhöhn carried out an extensive study of the geology of the region, thereby developing a ground-breaking new microscopic method "of opaque mineral identification".[14] Eventually, he became famous not only for his new microscopic method, but also for his theory on the genesis of ore deposits.[15] In 1919, Schneiderhöhn left South West Africa, and the protectorate was handed over to the South African Union. In that same year, the Geological Centre for the German Protectorates in Berlin was shut down.

In the following study, I examine the interdependence between geological knowledge production and the establishment of the flourishing copper-mining industry. In particular, attention is paid to the respective roles of the geologists and the circulation of knowledge between SWA and the PGLA. I will outline how the colonial-geological knowledge system emerged, beginning with rather unspecialized explorers, later through the commission of experts, and finally with the establishment departments by the government and by industrial interests of influential institutions. This article cannot reconstruct the system in all detail, and only a selection of the historic copper mines,[16] mining enterprises, and experts involved can be mentioned here. Thus, the article will shed light on the pivotal role of science and scientific institutions in colonial exploitation,

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[10] J. P. Ratledge, J. N. Ong and J. H. Boyce, "Development of metallurgical practice at Tsumeb", *Transactions of the American Institute of Mining and Metallurgical Engineers*, 202, 1955: 374-382 (374).

[11] Kurt von Gehlen, "Zum 100. Geburtstag von Hans Schneiderhöhn (1887-1962), dem bekannten Erzlagerstättenforscher und Mineralogen", *Erzmetall*, 41, 1988: 373 f.

[12] Percy Albert Wagner, *The Geology and Mineral Industry of South-West Africa*, Pretoria, The Government Printing and Stationery Office, 1916: 9.

[13] Hugo, P. J. and K. E. L. Schalk, *1880-1980: A Century of Earth Science in South West Africa/Namibia*, Department of Economic Affairs, Geological Survey of South Africa, 1982: 6.

[14] Paul Gerhard Söhnge, *Tsumeb. A Historical Sketch*, Windhoek, Committee of the S.W.A. Scientific Society, 1967: 58.

[15] Christian G. Amstutz, , "Hans Schneiderhöhn – ein Versuch einer Standortbestimmung seines erzgenetischen Lebenswerkes", *Erzmetall*, 41, 1988: 375-378.

[16] As "copper is by far the most abundant mineral commodity in Namibia", in 1992, the Geological Survey published a complete compilation of all copper ore occurrences of Namibia, including data on early historical mining activities; G. I. C. Schneider and K. G. Seeger, "Copper", in: Republic of Namibia, Ministry of Mines and Energy, (ed.), *The Mineral Resources of Namibia*, Windhoek, 1993, Chapter 2.3.

and shall provide a bottom line for more detailed future research on the transnational colonial-geological system.

Research frame and master narrative

In colonial history today, the theoretical framing is provided by *postcolonial studies*. According to Daniel R. Headrick, western science and technology were crucial for colonial expansion during the era of European imperialism.[17] In contrast to the traditional colonial narrative, the entanglement between the colonial power and the colony was not based on a one-way transfer of knowledge and technologies, but was shaped by transnational circulations. Thereby, the production of colonial knowledge even led to the formation of new scientific disciplines. One of the most prominent examples is provided by the history of geography.[18] Although Africa has been characterized as mining continent in colonial history, the role of geology in the colonial exploitation has not yet been the subject of more intensive scrutiny.

Despite the function of the PGLA in the geological exploration of the vast territories of SWA from the 1880s onwards, this chapter of its history has been largely neglected even in the memory of the institute itself. If at all mentioned, the colonial activities appear without any explanation of the context of colonial expansion and genocide.[19] Credit must be given to the science historians in the German Democratic Republic, who identified the connection between the disciplinary and institutional developments of geology and the prevailing relations of production.[20] In 1987, H.-J. Kamps stressed the relevance of the PGLA in the context of the German imperialistic aggression up to 1914. From the 1880s onwards, the Prussian Mining Authority and the PGLA published innumerable papers on the resource potential and the mining and metallurgical industries in foreign countries and in the colonies.[21]

The master narrative on the history of Namibia from 1884 to 1919 emphasizes the failure of German colonial rule and the genocide. The behaviour towards the African peoples was dominated by fraud, cruelty, racism, rape, murder, and land grabbing. The Herero and Nama uprisings from 1903 to 1907 resulted in a genocide which was carried out by the Germans. Of up to 100,000 Otjiherero-speakers before the Namibian War there were only around 20,000 survivors in 1911. According to Marion Wallace,

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[17] Felix Brahm, "Imperialismus und Kolonialismus", in: Marianne Sommer, Staffan Müller-Wille and Carsten Reinhardt, (eds.), *Handbuch Wissenschaftsgeschichte*, Stuttgart, Metzler, 2017: 287-294 (287).

[18] Carsten Gräbel, *Die Erforschung der Kolonien. Expeditionen und koloniale Wissenskultur deutscher Geographen, 1884-1919*, Bielefeld, transcript, 2015: 9 ff.

[19] Udluft, *Landesanstalt*: 20, 91, 93, 155.

[20] Martin Guntau and Hubert Laitko, (eds.), *Der Ursprung der modernen Wissenschaften*, Berlin, Akademie-Verlag, 1987: 18 f., 61, 75 f.

[21] H.-J. Kamps, "Die Bildung und Entwicklung zentraler staatlicher geologischer Institutionen in Berlin in der Periode von der Entstehung des deutschen Imperialismus bis zum Inferno des faschistischen Krieges", *Zeitschrift für angewandte Geologie*, 33, 1987: 148-153 (149).

> using even the most conservative of these figures, more than half the population classified as Herero was wiped out." Of around 20,000 Nama, roughly one third was killed. Other Nama-speaking groups were sent to concentration camps (Shark Island) and "almost wiped out.[22]

In historiography, different interpretations were presented for the causes of the Namibian War. As Jan-Bart Gewald put it, the origins are not to be found in "the loss of their lands", but "in the interpretations and perceptions of the German settlers and missionaries, rather than in those of the Herero."[23] It is not the aim of this article, to provide a conclusive answer to this question. But as Horst Drechsler and Marion Wallace pointed out, the uprising of the Herero was triggered by the decision of the OMEG to build a railway connection between Tsumeb and the Atlantic Ocean.[24] In fact, the OMEG forced the Herero to hand over without compensation parts of their most fertile pastures including the precious water rights.[25] The question is whether the geological expeditions that had brought to light the lavish copper deposits of Tsumeb were crucial in the chain of events that led to the genocide. With the inauguration of the railway connecting the mine with the Atlantic Ocean in 1906 and the ensuing copper rush, science and the railway turned out to be instruments of colonial domination (Headrick) in SWA and were conducive to the capitalistic exploitation of the colony that followed.[26]

Knowledge system, experts, expeditions: transfers and circulations

Apart from several adventurers, a growing number of qualified individuals became involved in exploring, consulting, planning, financing, building, and operating the colonial exploitation of SWAs copper. In fact, it was mainly powerful political instances, national scientific institutions, and transnational companies that provided the institutional structure for the overall colonial enterprise. All the departments, offices, laboratories, mineral collections, and dependencies involved, specialized in the various techno-scientific tasks required to reach the final goal. In these institutions, the experts were responsible for producing and transferring knowledge. In the history and sociology of science, the power of modern techno-sciences is not confined to the generation of knowledge, but also to its mobilization across the various institutions and beyond. Despite the individual character of these institutions, they establish a so called knowledge system. In the history of Germany's industrialization in the late 19th century, the chemical industry, and later, the metallurgical industries were regarded as prototype

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[22] Marion Wallace, *History of Namibia: From the Beginning to 1990*, London, Hurst, 2011: 177 f.

[23] Jan-Bart Gewald, *Herero Heroes. A Socio-Political History of the Herero of Namibia 1890-1923*, Oxford, Currey, 1999: 142.

[24] Marion Wallace, *Geschichte Namibias. Von den Anfängen bis 1990*, Basel, Basler Afrika Bibliographien, 2015: 250.

[25] Horst Drechsler, "Südwestafrika 1885-1907", in: Helmuth Stoecker, (ed.), *Drang nach Afrika. Die deutsche koloniale Expansionspolitik und Herrschaft in Afrika von den Anfängen bis zum Verlust der Kolonien*, Berlin, Akademie-Verlag, 1991: 36-58 (49).

[26] Wallace, *Geschichte Namibias* : 314.

models for the evolution of sectoral knowledge systems. There, the increasing number of academic employees became the key factor.[27] The variety of relations in the knowledge system included informal contacts, formal contracting, and the participation in decision-making interdisciplinary advisory boards and committees.[28] In order to evaluate the function of knowledge, its carriers, and its institutions in colonial exploitation, it is necessary to reconstruct the evolution of the knowledge system as well as to understand its internal mechanisms.

Early colonial historiography has not questioned how knowledge transfer functioned, but reduced it to a one-way operation from the colonial power to the colony. However, recent studies in postcolonial history of science emphasize the notion of circulations.[29] In the later colonies, bodies of knowledge existed long before colonization, and simultaneously, colonial knowledge was produced both in the territories after occupation as well as in the motherland. Thus, the evolving colonial knowledge system connected experts and institutions and induced an increasing circulation within the system. A recent study on the history of National Socialist colonial sciences establishes the notion of a proto-academic network that emerged up to 1918. Thus, individual experience rather than scientific professionalization was the prerequisite for membership to this scientific community.[30] The following brief examination of the historical case of the German colonial geology will ask whether this academic professionalization had not emerged much earlier than supposed. Additionally, these circulations were not restricted to knowledge. In the following section a number of forms of transfer will be presented. As was the case with geography, a variety of scientific expeditions cleared the way for military and commercial interests in the protectorate.

Tab. 1: Pre-colonial expeditions (selection)

1761/62	Hendrik Hop	Keetmanshoop
1791/92	Willem van Reenen	Rehoboth
1836/37	James Edward Alexander	Gnutuais/ Rehoboth
1850/51	Francis Galton; Charles John Andersson	Otavi mountains
1857	Theophilus Hahn; Johannes Rath	Missionaries

[27] See "Industrieforschung als Wissenssystem", in: Ulrich Marsch, *Zwischen Wissenschaft und Wirtschaft. Industrieforschung in Deutschland und Großbritannien 1880-1936*, Paderborn, Schöningh, 2000: 37-48.

[28] Thomas P. Hughes, "Managing complexity: Interdisciplinary advisory committees", in: Robert Fox, (ed.), *Technological Change: Methods and Themes in the History of Technology*, Amsterdam, Harwood, 1996: 229-245.

[29] Nadin Heé, "Postkoloniale Ansätze", in: Marianne Sommer, Staffan Müller-Wille and Carsten Reinhardt, (eds.), *Handbuch Wissenschaftsgeschichte*, Stuttgart, Metzler, 2017: 80-92.

[30] Holger Stoecker, "Afrika als „kolonialer" Ergänzungsraum im „Dritten Reich". Ressourcen, Visionen und Limitationen der NS-Kolonialwissenschaften", in: Sören Flachowsky, Rüdiger Hachtmann and Florian Schmaltz, (eds.), *Ressourcenmobilisierung. Wissenschaftspolitik und Forschungspraxis im NS-Herrschaftssystem*, Göttingen, Wallstein, 2016: 153-177 (154 f.).

1850s	Stinner, Director (1859/60)	Matchless Mine
1861	Thomas Baines	Artist, Explorer
1862	James Chapman	Trader, Explorer

Expeditions by geologists and mining experts were crucial for the generation of knowledge about colonial resources. The history of the numerous geological and mining expeditions to SWA from the 18th century onwards, can be reconstructed from a larger historiographical body of literature and published sources.[31] The expedition in the early 1760s, headed by Hendrik Hop (1716-1771), "obtained rich specimens of copper ore".[32] His reports mentioned copper processing[33] and trade.[34] Missionaries, traders and explorers – such as James Edward Alexander (1803-1885) or James Chapman (1831-1872)[35] – also added to the legends about the mineral resources of SWA (Tab. 1). Francis Galton (1822-1911), assisted by Charles John Andersson (1827-1867),[36] "was the first to mention the occurrence of copper in the Otavi mountainland." The copper "was smelted by an Ovambo tribe at Odangwa."[37] Samples of copper ore from the Matchless Mine near Rehoboth were shipped to Germany by its administrator Stinner. In 1861, the ore became the object of a publication by the German professor of mineralogy at Giessen, Adolph Knop (1828-1893), which "may well be the first scientific publication on a geological subject from the Territory."[38] The publication was broadly recognized in the geological and mining communities.[39] However, all pre-colonial commercial copper ventures failed at an early stage due to political issues or other circumstances, e.g. transportation of the copper ore was extremely costly.[40]

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[31] E. g. C. Liesegang, "Deutsche Bergmannsarbeit im alten Südafrika", *Glückauf*, 76, 1940: 308-312.

[32] Edward C. Tabler, *Pioneers of South West Africa and Ngamiland 1738-1880*, Cape Town, Balkema, 1973: 58 f.

[33] John Kinahan, "Eighteens Century Coppersmiths in Central Namibia. Comments on Some Sources and Syntheses", *Namibiana*, 2, 1980: 17-22.

[34] Martina Gockel, "Diversifizierung und politische Ökonomie der Damara im 19. Jahrhundert", in: Wilhelm J. G. Möhlig, (ed.), *Frühe Kolonialgeschichte Namibias 1880-1930*, Köln, Köppe, 2000: 97-135 (115 f.).

[35] Tabler, *Pioneers* : 1-3, 20 f.

[36] Ibid.: 3-8, 42 f.

[37] Levinson, *South West Africa* : 109.

[38] Hugo, Schalk, *Century* : 2 f.

[39] E. g. "Über die Kupfererzlagerstätten von Kl. Namaqualand und Damaraland. Ein Beitrag zur Entwicklungsgeschichte der Erzen", cit. Ursula Massmann, "Laien, Forscher, Wissenschaftler", in: Klaus A. Hess and Klaus J. Becker, (eds.), *Vom Schutzgebiet bis Namibia 2000*, Göttingen, Hess, 2002: 117-121 (119).

[40] Brigitte Lau, *Southern and Central Namibia in Jonker Afrikaner's Time*, Windhoek, National Archives of Namibia, 1987: 98.

Tab. 2: Colonial Expeditions, DKG and Government Geologists up to 1900 (selection)

1882	Karl Hoepfner	German Government
1884	Paul Prescher	Adolf Lüderitz
1884	Karl Hoepfner	Adolf Lüderitz
1884	H. A. Pohle; Adolf Schenck	Adolf Lüderitz
1885	Moritz Stapff	DKG
1888/89	Georg Gürich	South West African Gold Syndicate
1888	Philipp Braumüller	Deutsch-Afrikanische Minengesellschaft
1888	Georg Frielinghaus	DKG-Mining Authority
1888/92	Eduard Fleck	L. v. Lilienthal'sches Syndikat
1893	Gustav Duft	Gov. Mining Authority
1892/95	Mathew Rogers	SWACO
1893/1901	Georg Hartmann	SWACO/ 1902 Kolonialabt. Auswärtiges Amt[41]
1899/1900	Hermann Eichmeyer	Hanseatische Land-, Minen- und Handelsges.
1900	Christopher James	OMEG
1900	Theodor Gathmann	Gov. Mining Authority/ 1903 OMEG

The second phase of expeditions began in the early 1880s (Tab. 2). The earliest expedition on ore deposits commissioned by the German government was conducted in 1882 by Karl Hoepfner (1858-1900), a PhD mineralogist.[42] Adolf Lüderitz (1834-1886), who was mainly interested in gold and gemstones, initiated several expeditions. In early 1884, mining engineer Paul Prescher from the Mansfeld copper region discovered deposits near Aus.[43] Lüderitz also hired Hoepfner in 1884. Lüderitz´s second expedition was headed by the mining director Hermann August Pohle, accompanied by six miners from Freiberg, Saxony, and the former assistant of the Institute for Mineralogy at Bonn, Adolf Schenck (1857-1936).[44] Pohle did not identify

[41] Georg Hartmann (1865-1946) was geographer; Kurd Schwabe, *Im deutschen Diamantenlande. Deutsch-Südwestafrika von der Errichtung der deutschen Herrschaft bis zur Gegenwart (1884-1910)*, Berlin, Mittler, 1909: 419 f.; Rolf Peter Tschapek, *Bausteine eines zukünftigen deutschen Mittelafrika. Deutscher Imperialismus und die portugiesischen Kolonien. Deutsches Interesse an den südafrikanischen Kolonien Portugals vom ausgehenden 19. Jahrhundert bis zum ersten Westkrieg*, Stuttgart, Steiner, 2000: 235.

[42] Walther Fischer, "Hoepfner, Carl", *Neue Deutsche Biographie*, 9, 1972: 348; "Biographische Mitteilungen", *Leopoldina*, 37, 1901: 32-40 (35).

[43] J. H. Esterhuyse, *South West Africa 1880-1894. The Establishment of German Authority in South West Africa*, Cape Town, Struik, 1968: 89.

[44] Hans Lüert, *Deutscher Bergbau im Ausland: in der Vergangenheit, Gegenwart und Zukunft*, Köln, Grote, 1971: 178; Dietrich von Engelhardt, (ed.), *Biographische Enzyklopädie deutschsprachiger Naturwissenschaftler*, München, Sauer, 2003.

copper minerals. However, Lüderitz sold his prospecting rights to the "Deutsche Kolonialgesellschaft für Südwestafrika" (DKG). Lüderitz had claimed that the whole territory bore rich ore resources, mainly copper.[45] To address its lack of reliable expertise the DKG hired geologist Friedrich Moritz Stapff (1836-1895). After disappointing results (1885), Stapff advised against further expeditions.[46]

Several studies have revealed to what extent colonial enterprises could become driving agents for geological knowledge production. These enterprises – e. g. the South West Africa Company (SWACO)[47] and the OMEG[48] – launched further expeditions and hired experts from other fields such as mining and chemistry. These experts formed a collective which became responsible for the production, but also for the circulation of colonial knowledge. Circulations could be triggered by publications. In some cases, the experts were originally government employees and were subsequently hired by a company. Experts circulated between motherland and colony, thereby transferring knowledge and samples of minerals. After alleged discoveries of gold in 1887, several expeditions were launched.[49] Mining enterprises hired PhD geologist Georg Gürich (1859-1938).[50] Commissioned by the South West African Gold Syndicate, he searched for gemstones and noble metals.[51] PhD mining engineer Philipp Braumüller undertook an expedition for the "Deutsch-Afrikanische Minengesellschaft" (1888).[52] In the same year, mining expert and chemist Eduard Fleck (1841-1917)[53] was sent out by Ludwig

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[45] C. A. Lüderitz, *Die Erschließung von Deutsch-Südwest-Afrika durch Adolf Lüderitz*, Oldenburg, Stalling, 1945: 10, 100 f., 109.

[46] Horst Drechsler, *Südwestafrika unter deutscher Kolonialherrschaft. Die großen Land- und Minengesellschaften (1885-1914)*, Stuttgart, Steiner, 1996: 30; Stapff had graduated from the Bergakademie Freiberg; Heinz Gustafsson, *Namibia, Bremen und Deutschland. Ein steiniger Weg zur Freundschaft*, Delmenhorst, Aschenbeck und Holstein, 2003: 180 f., 187, 570; for his visit to the Hope Mine see Ludwig Conradt, *Erinnerungen aus zwanzigjährigem Händler- und Farmerleben in Deutsch-Südwestafrika*, ed. von Thomas Keil, Göttingen, Hess, 2006: 65-71.

[47] Richard A. Voeltz, *German Colonialism and the South West Africa Company, 1884-1914*, Athens, Ohio University Center for International Studies, 1988.

[48] Heidi Schnorbus, (ed.), *Die Geschichte der Otavi-Minen-AG, 1900-2000. Ein ereignisreiches Jahrhundert*, Eschborn, Otavi Minen AG, 2000.

[49] Georg Gürich, *Deutsch-Südwestafrika. Reisebilder und Skizzen aus den Jahren 1888 und 1889*, Hamburg, Friederichsen, 1891: 179 f.

[50] Kaulich, *Geschichte* : 58 f., 295 f.; Oskar Hintrager, *Südwestafrika in der deutschen Zeit*, München, Oldenbourg, 1956: 22; Werner Tabel, *Autoren Südwestafrikas. Biographien, Rezensionen und Hintergrundinformationen*, Göttingen, Hess, 2007: 200-206.

[51] Dehm, Richard, "Gürich, Georg", *Neue Deutsche Biographie*, 7, 1966: 281 f.

[52] Conrad Weidmann, *Deutsche Männer in Afrika. Lexicon der hervorragendsten deutschen Afrika-Forscher, Missionare etc.*, Lübeck, Nöhring, 1894: 18; Philipp Braumüller, *Der geognostische Aufbau Syderöe's, ein Beweis, daß die nordischen Basaltgesteine neptunischen Ursprungs sind*, Dissertation, Rostock, 1875.

[53] "Dr. Eduard Fleck", www.zobodat.at/personen.php?id=7612&bio=full

von Lilienthal (1828-1893), and in 1889, Fleck supposedly discovered "valuable mines" in the Rehoboth region.[54]

In 1888, the DKG was empowered to establish a mining authority.[55] Georg Frielinghaus (1855-1914), "Bergassessor" from Saarbrücken, became the director with "Bergreferendar" (first stage mining engineer) Gustav Duft (1859-1924) as his deputy. After the breakdown of the German "Herrschaft" in the Herero territory, from 1891 onwards, the Germans started to establish a military and civil administrative structure. A new mining authority under governmental rule was also established. These events have been studied in detail by Udo Kaulich. In 1893, Gustav Duft became head of the new mining authority. However, there was very little thorough geological research during the first two decades of German colonial rule. The results of the expedition by mining engineer ("Bergmeister") Hermann Eichmeyer (1864-1928) together with 10 German miners (1899-1900), commissioned by the "Hanseatische Land-, Minen- und Handels-gesellschaft", were disappointing.[56] A geological dissertation in 1896 stated that none of the copper mines – Kuyas, Hope, Matchless, Ebony, and Pot – had been successful,[57] which was especially disappointing for the colonial protagonists. According to Kaulich, all deposits of gold, copper, lead, and iron ore, up until 1903, were accidental discoveries without any following mining activities – except in one case.[58]

The outstanding exception to the rule was the expedition of Mathew Rogers which was commissioned by the SWACO 1892/95. The idea to explore the ore deposits of the Otavi Mountains was prompted by several older reports from travellers, missionaries, and traders about the trade of copper ore between the Ovambo and the Herero. They had observed camel trains loaded with copper ore, coming from Otavi, transporting around 60 t/ year. The detailed reconstruction of the events by Heidi Schnorbus, Gerhard Söhnge, and Wendell E. Wilson provide an impression of the sensation felt by Rogers when he discovered the 'green hill' of Tsumeb:

> I […] have visited various countries of the world, inspected mines, mineral outcrops, and prospecting for minerals; have been associated with the minerals gold, silver, tin, copper and lead; but in the whole of my experience I have never seen such a sight as was presented before my view at [Tsumeb], and I very much doubt that I shall ever see such another in any other locality.[59]

The hill was green because of its main mineral component, Malachit, a copper mineral. A 'biography' of this absolute superlative in Namibian mining was published recently by

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[54] "Ludwig von Lilienthal", *Export*, 15, 1893: 382-384.

[55] Gustav Duft, "Über den gegenwärtigen Stand des Bergbaues in Deutsch-Südwestafrika", in: Theodor Leutwein, *Elf Jahre Gouverneur in Deutsch-Südwestafrika*, 2nd ed., Berlin, Mittler, 1907: 375-390 (375).

[56] Drechsler, *Minengesellschaften* : 130.

[57] Ernst Freiherr von Stromer von Reichenbach, *Die Geologie der deutschen Schutzgebiete in Afrika*, Diss., Universität München, 1896: 141 f.

[58] Kaulich, *Geschichte* : 81, 87, 384-387, 620.

[59] Schnorbus, *Geschichte* : 59; Söhnge, *Tsumeb* : 18; E. Wilson Wendell, "Tsumeb! The world´s greatest mineral locality", *The Mineralogical Record*, 8, (3), 1977: 4-111 (11).

Judith Fait. She stresses the interplay of "copper, colonialism, [and] capital" leading to the exploitation, and mentions several of the experts involved. Surprisingly, the PGLA had already received ore samples from Otavi in 1887, but its experts had failed to draw the appropriate conclusions. In 1907, when this became public knowledge, the colonial mining companies´ confidence in the PGLA was deeply shaken.[60]

For the transport of the Tsumeb ores a railway had to be built to connect the mine with the Atlantic. Due to political tensions between Great Britain and the German Empire, the SWACO was forced to found a German company for this purpose.[61] In 1900, the OMEG was founded, with 60% of its shares held by the SWACO. Commissioned by the OMEG, the American mining engineer Christopher James – together with civil servants and 27 miners – set out for Tsumeb in order to open up the mine. At the end of the year 1900, 9 tons of Tsumeb ore were shipped to London for further analysis.[62] James estimated the ore deposit to be almost 300,000 t, and expected a profit of over 300,000 pounds Sterling per year.[63] However, before approving the project, another expert had to inspect the Tsumeb ore body. Theodor Gathmann, a geologist at the mining authority, confirmed the James' estimate.[64] Today there is still very little known about either James or Gathmann.

In the following years, the sensational mineral singularity of Tsumeb and the Otavi region was visited by several other experts from different fields (Tab. 3). Among them were the mining engineer Julius Kuntz (1865-1940) in 1904[65] and Paul Krusch (1869-1939),[66] later president of the PGLA (1923-1933). Mine surveyor Eberhard Rimann (1882-1944), mining engineer at the "Bergakademie Freiberg", was sent out by the "Metallurgische Gesellschaft AG/ Hanseatische Minengesellschaft" in 1910/12.[67] In 1908, samples of ore were shipped to Germany and analysed by the metallurgist and mineralogist Wilhelm Maucher (1879-1930)[68] in Freiberg, Saxony.[69] In 1910/12, Kuntz

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[60] Judith Fait, *Kupfer, Kolonialismus, Kapital. Das Bergwerk Tsumeb, Namibia*, Hamburg, Diplomica, 2019: 72.

[61] Voeltz, *German Colonialism* : 67 f.

[62] Schnorbus, *Geschichte* : 60.

[63] Karl Schmeißer, Karl [Kgl. Berghauptmann, Breslau], *Die nutzbaren Bodenschätze und die Entwickelung des Bergbaus in den deutschen Schutzgebieten*, Breslau, Korn, 1908: 12.

[64] Schnorbus, *Geschichte* : 61 f., 68.

[65] Lüert, *Bergbau* : 1971: 30-32; "Verstorben", *Zeitschrift der Deutschen Geologischen Gesellschaft*, 92, 1940: 610.

[66] Heinz Walter, "Krusch, Paul", *Neue Deutsche Biographie*, 13, 1982: 147 f.

[67] Eberhard Rimann, "Zur Kenntnis südwestafrikanischer Kupfervorkommen", *Metall und Erz*, 11, 1914: 624; "Verstorben", *Zeitschrift der Deutschen Geologischen Gesellschaft*, 96, 1944: 139 f.; Lüert, *Bergbau* : 130.

[68] "Wilhelm Maucher (Mineraloge)", https://de.wikipedia.org/wiki/Wilhelm_Maucher_(Mineraloge)

[69] Söhnge, *Tsumeb* : 58; Fait, *Kupfer* : 74.

was commissioned by the "Discontogesellschaft" and the SWACO for an extensive exploration of the concession area of the "Kaoko Land- und Minengesellschaft".[70]

Tab. 3: Colonial Geologists and Mining Engineers in SWA and Germany 1904-1919

1902	Hermann Eichmeyer	Zentrale für Bergwesen (commercial), Frankfurt
1902	Edmund Naumann	Zentrale für Bergwesen (commercial), Frankfurt
1904	Heinrich Lotz	PGLA, SWA mining authority, 1908/10 SWA Minensyndikat
1904	Erwin Semper	PGLA, SWA mining authority
1904	Julius Kuntz	Goertz & Co., Johannesburg
?	Paul Krusch	Later President of the PGLA (1923-1933)
1906	Kurt Pasel	SWA mining authority
1907/08	Gustav Hüser[71]	Later Ministerialrat, Prussian Ministry of Commerce
1906/14	Paul Range	PGLA (1904), SWA mining authority
1906/08	Paul Hermann	1904 Government Geologist, SWA
1907/10	Hermann Eichmeyer	Südwestafrikanisches Minensyndikat
1908/10	Albrecht Burchardt	Südwestafrikanisches Minensyndikat
1909?	Franz Rintelen	Chemical Laboratory, Swakopmund
1910/12	Eberhard Rimann	Bergakademie Freiberg; Metallurgische Ges. AG; Hanseatische Minengesellschaft
1910/12	Julius Kuntz	Discontogesellschaft, Berlin, & SWACO
1914/15	Hans von Staff	Kaiserlicher Geologe für Deutsch-Südwestafrika
1914/19	Hans Schneiderhöhn	Universität Berlin; OMEG, Tsumeb

Knowledge production and accumulation in Germany

From the 1880s onwards, the PGLA intensified its colonial activities. As H.-J. Kamps put it, beginning in 1900, especially under its president Karl Schmeißer, the PGLA was dedicated to colonial geology and 'German colonization'.[72] In 1893/94, Schmeißer was head of an expedition to Transvaal, South Africa. In 1902, he became member of the "Kolonialrat" of the German foreign office ("Auswärtiges Amt"), where he pressed for the exploration of colonial natural resources. With his own colonial experience and his expertise in geology and mining, he became a prominent protagonist of the colonization and exploitation of SWA. Thus, it is not at all surprising, that in 1905, Schmeißer was

[70] Lüert, *Bergbau*: 30-32.

[71] [Bergassessor] Dudweiler, "Gustav Hüser †", *Metall und Erz*, 24, 1927: 556.

[72] Kamps, "Bildung": 150.

appointed to a new scientific commission for studies on the German protectorates ("Kommission zur landeskundlichen Erforschung der Deutschen Schutzgebiete").[73] After Theodor Gathmann left his position as government geologist in SWA for the OMEG, Schmeißer convinced the colonial administration to send out geologist Heinrich Lotz (1873-1943) and mining official Erwin Semper (1872-1905), PhD geologist.[74]

Beyond the questions of employment and maintaining high standards of geological and mining expertise in SWA, under Schmeißer the PGLA itself acquired a new institutional quality. In 1902, the PGLA founded its own "Kolonial-Abteilung"[75] and began to build up a geological-mineralogical collection from the colonies ("geologisch-mineralogische Kolonial-Sammlung").[76] Up to now, very little is known about the establishment of these colonial departments, the geologists and mining experts involved or their actual work.[77]

However, these new departments within the PGLA must be perceived as the corner-stones of the geological colonial knowledge system. In connection with the mining academy, the PGLA collected, examined, and prepared the geological material that flowed in from the colonies. As a 1902 contemporary source put it, these collections served in the professional preparation of the experts who were to be sent out to the colonies in the future, and the PGLA advised these on the geological and mining equipment required in the colonies.[78] In contrast to the general history of SWA, the history of the German knowledge system of colonial geology and mining has not been studied in detail. Several enterprises involved established departments for colonial geology and mining, such as the "Metallgesellschaft AG", in cooperation with several other non-ferrous metal producers.

With the foundation of the colonial departments of the PGLA (1902), it was not long before the circulation of knowledge was in full swing. The collections of colonial minerals and ores served in the training of government geologists such as Heinrich Lotz. A further aspect of the case of Heinrich Lotz – government geologist in SWA – leads to another important topic that has been neglected up to now. Lotz had been student of the distinguished geologist Emanuel Kayser (1845-1927) at Marburg.[79] When Lotz arrived in SWA in 1904, field exploration was impossible due to the Herero uprising. Very little is known about Lotz's involvement in the genocide. Later he was decorated with the Prussian "Kronenorden am schwarzweißen Band" for his support for the

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[73] Gräbel, *Erforschung* : 64-68.

[74] Schmeißer, *Bodenschätze* : 1908, p. 16 f.; Erwin Semper, *Beiträge zur Kenntniss der Goldlagerstätten des Siebenbürgischen Erzgebirges*, Berlin, Feister, 1900.

[75] Udluft, *Landesanstalt* : 20.

[76] "Willi Koert †", *Jahrbuch* [der PGLA], 48, 1928: XX-XXXVII (XXIV, XXIX).

[77] Udluft, *Landesanstalt* : 20.

[78] Deutscher Kolonialkongreß, *Festschrift zum Deutschen Kolonialkongreß. Berlin, am 10. und 11. Oktober 1902*, Leipzig, Bibliographisches Institut, 1902: 106 f.

[79] Engelhardt, *Enzyklopädie* : 2003.

"Schutztruppe" on water supply issues.[80] When mining inspector Erwin Semper – PhD geologist – arrived in SWA in 1904, he also was unable to explore the territory. During the uprising of the Witboi, he volunteered as reserve lieutenant (artillery) for the "Schutztruppe" and fell in 1905. That is all that is known about his involvement in the conflict.[81]

Nudging exploration and mining: a new mining regulation (1905)

With the reluctance of the colonial societies,[82] and also of German banks, mining, metallurgical, and electrical industries to prospect and invest in SWA, the German government sought to stimulate activity. A key instrument of colonial politics, the legal regulation of mining in SWA, was revised. This change is congruent with the conception of a transition of colonial rule from trade and robbery to well-planned exploitation, proposed by Osterhammel and Jansen.[83] In 1904, prospecting rights in three quarters of the territory had been exclusively restricted to the colonial societies. With the introduction of the new mining regulation ("Kaiserliche Bergverordnung") in 1905, the right of public prospection ("öffentliche Schürffreiheit") was introduced step by step in the concession areas.[84] This expanded the opportunity for prospection beyond governmental agencies and colonial societies to the general public.

The outstanding profitability of Tsumeb inspired prospecting activities and the number of commercial expeditions increased. In 1907, for example, the "Südwestafrikanische Minensyndikat" was established for the systematic prospection and mining exploitation of the German protectorate, especially the deployment of expeditions for the identification and evaluation of mineral deposits.[85] Hermann Eichmeyer, "Berginspektor" in Clausthal, who had already headed an expedition in 1899/1900 (Tab. 2), was appointed chief engineer of the syndicate. He had left the civil service in order to take over the central office for mining ("Zentrale für Bergwesen") of the "Metallurgische Gesellschaft AG", Frankfurt, in 1902.[86] There, he collaborated with PhD geographer and geologist Edmund Naumann (1854-1927).[87] In 1907, several German banks, electrical, and metallurgical companies joined the new "Südwestafrikanische Minensyndikat", among them the largest German electrical engineering conglomerate "Allgemeine Elektrizitäts-Gesellschaft" (AEG) and the cable producer "Felten u. Guilleaume-

[80] Lüert, *Bergbau*: 112; Friedrich W. Voit has also been referred to as governmental geologist; Klaus A. Hess and Klaus J. Becker, (eds.), *Vom Schutzgebiet bis Namibia 2000*, Göttingen, Hess, 2002: 82.

[81] "Personal-Nachrichten", *Deutsches Kolonialblatt*, 16, 1905: 45 f.

[82] Kaulich, *Geschichte*: 307.

[83] See analogously "Der bürokratische Interventionsstaat"; Jürgen Osterhammel and Jan C. Jansen, *Kolonialismus. Geschichte, Formen, Folgen*, 7th edition, München, Beck, 2012: 73.

[84] Kaulich, *Geschichte*: 386 f.

[85] Schmeißer, *Bodenschätze*: 17 f.

[86] "Generaldirektor a. D. Hermann Eichmeyer †", *Metall und Erz*, 26, 1929: 27 f.

[87] Lüert, *Bergbau*: 24, 230; "Edmund Naumann", https://de.wikipedia.org/wiki/Edmund_Naumann

Lahmeyerwerke AG", to secure their interests in SWA copper deposits.[88] Up to now, very little is known about the biographies or the activities of the above-mentioned and other the experts involved.

In 1908, government geologist Heinrich Lotz was given leave from the SWA mining authority. Lotz took over the representation of the "Minensyndikat in SWA". Complementing geological with mining expertise, the syndicate also hired mining inspector "Bergassessor" Karl Burchardt († 1924). He was experienced in geology and mining in the Harz mountains.[89] To push exploration further the "Minensyndikat" expanded its activities in SWA, adding a new institutional element to the colonial knowledge system, which further underlines the function of science in colonial exploitation. The "Minensyndikat" established a chemical laboratory in Swakopmund (around 1909) to provide a service to prospectors of all sorts on questions of mining. PhD chemist Franz Rintelen, who had already proven himself in foreign services, was appointed head of the laboratory.[90]

For the implementation of the new mining regulation, the SWA mining authority was reinforced by additional personnel. In 1906, "Bergassessor" Kurt Pasel (1876-1944)[91] and two PhD geologists were sent out to Windhoek. One of them, Paul Range (1879-1952),[92] had been geologist at the PGLA since 1904, and took up the pompously titled position of Empire Geologist ("Reichsgeologe") in SWA. As a reserve officer, he also took part in the war against the Herero and Nama. Hugo and Schalk reported briefly about Range's activities and his contribution. Together with Range, Paul Hermann (1877-1956),[93] and Hans von Staff (1883-1915) became "other government geologists" in SWA:

> Although their progress was initially greatly impeded by the rebellions of the native population and the ensuing military campaigns, a considerable number of publications nevertheless originated from these geologists, especially from Range, who was one of the most prolific writers in his field. Mainly occupied with the search for groundwater in the southern districts, one of his duties was the technical management of the government´s drilling operation. Range, however, found the opportunity to describe in detail the ´Namaland´ and its geological formations, of which the Nama and Karoo successions received most attention.[94]

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[88] Schmeißer, *Bodenschätze* : 18.

[89] "Oberbergrat Burchardt †", *Metall und Erz*, 21, 1924: 396.

[90] Schmeißer, *Bodenschätze* : 18 f.

[91] In 1912, Pasel became Bergrat at the Reichskolonialamt; "Ministerialdirigent Geheimrat Curt Pasel †", *Metall und Erz*, 41, 1944: 48.

[92] Tabel, *Autoren* : 217 f.

[93] Paul Hermann, *Wie ich Südwestafrika sah. Reisetagebücher eines deutschen Geologen 1906-1908*, Göttingen, Hess, 2003: 148.

[94] Hugo, Schalk, *Century* : 5.

In fact, Range published no less than 22 articles in colonial, geographical, but mainly in geological journals.[95] For the involvement of government geologists in the genocide it might be indicative, that Range's successor, Hans von Staff, who volunteered for the war in 1914, bore the title war geologist ("Kriegsgeologe").[96]

Although the three tables above present only a selection, they provide a biographical line-up of geologists, mining engineers, and a chemist, that define an empiric bottom-line for further studies and the required archival research. Several other individuals have been identified as belonging to this pool of experts, but are not mentioned here.[97] However, the individual cases listed above represent the broad variety of professions and affiliations that define a distinctive quality of the colonial knowledge system and its hybrid character, e.g. the above-mentioned Paul Hermann (1877-1956) combined several qualifications and affiliations. He not only graduated as mining engineer from the "Bergakademie Freiberg", but was also PhD geologist. His professional experience comprised mining in the Black Forest as well as materials science at the Prussian materials testing office ("Kgl. Materialprüfungsamt"). He became government geologist in SWA mainly occupied with the search for groundwater. His SWA travel log was published in 2003. It reveals the contemporary mind-set of the colonial experts.[98]

In 1982, P. J. Hugo and K. E. L. Schalk published a comprehensive geological bibliography on SWA/Namibia for the Geological Survey of South Africa. In their introductory chapter on "The colonial period: 1880-1920", the work and influence of South African geologists and miners becomes visible. This is intimately linked with South African copper mining, beginning in the 1840s.[99] As this will be an important aspect for further research, the fact as such underlines the notion of the transnational circulation of colonial knowledge.[100] At least one distinguished South African geologist should be mentioned here. After the discovery of the lavish diamond occurrences near Lüderitzbucht in 1908, Percy Albert Wagner (1885-1929) studied those diamond areas and, in 1910, the Grootfontein District east of Tsumeb. Wagner had graduated from the

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[95] "Paul Range †", *Geologisches Jahrbuch*, 67, 1953: XXIII-XXXVI (XXVIII f.).

[96] "Über die Tätigkeit des Kriegsgeologen in Deutsch-Südwest und die letzten Lebenstage von Hans v. Staff", *Centralblatt für Mineralogie, Geologie und Paläontologie*, 1916: 229-232.

[97] Further geologist are mentioned by E. Krenkel, "Zur Geschichte der geologischen Erforschung Ost- und Südafrikas", *Zeitschrift der Deutschen Geologischen Gesellschaft*, 85, 1933: 134-146 (144-146); see also Hugo, Schalk, *Century* .

[98] Hermann, *Südwestafrika* .

[99] Smalberger, *Aspects* .

[100] For a comprehensive compilation of the South African geological community and its achievements see Carl Robert Anhaeusser, (ed.), *A Century of Geological Endeavour in Southern Africa*, Johannesburg, Geological Society of South Africa, 1997.

Bergakademie Freiberg and received his PhD at Heidelberg.[101] His above-mentioned compilation on the SWA geology and mining industry was published in 1916.[102]

Colonial knowledge, techno-scientific and material circulations after 1900

The influence – if not "power"[103] – of the geological knowledge system had increased due to the establishment of new institutions and dependencies in SWA and Germany. However, from around 1905 onwards, circulations were amplified by new features of the system. Hence, after completing their contract in the colony and either returning to their former positions or taking up new ones, these knowledge carriers became involved in the consultancy on, and planning and organization of new expeditions and mining projects. A second interesting aspect was mentioned by the PGLA president Schmeißer in 1908. As a common practice, on completion of a mission in the colonies, mining engineers returned to the PGLA in order to await new assignments.[104]

Apart from the colonial knowledge and personal experience being fed back into the circulation, universities, institutes of technology, mining academies, and commercial colleges increasingly offered lectures about the mineral deposits and geology of the colonies. Up to now, this significant asset of colonial education has not received adequate attention in academic studies. From 1905 onwards, PGLA geologist Curt Gagel (1865-1927) offered a lecture on the "Geologie der deutschen Kolonien".[105] Furthermore, the mining academy in Berlin paid special attention to the training of mining engineers for the colonial service. In this respect, the PGLA's collection of colonial minerals and ores had a crucial function. It provided the illustrative material consisting of the peculiar mineral species which did not occur in German or European ore deposits.[106]

From 1910 onwards, even civil servants of the Empire's Colonial Office ("Reichskolonialamt") were being trained by geologists from the PGLA. PGLA geologist Willi Koert (1875-1927) held several lectures for the "Reichskolonialamt" on the geology of the German colonies (1910), and later an introduction to the theme ("Einleitung in die Geologie der deutschen Schutzgebiete", 1912/13). Koert knew his topic from his own experience in the colonies (Togo).[107]

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[101] Davis A. Young, *Mind over Magma: The Story of Igneous Petrology*, Princeton, Princeton University Press, 2003: 317.

[102] Percy Albert Wagner, *The Geology and Mineral Industry of South-West Africa*, Pretoria, The Government Printing and Stationery Office, 1916.

[103] Heé, "Ansätze": 83.

[104] Schmeißer, *Bodenschätze* : 38.

[105] "Curt Gagel †", *Jahrbuch* [der PGLA], 48, 1928: I-XIX.

[106] Schmeißer, *Bodenschätze* : 37.

[107] "Willi Koert †", *Jahrbuch* : XXIV, XXIX.

The discovery of the 'green hill' of Tsumeb with its occurrences of high base metal content had triggered a copper and lead mining fever. With the beginning of mining in 1900, further circulations came about. Shortly after the foundation of the OMEG, samples of ores were shipped to the "Norddeutsche Affinerie AG", Hamburg, and the company Henry Bath, Swansea, South Wales, probably for test smelting.[108] Later, the ore processing and smelting created problems and had to be adapted to the local conditions. The ore samples with high metal content were picked up by hand and shipped to Europe. At the start, smelting in Tsumeb was impossible due to the lack of coal. The early procedure was also ineffective: "Many companies examined Tsumeb but quickly lost enthusiasm because of the formidable metallurgical problems presented by the dump ore."[109] However, new ore treatment technologies were developed by German and probably other companies abroad. The technologies have been delineated by Georg Bürg,[110] Judith Fait, Gerhard Söhnge, and Heidi Schnorbus. According to them, the smelting process in Tsumeb was improved by the investigation of 100 t of slag and lead at the OMEG, Berlin (1907). "Aaron Hirsch & Sohn" (Halberstadt) and the "Metallgesellschaft AG" (Frankfurt) also received ore samples.[111] For further research, information on the techno-scientific and material circulations relating to the Tsumeb mining and metallurgy must be reconstructed from a larger body of diverse publications including the journals of mining and metallurgical engineers.

Final stages of the colonial knowledge system and Schneiderhöhn's geological theory

With its collection of colonial minerals and ores, with its educational function for those being dispatched to the colonies and for the "Reichskolonialamt", and with its laboratories and library, the PGLA had presumably become the pivotal German agency for consulting and research on colonial geo-resources. Government geologists from the PGLA, most of them either PhD geologists or mining engineers, became deeply involved in exploration and exploitation activities in SWA. Several former government geologists held positions at colonial societies or mining companies. Due to the growing scope of functions, the PGLA reorganized its colonial activities – a measure that can be seen as the final stage of building a smoothly run and effective techno-scientific consulting agency. Hence, in 1908, negotiations started among the controlling authorities to concentrate the PGLA´s activities in one department. Shortly after that, the colonial archive of the PGLA ("Kolonial-Archiv") was founded (1909).[112] Finally, in 1912, the Central Geological Department for the German Protectorates ("Geologische Centralstelle

[108] Schnorbus, *Geschichte* : 71.

[109] Ratledge, "Development": 374.

[110] Georg Bürg, *Die nutzbaren Minerallagerstätten von Deutsch-Südwestafrika*, Berlin, deGruyter, 1942: 106 f.

[111] Schnorbus, *Geschichte* : 71.

[112] "Franz Beyschlag †", *Jahrbuch* [der PGLA], 56 (2), 1936: 2-36 (18).

für die deutschen Schutzgebiete") of the PGLA was inaugurated. The new department was headed by Willi Koert. He built up and administered the colonial archive, library and map collection, the collection of colonial minerals and ores, and the collection of lectures on the colonies.[113]

The results of expeditions had been published in a variety of techno-scientific professional periodicals including colonial, geological, mining, and metallurgical journals. With the inauguration of the new colonial department at the PGLA, a special series was introduced entitled "Contributions to the Geological Exploration of the German Protectorates" ("Beiträge zur geologischen Erforschung der Deutschen Schutzgebiete"), edited by Willi Koert. In the first volume, he summarized the results of the recent geological exploration in the German-African protectorates ("Ergebnisse der neueren geologischen Forschung in den deutsch-afrikanischen Schutzgebieten"). Up to the beginning of the 1920s, 20 booklets were printed, presenting the work of PGLA members and other authors. Due to loss of the German colonies after the First World War, the Central Geological Department for the German Protectorates was dissolved at the end of the year 1919.[114]

Despite its significance for the colonial knowledge system and its key role in providing highly qualified personnel for the exploitation of SWA, neither the PGLA nor its Central Department have been the focus of academic study in this seminal function. While government geologists and mining engineers are mentioned in postcolonial historiography, the connection to Berlin and the circulation of experts, materials, and techno-scientific knowledge is not taken into account. Beyond these functions, the "Kolonial-Museum" of the PGLA´s Central Department gained an additional, political role. In its building, the rich and beautiful collection, as a contemporary author put it, was arranged for an exhibition for the general public. Thus, the museum served to demonstrate to the visitors the relevance of 'our colonies' in supplying Germany with industrial raw materials and gemstones.[115]

From 1907 onwards, the OMEG was able to pay remarkable dividends. In 1913/14, ore mining in Tsumeb reached its peak (70,000 t). Surprisingly, it was not until 1913 that the company decided to hire a geologist for the thorough exploration of the mines' deposits. Initially, the young geologist Hans Schneiderhöhn (1887-1962), University of Berlin ("Mineralogisch-petrographisches Institut"), was only scheduled to spend three months in Tsumeb, beginning in April 1914. Due to the outbreak of war, he did not return to Germany until 1919.[116] Schneiderhöhn considered the total lack of geological, stratigraphic, and tectonic studies on the Otavi mountains. In 1915, the Union Defence Force took over the region, but did not interrupt the mining or Schneiderhöhn´s research. Chemical assistance was provided by the laboratory of the Tsumeb mine. After

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113 "Willi Koert †", *Jahrbuch* : XXIX.

114 Udluft, *Landesanstalt* : 20.

115 "Willi Koert †", *Jahrbuch* : XXIX.

116 Schnorbus, *Geschichte* : 64.

the war, he published the results of his field and laboratory studies on Tsumeb and the Otavi region. Apart from the rich knowledge transfer, Scheiderhöhn conveyed an enormous mineral collection to Germany, which generated several dissertations.[117]

With the transnational circulations in full swing up to 1914, Tsumeb´s eruptive body of rock even challenged the established geological paradigms. It became the nucleus for a new pre-eminent scientific method and theory, both created by Schneiderhöhn. As Söhnge put it in 1967:

> By adapting and modifying a biological and a petrographical microscope he fashioned an experimental reflecting ore microscope and developed the technique of opaque mineral identification for which he soon after became world famous.[118]

But Schneiderhöhn not only revolutionized laboratory methods.[119] His successors in the geological sciences later celebrated him for decoding the complex mechanisms of the genesis of eruptive ore bodies. At Tsumeb, Schneiderhöhn had developed a genetic system for the classification of mineral deposits on a physicochemical basis.[120] Thus, Tsumeb not only became the source of lavish profits for the OMEG, but the starting point for a new era in geological theory and economic geology.[121]

Conclusion

Up to today, the concept of transnational circulations has not been applied to the historic knowledge system of colonial geology, mining, and metallurgy. In contrast to the formation of geography, which was framed by the colonial context, a postcolonial history of geology does not exist. In fact, the formation of the colonial knowledge system was a necessary condition for the establishment of colonial rule, and in the case of geology, mining, and metallurgy for the successful exploration and exploitation of the copper deposits of SWA. The extent of the involvement of government geologists and mining experts in the genocide – who were at least responsible for the water supply for the "Schutztruppe" – is unclear. Taken together, the complex created tremendous techno-scientific and institutional effects in SWA as well as in Germany and probably other colonial powers. The colonial societies and metallurgical companies did not merely enter the system, the PGLA took a leading role in knowledge generation, accumulation, circulation, collection, in consulting and training, and in colonial propaganda.

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[117] Hans Schneiderhöhn, "Zur Erforschungsgeschichte der Erze der Tsumeb-Mine und der geologischen Verhältnisse des Otaviberglands, Südwestafrika", *Neues Jahrbuch für Mineralogie*, 1958: 125-136.

[118] Söhnge, *Tsumeb* : 58.

[119] Hans Schneiderhöhn, *Anleitung zur mikroskopischen Bestimmung und Untersuchung von Erzen und Aufbereitungsprodukten besonders im auffallenden Licht*, Berlin, Gesellschaft Deutscher Metallhütten- u. Bergleute e. V., 1922.

[120] Gehlen, "Schneiderhöhn".

[121] Amstutz, "Schneiderhöhn"; for an international comparative discussion of the new theories up to 1928 see Radmann [Bergassessor]: "Neuere Theorien der Erzlagerstättenbildung und ihre praktische Anwendung", *Metall und Erz*, 25, 1928: 543-549.

Taken as a whole, further research shall combine quite different fields of investigation and challenge several established historiographic narratives. Firstly, postcolonial studies on German rule up to 1919 represent the current state of research. They examine the establishment of the colonial administration and the genocide. Secondly, economic activities and the history of the businesses and colonial societies involved must be scrutinized. Framed by the concept of transnational circulations, a third complex is essential for the identification of further primary factors that influenced the events, namely the evolution of colonial geology and mining engineering as a techno-scientific complex in its own disposition of theories, methods, objects, and resource for knowledge and manpower. In fact, the phenomenal economic success of SWACO and OMEG, the knowledge production of Schneiderhöhn and the resulting dawn of a new era in geological theory and economic geology became the obvious manifestations of this techno-scientific complex.

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