Creole Objects and Techniques: Gold Mining, Gold Panning and Gold Working in Colonial Indonesia

MAI LIN TJOA-BONATZ, Berlin, MIKAEL HÅRD, Darmstadt

Abstract. Museum exhibitions on gold tend to feature jewellery and other aesthetically valuable objects, whereas the extraction and processing of gold seldom play a central role. Bringing to the fore the technologies of gold mining, panning, working and trade, the article makes a case for the need to increase our understanding of items such as pans, chisels, lanterns and scales – in addition to the knowledge and skill involved in their use. Focusing on artifacts from the former Dutch East Indies (today's Indonesia), the paper documents a high degree of variety across this Southeast Asian archipelago. Rather than interpreting the history of gold technologies in terms of successive evolution and transfer, the authors emphasise locally specific solutions and contextually embedded technological complexes. Criticising traditional narratives in the history of technology, they show that indigenous Indonesian craftspersons continued to use their own tools, knowledge and skill well after Chinese and European exploiters had entered the scene. After the turn of the twentieth century, the local gold trade was characterised by hybrid solutions and the co-existence of technologies of different origin. The authors apply the concepts of "creole technology" and "trading zone" to analyse the sites where different technologies and groups interacted.

[gold, craft, history of technology, Indonesia, material culture]

Background & Argument

Gold has, primarily, caught the interest of art historians and anthropologists – in addition to museum curators, connoisseurs and private collectors. The latter two groups have almost exclusively focused on *artifacts* made of gold: jewellery and ornamentation (van Cutsem 2000; Richter 2010; Richter/Carpenter 2011; Sibeth 2012; Geoffroy-Schneiter/Crick 2016). Reflecting the importance of gold products, anthropologists have analysed meanings and rituals associated with this precious element (Roth 1985; de Moor 1990; Brinkgreve 2013; von Römer 2018). With the exception of archaeologists (Harrisson/O'Connor 1969; Swan/Scott 1990; Miksic 1979, 1988, 2011; Riederer 1994; Rispoli 2001; Bennett 2009; Tjoa-Bonatz/Lockhoff 2019) and historians using European written sources (Lombard 1971; Rueb 1991), few scholars have investigated the *production* of gold: what technologies were used in the process of mining, panning and working gold? Although gold working was an important economic factor, and goldsmiths enjoyed high status in many regions of the Indonesian archipelago (e.g., on Nias: de Moor 1990: 127–128), we know comparatively little about the knowledge and skill artisans and traders of gold employed. Whereas anthropologists have discussed the social and cultural capital attached to gold throughout history (Rodgers 1985; Tropenmuseum Amsterdam 1993; Lombard-Jourdan 2000; Barnes et al. 2015), Wolfgang Marschall's (1968) over fifty-year-old monograph still remains unique in that it pays serious attention to extraction and processing and to the instruments involved – albeit from a clearly diffusionist perspective. In the history of technology, one looks in vain for scholars who have investigated gold manufacturing in colonial settings.[1]

Focusing on Sumatra and Kalimantan (the Indonesian part of the island of Borneo), we show that the technologies involved in the production of gold had a highly diverse character and were constantly in flux. On the basis of primary sources – objects, written and visual material – from the eighteenth to the first quarter of the twentieth century, we illustrate the complex interplay between local and translocal technologies and actors.[2] Although immigrating Chinese craftspersons brought with them techniques from their

1 This is, e.g., born out by the result of a search in the leading databank for the history of science, technology and medicine: https://data.isiscb.org [accessed 9 July 2021].

2 We gratefully acknowledge the support by Dr Francine Brinkgreve, National Museum of World Cultures in Leiden; Dr Andreas Isler, Völkerkundemuseum der Universität Zürich; Dr Richard Kunz, Museum der Kulturen in Basel; Dr Petra Martin, Ethnological Museum in Dresden; Dr Sonja Mohr, Rautenstrauch-Joest Museum in Cologne; Dr Alexis von Poser, Dr Roland Platz, Henriette Lavaulx-Vrécourt, Kai-Patricia Engelhardt and Claudius Kamps, Ethnological Museum Berlin; Marcel Zünd, Museum Heiden; Marleen Labijt, Eye Filmuseum Amsterdam. The selection of the museums' objects is far from being complete but gives a representative overview. Thanks also go to Nicole Lockhoff, Curt-Engelhorn-Zentrum Archäometrie in Mannheim, Prof Uli Kozok, University of Hawai'i at Mānoa, Prof John Miksic, Singapore, Johnnes Maria Hämmerle and Filemon Hulu, Gunungsitoli/Nias.

Colonial-period Indonesia with the sites mentioned in the article (FreeVectorMaps.com and Patrick Gilve).

home country, tools and methods used by local artisans did not disappear (Jackson 1970; Somers Heidhues 2003). And, although European investors set up industrial plants, they continued to rely on the knowledge and skill of indigenous workers. Extraction and production sites became "trading zones" where members of different social groups exchanged information, experience and techniques (Gorman 2010; Long 2015; Hård/Tjoa-Bonatz 2020). Taken from the field of anthropological linguistics (Mühlhäusler 1986), the concept of "trading zone" is meant to highlight the fact that such exchange is possible even when the communication between groups is linguistically, culturally and socially limited. Inspired by the use of this concept in the history of modern science to interpret the collaboration between scientists, engineers and technicians (Galison 1997), we apply it in our analysis of gold-working sites where different groups traded not only gold but also knowledge, skill and tools. We argue that mines and riverbeds developed into trading zones, where panners, miners, goldsmiths and traders collaborated and competed, as well as discussed and observed each other's work.

Originally, the concept of "trading zone" was developed to analyse the emergence of pidgin and creole languages. In particular, the concept helped linguists better understand the creativity that accompanies this process (Romaine 1988). Our observations, similarly, support a view of technological change that emphasises the creative aspects of cultural encounters. In his seminal work *Image and Logic: A Material Culture of Microphysics* (1997), Peter Galison convincingly shows that even a high-energy physics laboratory can be interpreted as a "trading zone", in which theoretically and practically oriented professionals are able to successfully collaborate – despite different knowledge paradigms and educational backgrounds.

The application of the trading-zone concept follows recent developments in the history of technology. Having left one-sided diffusionist and evolutionist perspectives behind (e.g., Basalla 1988), historians of technology nowadays emphasize the reciprocal character of technological encounters in local settings around the world (e.g., Mullaney 2017; Montaño 2021). Encouraging the investigation of concrete sites and practices, the trading-zone concept is meant to complement concepts such as global "circulation" and local "appropriation" (Hård/Jamison 1998; Hård/Misa 2008). In the last decades, these concepts replaced cherished notions such as technology "transfer" and "diffusion", while the research program of social construction of technology made simple evolutionary models of technological change obsolete (Pinch/Bijker 1987). Since the publication of David Edgerton's book *The Shock of the Old* in 2006, those who attempt to write a global history of technology can no longer regard certain parts of the globe (typically Europe or North America) as the sole producers of novelty, but must take the innovativeness and creativity of people living on other continents seriously. A common outcome of cross-cultural encounters, Edgerton (2006: 43–48) suggests, is "creole" technologies, a concept which – in our interpretation – is meant to reflect the "creativity" and "richness" involved in such encounters (Hannerz 1996: 66). This is in fact the gist of our argument: the history of gold working in the former Dutch East Indies shows that local artisans, on the one hand, had developed their own practices, while, on the other hand, they willingly adopted extraction and manufacturing technologies from others. Inspired by Gilson, Edgerton and Hannerz, we conclude that creole tools, techniques and designs were the result of concrete intercultural exchange in various kinds of trading zones – be it mines or waterways, workshops or marketplaces.

Most of the sources we refer to in this article were produced by Western commentators, thus presenting today's historians with certain challenges. Since they were written in an era when it was common to rank cultures according to European standards and to regard technological development as a history of constant progress (Adas 1989), such sources must be brushed against the grain, as it were. Although we are aware that the collections by travellers, missionaries and other professionals from Germany and Switzerland might in some cases have an illegitimate provenance (Tythacott/Ardiyansyah 2021), we still believe it is important to use them for historical research – especially since our purpose is to bring out the innovative character of local crafts. We do hope, however, that future research will be able to investigate the earlier acquisition methods of collectors and museums, also when it comes to the gold-working tools which local craftspersons deployed.

Sources & Methodology

Encounters on the micro level highlight instances when the transfer of knowledge and technology instigated fruitful combinations, creole solutions and new applications in a symbiotic manner. As indicated above, this view is born out of the dire need to deploy concepts in the history of technology that fit developments in the so-called Global South, as well as the necessity of acknowledging the malleability of so-called traditional or ethnic techniques. By focusing on the knowledge involved in the investigation of gold resources and qualities and on the skills involved in the operative solutions of panning, mining and manufacturing, we are able to grasp the complex dynamics that moulded the cultural layering of technological expertise in its specific time and space. In the former Dutch East Indies[3] (today's Indonesia), the history of mining and goldsmithing reveals the multicultural involvement of various ethnic groups of the archipelago and immigrants. In the middle of the eighteenth century, Chinese migrants – predominantly Hakkas – came in large numbers to mine gold in western Kalimantan, and

3 We are aware that the borders of Indonesia and the former Dutch East Indies are not exactly equivalent and that some of the areas we discuss were conquered by the Dutch relatively late. For simplicity, though, we apply the term "Dutch East Indies" throughout the article.

Fig. 1 Baskets full of ore are pulled from a shaft using a self-made wooden reel with a rope winch, Tewah/Kalimantan, photo by Karl Helbig, 1937 (Roemer- und Pelizaeus-Museum Hildesheim).

in the 1880s they were followed by Western, mainly European, entrepreneurs, companies and geologists in Kalimantan and on Sumatra.

On Sumatra, gold panning and mining was an activity that, since pre-colonial times, attracted a large numbers of individuals, whereas gold-working artisans were specialists and experts in their craft. Goldbearing rocks are found through almost the entire Barisan Range. The extensiveness of gold workings indicates a thorough organisation in which thousands must have been employed. It is evident that considerable quantities of gold were produced in the former Dutch East Indies. During the period 1900–1940, the gold production totalled more than 120 tonnes (van Bemmelen 1944, II: 105; Miksic 1979: 261–265). By studying the technologies of mining, extraction, alloying and smithing, we are able to improve our understanding of the variations and connections between different gold regions across the archipelago. The setting-up of the production line from processing the raw product to the working of gold and silver corresponded with the employment of a variety of metal-crafting techniques. In this article, we focus on these technological artifacts and the knowledge and skill connected to them.

In contrast to gold and silver jewellery from early Indonesia – collected by at least 22 museums worldwide,[4] ethnographic objects connected to gold working are rarely found in museum collections. The objects which interest us were brought to Europe by explorers on field trips and by professionals working in the former Dutch East Indies – and they were obtained by travellers, adventurers and other collectors. In ways that later research will have to clarify, the museums received them as gifts or acquired them in the last quarter of the nineteenth and the first decades of the twentieth century. The National Museum of World Cultures in Leiden/the Netherlands provides the widest collection of such tools. These objects were acquired in Java and East Indonesia, and they also include gold-working tools from West Sumatra collected by A. L. van Hasselt (1881) during the Sumatra Expedition (1877–1879) organized by the Royal Dutch Geographical Society which donated the objects to the National Museum of World Cultures. The Zürich Museum and the Museum der Kulturen in Basle/Switzerland feature gold tools from East Indonesia, Sulawesi and Sumatra, acquired from Swiss academics until 1935. Some of these objects were gathered by the naturalist brothers Paul Benedict Sarasin and Fritz Sarasin during their expeditions to Central Sulawesi in 1893–1896, and by geographer August Tobler to Palembang and Jambi on Sumatra in 1900–1912 (the latter

4 In Asia (Singapore, Kuching, Jakarta, Cirebon, Yogyakarta, Surakarta, Semarang, Surabaya), Europe (London, Rotterdam, Leiden, The Hague, Amsterdam, Stuttgart, Frankfurt/M., Leipzig, Vienna, Rome) and the US (Chicago, New York, Houston, New Haven).

Fig. 2 Dayak goldminers bring ore to their houses where they grind and wash it, Tewah/Kalimantan, photo by Karl Helbig, 1937 (Roemer- und Pelizaeus-Museum Hildesheim).

partly working for the Dutch Koninklijke Nederlandse Petroleum Maatschappij). The Ethnological Museum of Dresden/Germany stores gold instruments obtained during the period 1867–1927 by the art dealer Julius August Konietzko, the German Lieutenant-General Wolf Curt von Schierbrand who was stationed in the former Dutch East Indies for forty years between 1825 and 1865 and Kuno Graf von Hardenberg who had obtained the artifacts in Java on his world trip in 1901. Between 1880 and 1901 the Ethnological Museum in Berlin/Germany acquired gold tools from various collectors, including missionaries of the Rhenish Missionary Society who were based on Nias. Among them are Wilhelm Thomas who has published on various religious and socio-cultural topics of the island and Friedrich Kramer. In 1880, Kramer's collection sent from their missionary house in Barmen/Germany was received by the founder of the Ethnological Museum of Berlin, Adolf Bastian.

The available literature on colonial-period Indonesian gold and silver working is scanty. To amend this situation, we brought together information from an array of ethnohistorical material, including unpublished archival documents, primary and secondary writings, images and artifacts from museum collections. Archival sources include diaries, descriptions of expeditions and visual documents. Local histories are transmitted orally, while Chinese sources are limited (Somers Heidhues 2003: 13, 42–43). The account books of the Chinese mining companies on Kalimantan were annually destroyed to avoid fees (Posewitz 1884: 187). Although Western sources only provide biased and incomplete views of the inhabitants' interpretations and generally doubt the credibility of the locals, they include important field observations and recorded oral accounts. Regional studies by Western ethnographers and mining experts on gold extraction are particularly rich for Kalimantan (Schwaner 1854; von Faber 1864; Posewitz 1884, 1889) and Sumatra (van Hasselt 1881; Müller-Herrings 1915; Hoogenraad 1934; Marsden 1975). The geographer Karl Helbig travelled to mining sites on Sumatra, Bangka and Belitung. He crossed the remote interior of the island of Borneo as one of the very first Europeans during eight months in 1937 (Helbig n.d. K. 09; n.d. K. 43, 1937, 1938, 1955, 1982). At the mining site of Tewah in Kalimantan he used information of missionary Hugo Haffner (1937) who was stationed there from 1932 to 1938 for the Basel Mission. Helbig left diaries, descriptions and photo documentation on Kalimantan and Sumatran gold-working sites (Figs. 1–5).[5]

5 This material is available at the Roemer- und Pelizaeus-Museum Hildesheim and the city archive of Hildesheim, kindly accessed by Dr Andrea Nicklisch. Translations of Stolze-Schrey stenograph were provided by Dr Rainer Hatoum.

The prevailing narrative of Sumatra and Kalimantan's gold working in Western sources is that indigenous tools and methods are extremely primitive, and that mining techniques and shaft design were utterly dangerous (Rosenberg 1878: 256; Posewitz 1884: 176, 183). Symptomatic for the evolutionist view of those days is the derogative opinion of the native population. The local people are said to lack effort, enterprise, knowledge, "brains and good taste" (Schwaner 1854: 108). Accordingly, the outcome is poor gold extraction and limited processing, despite the fact that the mineral resources are abundant. Geologist Carl Schwaner (1854: 107–108) reproduced this narrative after his visit to Southeast Kalimantan.

Addressing experts in the field, reports from the first half of the twentieth century tended to focus on heavy machinery, engineering solutions and elaborate extraction techniques (e.g., Hoogenraad 1938). The manuscript of the Sumatra-based, German miner Franz Zeumer, which was handed in for publication to the weekly journal *Kalibergmann* in 1941 provides an illustrative case of the one-dimensional view on colonial mining enterprises. The editor of the journal deleted most of the passages dealing with the problems of acculturation and local conflicts, thus placing the Western industrial endeavours in an undeservingly positive light.

Industrially organized mining is still today regarded as more advanced and advantageous than local mining methods. For example, in a chemical manual from 2013, the author suggests that gold mining areas on Kalimantan are only suitable for indigenous mining ("Eingeborenenbergbau") – a concept that denotes techniques which are otherwise said to be totally useless (Meyer 2013: 175). Similarly, in a 2020 exhibition catalogue from the Heide Museum, a historian reproduces a similar perspective, claiming that, around the turn of the twentieth century, "in the Netherlands Indies mining was still in its very infancy" (Zangger 2020: 67). We question such derogatory value statements on principal grounds. Not only might socially and culturally deeply embedded techniques be more efficient for working smaller and more remote deposits. More importantly, such locally well-established techniques may very well be much more appropriate to the indigenous population than high-tech solutions.

Although European commentators criticised local extraction, they appreciated the archipelago's gold and silver jewellery. The interpretation by Austrian traveller and photographer Joachim Freiherr von Brenner von Felsach in his account of his *Visit to the Cannibals of Sumatra* reflects this tension. Discussing Batak goldsmiths and their products, the author claims that the "instruments are utterly simple; their primitive character contradicts sharply to the manufactured artifacts" (von Brenner 1894: 289). He (von Brenner 1894: 274) is indeed "surprised by the many noble forms, the subtlety and delicacy" of the Batak jewellery. In a comprehensive overview from 1927, the Dutch and Javanese authors J.E. Jasper and Mas Pirngadie (1927) record approvingly the making of precious metal objects in great detail. Written at a time when customary craft methods were threatened by industrially manufactured products, their observations served the purpose of protecting these traditions. Other authors are somewhat ambiguous but still appreciate local experts and their "great expertise" (Helbig 1938: 390; Marsden 1975: 167, 171, 180). Driven by an encyclopaedic interest, the then editor of the *Baessler-Archiv*, Alfred Maaß (1910: 371–373), recorded and described a high number of specialised and efficient tools from Central Sumatra, each with its own technical name.

Objects & Myths

Indigenous metallurgical traditions were neither stagnant nor imitative but exhibited a pronounced ability to adopt themselves to intra- and interregional variations and influences. Metal artifacts – particularly those made of gold and silver – provide information

on networks of commerce (e.g., Dobbin 1993: 61–69), the transfer of ideas and the interchange of goods and technologies. Designs circulated widely within the trading networks in Asia. This exchange led to the introduction of novel elements: raw materials, design patterns or manufacturing techniques. When investigating cross-cultural interaction, the main challenge is to reveal in whose hands such circulation lay. Interisland and international movement of people – such as merchants, migrants, itinerant craftspersons or elites – encouraged the production of similar objects. Trade relations supported the reciprocal transfer of both knowledge and tools, carried by highly mobile groups of goldsmiths who sensed new opportunities and occupied emerging economic niches. Certain ethnic groups or areas of Indonesia were associated with specific jewellery techniques. For example, gold traders from Palembang/South Sumatra and Banjarmasin in South Kalimantan sold their gold products in West Java – together with filigree jewellers from Padang/West Sumatra (Marschall 1968: 120). Chinese goldsmiths worked partly alongside, partly together with other local ethnic groups, and sometimes they even surpassed indigenous production. Chinese situated in Padang knew how to work silver filigree. In Aceh they applied red coating on gold with salt and vegetal liquids and produced typical Aceh-style objects (Marschall 1968: 91; Miksic 2011: 13).

Gold working was not conservative but changed constantly. Gold items are "sensitive indicators of cultural and artistic trends" and thus a predestined barometer of trade (Miksic 2011: 14). Since natural gold deposits are only found in certain regions of Southeast Asia, the exchange of gold objects contributed substantially to cultural change and transcultural communication. In the middle of the eighteenth century, Ernst Christoph Barchewitz, a German officer of the East Indian Company learnt the craft from the goldsmiths of Moa in East Indonesia and brought this knowledge with him to the neighbouring island Leti where no goldsmiths lived. Here, he started making various kinds of personal adornments such as gold chains and the locally renowned *bulang* and *biring*[6] armrings (Barchewitz 1752: 277, 502). According to his own account, Barchewitz competed with the *biring* and *bulang* of Moa goldsmiths but claimed that his products were of better quality and more durable. His objects were allegedly sold through a Swiss middleman in exchange of "thirteen slaves, eleven quintals of wax and 130 pounds of turtles" (Barchewitz 1752: 504). In the nineteenth century, cross-cultural linkages motivated Chinese goldsmiths to begin enamelling their gold and silver objects. They obtained the glazing raw material from former British India and Penang (today's Malaysia), where strong Chinese networks were in place (Veltman 1904: 348; Jasper/Pirngadie 1927: 89).

Not only economic relations but also power differences influenced the dissemination of jewellery forms. An account of the origin of a new design in gold working reveals these asymmetrical linkages. A Dutch military officer, stationed in Banda Aceh/North Sumatra, ordered a special piece of jewellery for his wife. Inspired by the shape of Sultan Iskandar Muda's palace gate *pinto(u) khop* of the seventeenth century he asked Mahmud Ibrahim to create a sophisticated adornment. Known as the expert craftsman called *utoh mud*, he was not only the most talented goldsmith in Aceh but also certified by the Dutch at a fair in Kutaraja in 1926. It was such connections to the colonial rulers which opened him a lucrative market for his design patterns. Although a relatively new creation, the design of the *pinto(u) Aceh* became one of the most well-known "traditional" jewellery types of this region (Leigh 1989: 93–95, fig. 1; Harun Keuchik Leumiek 2016: 13–21). Supply and demand took new paths, and markets absorbed new materials and ideas through new forms and socio-economic networks.

Kalimantan was a true hub in the gold trade, illustrating the complicated entanglement of transcultural processes in an exemplary fashion. By the 1820s, gold from Kalimantan was sold to British traders and shipped to Siam (today's Thailand), Java, Singapore and China (Somers Heidhues 2003: 50). From China, in turn, the gold was redistributed to Southeast Asia as adornment or worked into textiles. In the 1880s, Chinese

6 Apart from direct quotations, geographic names etc. are written according to the writing convention of 1972 in the Kamus Besar Bahasa Indonesia.

traders were selling embroidery made from golden threat to the *peranakan* (Chinese-Malay mixed families) in the archipelago and on the Malay peninsula and also to Europeans. In the trading centre Banjarmasin, five categories of gold products were distinguished. Despite the local availability of gold on the island, the high-priced raw material featured imported gold: gold leaves imported from Singapore; *emas paoen* (*paoen* is derived from pound) gold of smelted British, American or Turkish coins; South Kalimantan gold and Dayak gold from central and south Kalimantan (Jasper/Pirngadie 1927: 20).

Despite the local availability of gold in Aceh, goldsmiths in the 1920s worked with processed gold obtained from Penang or a Dutch trading company in Kuta Raja which distributed gold leaves of pure gold of 24 Karat from refining companies in Hong Kong. Due to the stamp design, this material was known as "dragon gold", *meih tjab naga* (Marschall 1968: 90–91). Works made from pure gold leaves were ordered by the local upper class or the Chinese (Jasper/Pirngadie 1927: 17). This exemplifies various directions the trade went: stories of symmetry, or at least reciprocity – not of one-sided diffusion.

Legends, oral traditions and ethnographic descriptions of rituals and taboos provide us with information about gold working and mining tools from a local perspective. The Dayak, living near the Kahayan river in Kalimantan, believed that after a lethal combat between the gods, their blood and brain had turned into gold nuggets and veins, and that the gods' footprints had created the valleys and mountains – an obvious reflection of the geological setting and landscape of the region. The Dayak connected gold to the divine and understood gold-working tools and gold products as technological and aesthetical gifts to mankind (Helbig 1982: 364). Since gold and silver smithery was considered a dangerous activity – not least concerning the fire hazard, it should only be carried out by skilled persons. The special knowledge of how to transform material properties gave gold- and silversmiths the potency to propitiate spirits and supernatural forces. Before Toba and Karo Batak goldsmiths in North Sumatra started working, a sacrifice – blood or innards of a chicken or piglets – was made to the gods. While working, the smith used different euphemistic names for his implements (Neumann 1903: 17; Jasper/Pirngadie 1927: 26; Sibeth 2012: 26–27).

Although Posewitz (1889: 253, 262–264) was of the opinion that locals lacked formal geological knowledge, he recognized that they had an acute appreciation of the composition and quality of the gold-bearing deposits, and that they were able to assess the economics of mining correctly. They often memorized their experiences by developing stories and parables which included more or less fabulous devices or animals. It is said, for example, that the Minangkabau migrants from the gold-rich highlands of West Sumatra possessed a magic cock which crowed when approaching gold sites along the Batanghari river (Watson Andaya 1993: 275, ft. 19). On Kalimantan, prospections with test digs were made by Chinese and indigenous gold seekers. It was told that the latter detected gold-bearing sites with a dowsing rod or when a specific type of bird started singing (Posewitz 1884: 183). Punan, an ethnic group of Central Kalimantan, are said to have retrieved gold nuggets with sticks rubbed with a specific resin and stuck into the ground (Dewall 1855: 434).

Taboos were frequent before and during mining activities. Many taboos were purely auspicious, whereas others were related to worker's protection (e.g., dress codes) or working conditions (e.g., during pregnancy or bad weather). Yet other taboos seem to have been less related to practical issues but reveal a strong appreciation of the miner's implements and outline strict social behavioural rules (e.g., when and where mining activities should take place on Sulawesi: Marschall 1968: 108–116). Rituals connected to gold mining in Silago/West Sumatra followed the operational sequence in which the physical properties of the material were transformed and accompanied the whole min-

ing procedure (van Hasselt 1881: 402–403). First, the gathering of capital and labour was concluded by the blessing of the family which provided the capital and other village representatives, making evident that the mining process was considered a communal act. The second ritual took place in the evening of the first day of the actual mining which was dedicated to the digging of a pond for watering the gold-bearing sand. The final act concerned the miners' tools, mainly digging and scratching instruments. A chicken was slaughtered, the blood was spread on the tools and the feathers together with rice on the ore. Then, the meat was served as a communal dish to all artisans. The third ritual was performed by burning three pieces of fabric on the set of panning implements, a wooden pan and a container. Only by heeding to these rituals would it be possible to achieve the final product: gold dust.

Collections & Artifacts

In order to give readers a better understanding of the various techniques and artifacts involved, we present and interpret selected objects. Our account focuses on material technologies, but it also highlights the knowledge and skill involved when the various objects were employed.

Implements connected to gold working were in high esteem. Historian Barbara Watson Andaya (1993: 275, ft. 18) recalls that gold working implements such as scales, scoops, brushes and knives were kept as heirlooms at Bangko/Central Sumatra. From Sulawesi we know that it was recommended to store washing pans carefully and to cover them with *areca* palm – probably to prevent distortion or cracks of the wood (Grubauer 1913: 538). The Karo Batak were of the opinion that the selling of gold-working tools would bring misfortune, which probably explains why we could not trace implements from this ethnic group. In other regions, economic reasons explain much of the tools' trade, but we cannot rule out the possibility that some of the objects entered the collections illegitimately. In some cases, collectors ordered specially made unique ones or obtained worn-out implements. Showing how father and daughter handle the washing pan (*dulang*) side by side, figure 3 illustrates that not only the objects but also the necessary knowledge and skill were transferred from one generation to the other.

In Indonesia gold was either washed or obtained in the form of gold dust, gravel or nuggets coming from hard rock deposits or in sedimentary placer deposits. Commercially offered gold was differentiated and priced depending on visual qualities and where it was mined. Both criteria defined the presumed purity, but the value was also guided by taste and consumption preferences. Gold generally occurs in alloys with other metals. In Kalimantan, there was "old gold" of reddish colour, probably of copper-rich content, "young gold" of yellow colour, probably of higher silver content, and "diamond gold" which was mined together with diamonds (Posewitz 1884: 181–182; 1889: 262–263). Similarly, in the Minangkabau highland, gold was distinguished between placer or river gold and by its physical form (Marsden 1975: 166).

The locals panned for gold in streams to supplement their agricultural income. On a seasonal basis, they did so after the rainy season when gold-bearing soils were washed down the rivers. Gold was collected in channels, standing pools of water or in dug holes to which a stream was directed. In some areas of West Sumatra and Central Kalimantan, gold was panned from a boat which was kept from drifting downstream by a boulder or dam made of wood and stones (van Hasselt 1881: 403, pl. C: 7–8; Posewitz 1889: 263–264; Marsden 1975: 167). The boat could be fixed on the boulder serving as a working platform. After the water had been whirled up with long rods, workers lifted the gold-bearing sand with dishes or textile bags which were left open with a ring of rattan or iron while they were diving. As documented in the Batak area, the gold-bearing sand

Fig. 3 Malay goldminer with his daughther while washing the gold sand with a wooden pan (*dulang*), Tewah/Kalimantan, photo by Karl Helbig, 1937 (Roemer- und Pelizaeus-Museum Hildesheim).

Fig. 4 Malay or Dayak goldsmith, Tewah/Kalimantan, photo by Karl Helbig, 1937 (Roemer- und Pelizaeus-Museum Hildesheim).

Fig. 5 The ruins of the installations of the Mining Company Kahajan are quickly covered by jungle, Tewah/Kalimantan, photo by Karl Helbig, 1937 (Roemer- und Pelizaeus-Museum Hildesheim).

Fig. 6a–b Washing pan and gold panner's tools, Sarolangun/Central Sumatra, donated in 1913 by August Tobler (Museum der Kulturen Basel inv. nos. IIc-1321, 1322).

was washed in the cross-sections of the hollow stem of a bamboo which was available and quickly split from the tree in smaller compartments on site (von Brenner 1894: 56).

The large numbers of gold pans in various museums illustrate what anthropologist Ulf Hannerz (2010) calls the "diversity" of cultural forms. Throughout the Indonesian islands the *dulang*, a wooden dish, is used as washing pan (Fig. 6a). The panner allows water and sand to swirl, so that that the gold is separated from the rest of the river sediments. The gold sinks to the bottom of the pan and is carefully selected when glittering. A *dulang* typically has a round shape, 49–74 cm in diameter, and is made of a solid piece of wood with fluted walls. Depending on the type of wood, some were fairly heavy (up to 1.5 kg) and needed an accomplished panner. Others were available in smaller size for children. An extremely large round pan of 74 × 22 cm from Martapura/Southeast Kali-

mantan was acquired from the director of a rubber company Carl Boehmer in 1901 (Ethnological Museum Berlin inv. no. I C 31615). The larger pan load requires greater stamina and better technique but allows to process more material. Some devices are decorated and were furnished with handles for suspension. A round dish of 58 cm in diameter of the Ngaju Dayak of the Upper Kahayan in Central Kalimantan has two suspending holes and was donated in 1934 by doctor Mattheus Vischer-Mylius to the Museum der Kulturen Basel (inv. no. IIc 3005). Figurative carving of opposed boar heads on the backside allows two holes for suspension, seen on a heavy pan of 1452 g and 59 × 13.5 × 60 cm from Kulawi/Central Sulawesi called *dura pangemóa*. The pan is furnished with a central plug made of fibre or wood which helps trapping the gold. It was obtained by Albert Grubauer, ethnologist and zoologist, on his three-months fieldtrip to Sulawesi in 1901. It was donated to the Rautenstrauch-Joest Museum in 1910/1912 (inv. no. RJM 27983; cf. Grubauer 1913: 538–539, fig. 296). From neighbouring Bada and Gimpu/Central Sulawesi a slightly smaller round gold pan of 61 cm in diameter is provided with a small central incarnation at its bottom. The dish was donated by the Sarasin brothers to the Museum der Kulturen Basel in 1904 (inv. no. IIc 786).

The variations on Sumatra range from round to ovoid shapes with pointed ends, deep or flat inclination, furnished with or without a rim. We find a round device of uneven diameter of 50.5 cm from Muara Lembu near the Kampar Kiri river/West Sumatra, donated by geologist Dr Hans Hirschi in 1919 (Museum der Kulturen Basel inv. no. IIc 1684). Some round ones are roughly carved, what allows the panner to hold the gold better due to the textured surface, exemplified by two devices from Supayang/West Sumatra collected by van Hasselt between 1877 and 1879: one without a rim and of 51 cm (National Museum of World Cultures inv. no. RV-268-370) and one with a flat rim of 49 cm and of dark-brown wood what permits that even the tiniest flakes of gold can easily be seen (National Museum of World Cultures inv. no. RV-268-371; van Hasselt 1881: pl. XCIX: 4). To the most particular variants belong an ovoid dish with pointed ends called *djahé* made from *madang boenga* wood from Supayan collected by van Hasselt between 1877 and 1879 (National Museum of World Cultures inv. no. RV-268-364; van Hasselt 1881: pl. XCIX: 3). It allows that sand could be kept on the flat part of one side of the dish for later separation by jigging or tabling processes done in the mould on the other side.

In the earlier days, the washing pan was individually made, but in the 1930s, ready-mades or re-used commodities had entered the tool set. The creative appropriation of imported objects from China and the West is seen when in the last steps of panning the artisan in Kalimantan used a dish of enamel or porcelain instead of the wooden dish, probably to identify the gold glittering on the white and smooth surface more easily. This commodity is seen behind the female panner on figure 3.[7] A tin with a cover served as a storage container for gold or mercury, an extremely toxid liquid which is used for the extraction of gold (Helbig 1937: 22; 1938: fig. on p. 387).

With the pan went a full tool kit. In Supayang the gold panner's set included as many as seven tools, highlighting the well-differentiated operational procedures from retrieving the gold-bearing sand and gravel, washing, weighing and to storing the gold (van Hasselt 1881: pl. XCIX): a scoop basket made of rattan called *tanggoewq garei* to lift the gravel and sand from the river bed; a wooden panning dish called *djaé* of ovoid shape with pointed ends; a narrow wooden dish of rectangular shape but rounded sides, sometimes decorated with a carving, called *tintīngan amé* which is used during the transaction with gold dust to clean it from dust or impurities (the onomatopoeicum describes the cleaning process by beating and shaking);[8] a bag called *poerō* made of chicken skin, in which the gold dust is stored in a cotton cloth, is wrapped by a cord and adorned by beads; a spoon called *sidiēq amé* made of horn or bone is used to put the gold dust from the gold-storing bag onto the balance and it also allows to re-investigate

7 Helbig (1938: fig. on p. 387 left; 1982: fig. 120); Somers Heidhues (2003: pl. 1) reproduced the photo mirror-inverted.

8 Cf. the wooden dish of 28 cm in diameter collected by van Hasselt between 1877 and 1879 (National Museum of World Cultures inv. no. RV-268.354) and a similar dish called *tjoebada* of 25 cm from Alahan Panjang/West Sumatra (National Museum of World Cultures inv. no. RV-1623-188).

the gold quality as the word *sidik* indicates*;* another device called *toejé*, a rolled cotton cloth for cleaning the dust from the wooden dish; a scale called *nāratjō* within a carved wooden case called *pālātaq nāratjō*. The tools at the end of the production chain – the cleaning dish, scale with its container, the storage bag and a wooden spoon – were delicately decorated, a fact that reveals a high aesthetic appreciation.

A gold-panning set documented before 1913 in Sarolangun near the Tembesi river in West Sumatra consists of auspicious devices as well as specialised tools (Fig. 6b). A *dulang* of light-weight wood, 45 cm in diameter and of 6 cm depth and a coconut bowl of 14 cm in diameter in which the following items are stored: a piece of a soaked turmeric root which preserves the yellow colour of the gold described as the companion of gold (*teman mas krana sama kuning*); a device to prevent that the gold is lost (transcribed as *obas mas djangan ilong*) which are three stones of different colour so that the bowl would not float away while washing the gold; two bags to keep the small package of gold, the outer one consisting of two different textiles finished with a buttonhole stitching, bobs and white beads, whereas the inner bag is a torn piece of dyed woven cloth (*ikat)*.

Gold-storing devices are regionally distinct made of feather shafts, integuments from buffalo heart or covered containers (e.g., Grubauer 1913: 506, fig. 268; Kruyt 1938, vol. IV: 428; Marsden 1975: 171). Gold dust, for example in Supayang, was kept in three bags called *poera* made of chicken skin, one put into the other (collected by van Hasselt between 1877 and 1879, Museum Volkenkunde inv. no. 268-376); in a small basket from Nias called *moku moku naha gana'a*, acquired from von Brenner von Felsach in 1901 by the Ethnological Museum Berlin (inv. no. IC 31767 a, b) or in minuscule gold container called *abal-abal* due to the use of bamboo. One of them is provided with a cover of 4.5 × 1.7 cm, and another one is made of bamboo (5 cm high) which is inserted in another small container made of bone. Both were collected between 1896 and 1903 by doctor Dr Oscar Henggeler in the Karo Batak region (Völkerkundemuseum der Universität Zürich inv. no. 5780). In other words, the sample illustrates the diversity of cultural forms.

Panning was a wide-spread activity in large parts of Indonesia, but for a long time, the fear of earthquakes prevented locals from excessively deep mining (Marsden 1975: 167). Nevertheless, miners developed comparatively complicated technological systems of ground-slicing and mining throughout the archipelago. For example, in the 1740s, panning and the digging of canals were carried out along the riverbanks at the upper end of the Tulang Bawang river in South Sumatra. Records document how waterwheels were erected to dewater mining shafts, "two or more rods wide and 1.5 fathoms [2.7 m] deep" (Watson Andaya 1993: 200–201; addition by the authors). Probably, these mining techniques originated in the highlands of the Minangkabau area, from where they were introduced to the lowlands of Sumatra. In the first half of the nineteenth century, a number of sites in West Sumatra developed into innovative trading zones. Here, one distinguished between underground mining accessed by means of shafts, tunnels or galleries and surface mining along steep walls which were extracted by removing the covering layers of rock and soil with water pipes (van Hasselt 1881: 401). In the nineteenth century, shafts were dug to at least 2.5–3 m depth and underground galleries of up to 28 m, some of which did not even reach 1 m in width. No less than 154 gold-mining sites had originally existed in Supayang of which by 1877/1879 only few were still worked (van Hasselt 1881: 399).

Mining equipment for the breaking, crushing and grinding of the ore included various kinds of hoes, shovels, crowbars, heavy mallets and hammers made of iron or quartz, shafted with bamboo and rattan (Rosenberg 1878: 254–255; Posewitz 1884: 265). In West Sumatra, backfill and ore were transported on wooden slides or carried by workers (van Hasselt 1881: 401). Timbering had to be prepared around the mouth or the top of a

shaft, and the walls had to be stabilised with beams, planks or bamboo (Fig. 1; Helbig n.d. photo album "Borneo Mappe I": fig. F: 62/7; Harb/Thomsen 2020: figs. on pp. 126–129). Although Dayak miners took certain precautions, they did not shun away from cutting off the mines of the competitors from above or filling them with groundwater (Helbig n.d. K. 43: 20; 1937: 20).

A closer look at the material used for the manufacturing of various tools illustrates the creole character of gold extraction and working. The elevator technique used in the shafts is a case in point: by turning a spoked wooden wheel, the load filled in baskets was lifted from the shaft by a winch made of wicker turning an iron wheel on a wooden tripod (Fig. 1).[9] Apart from a metal pulley block, locally available material was used. Furthermore, the ore was pulverized in wooden or stone mortars which also served for food production (Rosenberg 1878: 255; Helbig n.d. photo album "Sumatra und Nias 389 – Schluss": figs. 130/3–8). During his 1937 journey, Helbig (1937: 21; 1938: fig. on p. 390) recorded metal mortars using iron, stone or wooden anvils (Fig. 2). Mining and gold working tools are displayed in various provincial museums in Indonesia such as in the Museum Adityawarman in Padang and the Geological Museum in Bandung/West Java where grinding stones for gold from Bengkulu/Sumatra of supposedly precolonial period are shown.[10]

When gold is reworked, traded and recycled, the true gold content needs to be determined, and the quality has to be tested. Before the gold dust is weighed, it is cleaned from heterogeneous alloys and impurities associated with alluvial ores or added fraudulently by chemical, mechanical and visual means. Such evaluation required special expertise, long experience and a sharp eye.[11] Fraudulent efforts address the addition of fine copper, less gold content in the inside of gold bars or other false material found within heavy jewellery (Helbig 1938: 390; 1982: 366). In Central Sumatra a *basi barani* (literary "courageous steel"), a magnet, helped cleaning the gold powder from impurities (Maaß 1910: 372). The Minangkabau spread out the dust on a wooden platter and sorted out non-gold particles by means of a piece of cotton cloth which had been rolled to form a point. Finally, for touching gold it was re-tested by applying nitric acid called "aqua-fortis" (Marsden 1975: 171).

Due to the monetary value of gold for jewellery and gold bars and its use as a medium of local exchange, gold-weighing scales were widely used in transactions throughout the archipelago. We interpret scales as creole technologies which combine translocal agreements on the definition of the magnitude of certain weights with locally and even individually designed weighing tools. One example consists of two weighing dishes made of tortoise shell, horn or metal suspended at equal distance hung down from a beam on fibre, metal or cotton strings (Fig. 7a–b). The fulcrum at its centre as well as the attachments were made of wood or metal furnished by ornamental elaboration – especially on the central pole, the centre of gravity of the balance. The artifact was collected by missionary Kramer on Nias, acquired by the Berlin museum in 1881. Other museum collections provide examples of these balance scales from the late nineteenth to the early twentieth centuries from West to East Indonesia, suggesting variations in the weighing scale design. In contrast to a simple wooden arm of a balance called *tataïs* possibly from the regency Rote Ndao on Roti dated pre-1891 and collected by Dr H. F. C. ten Kate jr. (National Museum of World Cultures inv. no. RV-858-280), we also find a scale completely made of metal which allows very precise measurements by attaching a pointer to the beam which amplifies any deviation. Such a metal scale was collected by von Hardenberg, a German jurist, art historian, writer and *Hofmarschall* (Grand Ducal Court Marshal) of Hessen-Darmstadt, who had obtained it in Java during a journey in 1901 (Ethnological Museum Dresden inv. no. 34674). Similarly, a finely crafted fulcrum with a pointer allowed greater ease of weighing with a balance using a brass arm and copper pans hung on a string, originating from the Karo Batak region and

9 At least in one known instance, a robe winch was also in use in Gorontalo/North Sulawesi (Rosenberg 1878: 255).

10 Miksic (1988: 10). If the artifacts are not retrieved from a controlled excavation or survey, the dating remains unknown, cf. similar devices of unknown age photographed by Helbig (n.d. photo album "Sumatra and Nias 389 – Schluss": figs. 130/3–8). See also mining instruments made of stone from Southwest Sumatra and Rejang Lebong collected by J.H. Schmiedell in 1929 (National Museum of World Cultures inv. nos. TM-513-1, TM-513-3, TM-513-4, TM-513-5).

11 This is transmitted in the story about specialists in Damar in the Maluku province who supposedly could smell the quality spectrum of gold (Jasper/Pirngadie 1927: 22).

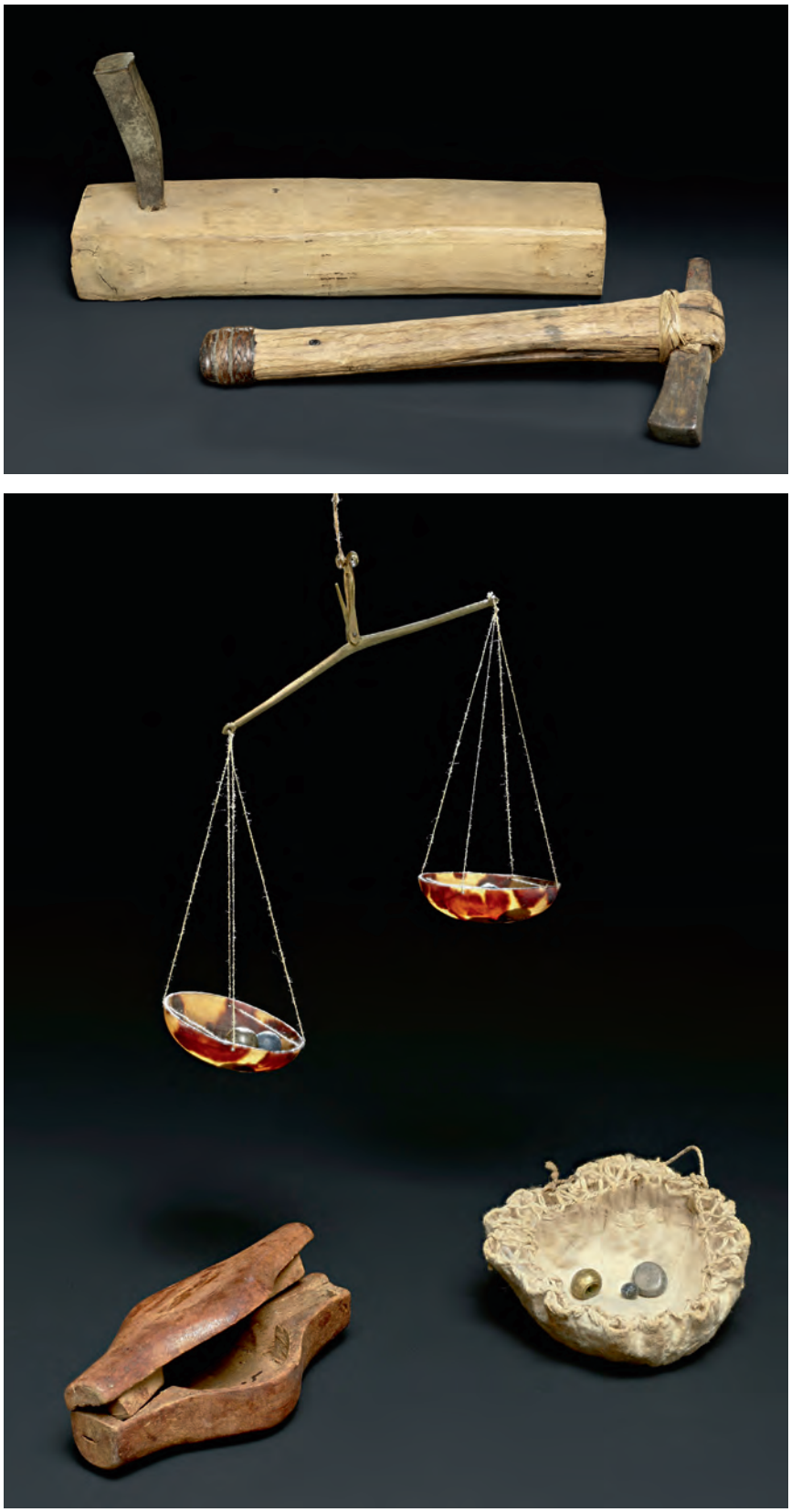

Fig. 7a–b Goldsmithing anvil, hammer (*farocha ba siemu*) and gold weight (*faliera*) in a case with a bag where metal and glass gold weights are stored (*saga*), Gunungsitoli/Nias, collected by Friedrich Kramer, Rhenish Missionary Society, acquired in 1881 (Ethnological Museum Berlin inv. nos. I C 10664, I C 10665, I C 10715 a–c; Foto: Staatliche Museen zu Berlin, Ethnologisches Museum, Martin Franken).

Fig. 8 Chinese gold and opium weight in a container, Sumatra, collected by H. Engelbrecht around 1886 (Ethnological Museum Berlin inv. no. I C 13626 a; Foto: Staatliche Museen zu Berlin, Ethnologisches Museum, Martin Franken).

collected by Dr Oscar Henggeler between 1896 and 1903 (Völkerkundemuseum der Universität Zürich inv. no. VMZ-05725).

The Chinese, on their part, used a portable unequal arm scale with one arm, only one pan hanging down on one side and a counterweight on the other, while holding it by a string on the side of the pan. The measuring arm of the beam made of bone or ivory shows three different measurement hexadecimal and decimal units marked by black dots. Illustrating how foreign and indigenous techniques could co-exist, Helbig (n.d. K. 09: 88) explains that in Borneo – regardless of the kind of scale being used – one *chi* of gold (divided into ten *hun*) weighed 3.75 g. The scale with a plate of a brass alloy from Sumatra was acquired by the Ethnological Museum in Berlin from H. Engelbrecht in 1885/1886 (Fig. 8). This kind of handheld scale was also used for weighing silver, opium or medicine – as known from China (Ethnologisches Museum Berlin inv. nos. ID 5177, ID 47651, ID 830) and well before 1964 on Java.[12]

Balances were stored in a wooden case and suggest widespread portable use: examples include a rectangular box of 128 × 34 × 62 mm held together by a rattan band which stows a scale from Watutau/Central Sulawesi of 1910/1912 (Rautenstrauch-Joest Museum inv. no. RJM 27984),[13] a curved case of two halves closed with metal hinges holds a scale called *maratja* from West Sumatra collected by van Hasselt between 1877 and 1879 (National Museum of World Cultures inv. no. RV-268-381; cf. van Hasselt 1881: pl. XCIX: 10, 13) and an omega-shaped, silver/copper-plated wooden case with geometric and floral decoration from Aceh collected by H. Gramberg, leutnant in the Royal Netherlands Armee, in 1923 (National Museum of World Cultures inv. no. RV-3600-806).

12 A similar gold and opium scale was stored in a violin-shaped case, furnished with a coin-like counterweight in pre-1964-Java (National Museum of World Cultures inv. no. TM-3401-1139).

13 Cf. an artifact from the neighbouring village Bada (Grubauer 1913: 507, fig. 268).

Gold weights consisted of vegetal material, stones, coins or cast metal beads.[14] Some precision scales allowed weights as low as 0.03 g (Roth 1985: 127). There are lead weights from Central Sumatra collected by van Hasselt between 1877 and 1879 (National Museum of World Cultures inv. no. RV-268-386); plant seeds from Java (National Museum of World Cultures inv. no. RV-852-11) and from pre-1913 Sarolangun, collected by Tobler (Museum der Kulturen Basel inv. no. IIc 1320); three precast metal gold weights held in a wooden container were collected by missionary Thomas on Nias before 1880 (Ethnological Museum Berlin inv. no. I C 8268). Complete sets from the colonial period – with scale, weights and case – are rarely found in museum collections. Exceptions include the pre-1935 set of a scale called *kaússe* with its case *ndúna tatáiss* and weights from Rote Ndao, the Tudameda region on Roti, collected by ethnologist Alfred Bühler (Museum der Kulturen Basel inv. no. IIc 4030). A set collected by missionary Kramer before 1881 on Nias includes a scale made of a metal arm and tortoise dishes stored in a wooden case and the weights put in a bag (Fig. 7b). The locking mechanism of the wooden case reveals the artisanal skill involved in its design. It consists of a tongue and groove – mirrored but not set in a horizontal axis to each other. The ten weights consist of various metal shapes (including lead-alloy), beads of glass and copper alloy, probably re-used for this purpose. They are stored in a cloth bag, finished with a decorative band of knots. In gold-bearing regions of Sumatra it was observed: "every man carries small scales about him, and purchases are made with it so low as the weight of a grain or two of *padi* [rice]." (Marsden 1975: 171; addition by the authors).

The question of weights, as well as the assay of the gold content, concerns a sensitive matter in trade, because it demands exactness and consistency. Based on visual qualities, the content of alloyed gold was assayed by touchstones of black pebble (Fig. 9), sometimes together with assaying needles. Assaying needles are documented on Nias before 1890 (Roth 1985: 125, ft. 21). The gold object was rubbed onto the dark stone, allowing a well-trained eye to distinguish the slight colour differences of the streaks of gold (Helbig n.d. photo album "Borneo Mappe I": fig. F: 13/4). Traces of abrasion on all sides of the Nias stone show strikes of different colour and intensity. Wax came in handy when removing the streaks of gold which could then be kept and later re-used.

Showing how local craftspersons were involved in a global economy, the expanding monetisation of the economy increased the availability of raw material for jewellery making. The standardised contents of coins facilitated the work process and made coins predisposed for recycling. In Aceh, gold dirham coins had probably been reused ever since they were minted in the fifteenth century – due to their high purity of gold. Colonial silver coinage was in demand as a raw material throughout the whole archipelago. The coins were melted, simply cut and bent to make rings, adornments, necklaces and bracelets or sewn on cloth or headbands (Jasper/Pirngadie 1927: 13–22; Marschall 1968: 94, 96, 102, 123, 126–127; Roth: 1985: 126; Sibeth 1990: fig. 254; von Römer 2018: fig. 15). Especially the so-called cannon dollars were high in esteem, that is, Spanish or Mexican silver coins with a high degree of purity, the most widely accepted currency in the area during the eighteenth and nineteenth centuries (Sibeth 1990: 181; 2012: 32).

The use of recycled coins required refining skill. Local smiths needed substantial knowledge of assaying and cupellation in order to control colour and mechanical properties. An account from eighteenth-century East Indonesia highlights the time-consuming procedure. While being observed by two Moa goldsmiths, Barchewitz (1752: 503) smelted scrap gold from Timor which was adulterated with copper, forged it and alloyed it with half a silver *ducatoon*. Only after reprocessing and forging it, he finally achieved the desired consistency after five days of work. At each stage, the refining process required new crucibles. However, the use of coins made it easier for goldsmiths to respond to individual customer wishes. For example, Karo Batak artisans complied to

14 A gold weight made of copper was found in an unstratified archaeological context circa 1400–1800 in West Sumatra (Tjoa-Bonatz 2020: 196, fig. 4.20F on p. 191, including references to museums' collections).

customers' requests to produce a piece of jewellery with a specific gold-silver-copper alloy of a certain weight (Jasper/Pirngadie 1927: 19). During recycling processes the silver quality was more important than the designated function. For example, silver Spanish coins were "melted down to make jewelry or to decorate a *kris* [weapon], and on one occasion even a tea service for the Palembang ruler" (Watson Andaya 1993: 81, addition by the authors).

Working tools reveal the jeweller's metal-smithing skills and the translocal circulation of designs.[15] Tool sets obtained by collectors in the nineteenth century exemplify the multitude of these skills. One set from Java includes high-precision iron tools for hammering, shaping and cutting. The set was donated to the Ethnological Museum Dresden by von Schierbrand (inv. nos. 01864, 01867, 01869, 01870, 01872). Some of the artifacts allow close references to other gold-working centres or highlight regional peculiarities. As known from illustrations in Jasper/Pirngadie (1927: fig. 28) and van Hasselt (1881: pl. CII: 9), the loop form of the plier in the Ethnological Museum Dresden (inv. no. 01867) was used as a fire tong in Aceh, whereas in West Sumatra this instrument – called *sāpi barō* – was furnished with an eyelet on the top. The pointed anvil was used to shape the gold after it had been heated, and the plier with a flat edge was probably used for pulling wire (Ethnological Museum Dresden inv. nos. 01864, 01868). The latter and a small hammer with wear traces (Ethnological Museum Dresden inv. no. 01872) allow comparisons to Central Sumatra where the first is called *sapi bingoeēng* and the second *pānoekò ame.*[16] A basic goldsmith's tool kit which von Hardenberg brought with him from turn-of-the-century Java includes a scale, a bellow and a wooden box with a sliding cover in which twelve goldsmith's tools are stored: two ceramic crucibles, two pincers, seven chisels with flat, bevelled and round edges and a file.[17] The scale addresses weighing, the bellow and the crucibles refining tools in order to smelt, solder and anneal the gold, whereas the selection of iron devices are finishing tools for engraving, cutting, bending and scoring. The wooden-box bellow was designed to allow compressed air through two flaps to superheat the inside in three chambers, a device still in use by 1927 on Java (Jasper/Pirngadie 1927: fig. 18).

Two gold-working sets were collected by missionaries of the Rhenish Missionary Society on Nias. Thomas's collection, obtained by the Berlin Museum in 1880, includes a hammer consisting of an iron inserted into a wooden stick, an assaying and a grinding stone of black colour, a gold weight (*faliera*) in a wooden box and a container with weights and employed to assay, weigh and polish metal (Fig. 9 and Ethnological Museum Berlin inv. nos. I C 8267 a, b, I C 8268). Kramer's collection, filed at the Berlin Museum in 1881, also deals with goldsmith craftmanship in the weighing and shaping of metal: originating from Gunungsitoli, it includes an anvil, a hammer (*"farocha" ba siambu*), a scale (*saga*) in a wooden box and a bag with stones used as gold weights (Fig. 7a–b). The irons of slightly curved shape with tappering and rectangular ends are of identical shape, indicating that the production of anvils and hammers might have been produced in series. One iron is stuck in a rough piece of wood of rectangular intersection. The iron of the hammer is held by a piece of wood which is folded over it. Rotan bands at both ends and a single pin hold it tightly. Comparing the goldsmith's hammer during the same time period on the small island of Nias ennumerates the variaties of tools.

The origins of the three types of bellows are debated: first, the box bellow seen on Java, Sulawesi and Kalimantan (Posewitz 1884: fig. on 189; Rinne/Rinne 1900: 125); second, a vertical cylinder bellow which consists of bamboo pipes held together by rotan in which wooden pistons are moved up and down, for example, documented as *linggar* in the Mandailing and Karo Batak regions between 1877 and 1903 as well as in West Sumatra (National Museum of World Cultures inv. no. RV-268-346; van Hasselt 1881: pl. CVI: 6; Neumann 1903: 17); third, the bag bellow made of animal skin. Interpreting the history of these objects from his typically evolutionist and diffusionist per-

15 See an overview on Java (Jasper/Pirngadie 1927: 24–29) and West Sumatra (van Hasselt 1881: pl. CII: 8, 9, 13–15).

16 Cf. van Hasselt (1881: pl. CII: 8, 13); see also a roughly forged steel hammer from Java with a wooden shaft collected before 1927 by Konietzko (Ethnological Museum Dresden inv. no. 42055).

17 Ethnological Museum Dresden inv. nos. 34674, 34677, 346855. See https://skd-online-collection.skd.museum/ [accessed 9 July 2021].

Fig. 9 Goldsmith's tools: hammer, assaying stone and grinding stone, Nias, collected by Wilhelm Thomas, Rhenish Missionary Society, sent by August Mohri and received by Adolf Bastian in 1880 (Ethnological Museum Berlin inv. nos. I C 8300, I C 8265, I C 8266; Foto: Staatliche Museen zu Berlin, Ethnologisches Museum, Martin Franken).

spective, Marschall (1965: 292–297) assumes that the box bellow originated from China, the cylinder bellow is pre-European, thus fully indigenous Southeast Asian, whereas the bag bellow was influenced by the Arabic world.

Anthropological descriptions show that goldsmiths' instruments are far from being homogenous and uniform. The data bring out a high degree of variability, indicating that we do not have to do with a simple diffusion process but, rather, with the local development of creole forms. Apart from prefabricated instruments, others were made of semi-permanent but locally available resources, representing an obvious economic advantage. In addition to bamboo – an extremely versatile material, tools were made of vegetal or animal material. In the Batak region, pincer, moulds, bellows, the handle of a hammer, the cooling basin filled with water and the cylinder bellow were all of bamboo (von Brenner 1894: 289; Neumann 1903: 16; Jasper/Pirngadie 1927: 25, 27). Among the Karo Batak, a tree called *liun* indicates a smith's workshop because it served as a spool to wind silver wire (von Brenner 1894: 289; Sibeth 1990: fig. 252). Similarly, on Nias, an edged trunk in which a piece of iron is inserted was utilized as an anvil (Jasper/Pirngadie 1927: 27). Upon availability, nature created hand tools – a palm leaf to stir on Nias or shells serving as shovels on Sumatra (Maaß 1910: 373; Jasper/Pirngadie 1927: 27). Manifold variations of moulds were collected and reported. Examples include moulds made of wood or buffalo horns in Padang; made of coral on Timor; made of the mantle of a squid on Java; made of resin in Central Sulawesi; made of oiled "cork", probably wood, in North Sulawesi; and made of stone on Nias (Rinne/Rinne 1900: 125; Rouffaer 1904: 93; Maaß 1910: 372; Schröder 1917: 220; Jasper/Pirngadie 1927: 30, 46; Marsden 1975: 180).

We find cultural diversity and technical transformations also in the areas of manufacture and forming. A 1927 source describes both the co-existence and the creole mixing of techniques of different origins in the workshops. A wire, drawn by manpower through a piercing iron or mechanically with a handwheel reveal the ingenuity that developed in the trading zone of the "modern gold- and silver workshops" (Jasper/Pirngadie 1927: 57). At the Southeast coast of Kalimantan, a self-made draw bench was equipped with a wheel. A rope was attached to the axis of the wheel to which the pincers were fixed. By rotating the wheel, the pincers pulled the wire through the hole of the crowbar, as described in Kalimantan and Java (Jasper/Pirngadie 1927: 60). The Malay or Dayak goldsmith in Kalimantan largely used handcraftsmanship in an era of increased machine production – as revealed by the wire-drawing equipment in the background on Figure 4. To use such a rolling mill requires quite another kind of skill than the Javanese goldsmith who fixed the piercing iron with his feet while drawing the thin wire (Jasper/Pirngadie 1927: fig. 61).

We find creole techniques also in joining and decoration. First, in the Minangkabau highlands, a vegetable paste extracted from the red sago bean served well as solder. A Javanese mixture added rat poison so that the solder points were not visible, what was a big advantage in comparison to mass-produced jewellery (Jasper/Pirngadie 1927: 30). Second, the Batak developed a liquid of lemon juice, salt and gun powder as red stain (Jasper/Pirngadie 1927: 95). In Central Sumatra, stone settings were fixed with wax (Maaß 1910: 372–373). In analogy to the "modern way" in Semarang/Central Java, where glass powder is hammered to the surface, alternative local solutions created an equivalent matt surface by burning a vegetal acid, by engraving or by hammering. These techniques were appreciated as locally invented technologies in the late 1920s (Jasper/Pirngadie 1927: 44).

To a large extent, goldsmiths made their working tools themselves, whereby they often applied recycled material. To illustrate the emergence of creole techniques in a typical trading zone, we refer to a couple of gold workshops: in Central Sumatra, the smelting furnace was made of a fire-safe container tinkered with a tin basin filled with soil and saltwater, and placed on a wooden frame put on a fire of coconut bark or charcoal (Maaß 1910: fig. 163). Two broken sherds from a rice pot or an old broken iron pot (*kwali*) served as crucible. Its fire was tended by three to four men, blowing through a joint of bamboo while sitting around the fire, as documented among the ethnic group of the Rejang and Batak on Sumatra (von Brenner 1894: 289; Marsden 1975: 179). The dish-shaped crucible had to resist high temperatures and was also self-made. When necessary, ashes, powder or roasted straw of rice were added to the clay to comply to the thermic qualities: for example, a dish-shaped crucible with a flat bottom of 3.5 cm in diameter from Flores before 1890 (National Museum of World Cultures inv. no. RV-804-209; cf. Jasper/Pirngadie 1927: 19, 24, 29). In Makassar/South Sulawesi gold was melted in a bamboo container by using a bent pipe and the flame of a petroleum lamp – a technique which was judged as "extremely modern" (Jasper/Pirngadie 1927: 29, 89; citation from Marschall 1968: 117). Tins, a pig trough or wine bottles were re-used as containers (Fig. 4; Maaß 1910: 372; Schröder 1917: 219–220; Jasper/Pirngadie 1927: 27).

The adaptive durability of recycled materials is also true for the jeweller's shaping tools. In Central Sumatra, iron pins or nails worked as a kind of chisel or puncher (Maaß 1910: 372). In South and Central Timor, the goldsmith recycled rifle butts as pincers (Jasper/Pirngadie 1927: 30). While working, the goldsmiths sat on the floor, on a wooden block or mat (Fig. 4; cf. Jasper/Pirngadie 1927: fig. 28, 31, 50, 61, 75–76). Alternatively, as in Aceh, a wooden Dutch packaging box represented his workbench (Veltman 1904: fig. X). On Sumatra, the goldsmith forged the iron tools and made a hollow punch from an iron strip and inserted a worn-out hammer head into a block as an anvil (Marsden 1975: 179).

Co-existence & Trading Zones

Complementing the stories the objects tell us, we in this last section discuss the broader technological landscape of gold extraction and working in Kalimantan. Our main sources are contemporary accounts and photographs made by Western observers in the century and a half preceding the 1930s. The documents make it abundantly clear that the gold-working sites were places where technologies of various origins met – either entering fruitful, creole combinations or being employed side by side. We call these sites "trading zones". Aceh and Padang on Sumatra may be considered exemplary trading zones as described above but we also find similar sites elsewhere in the former Dutch East Indies.

Since the eighteenth century, Chinese immigrants introduced large-scale gold mining by means of ground-sluicing with water management and mobilised labour forces mainly from China. Mining in Kalimantan underwent significant technological changes during the peak period from the 1770s to the 1810s, when waterwheels allowed the exploration of deeper deposits. The Chinese waterworks included reservoirs, chainpumps and sluice-gates connected to washing channels. The miners loosened the paydirt with hoes, tossed it into the channels where the water current mechanically separated the waste material and the gold dust which settled at the bottom. There, it was collected and washed by panning (Jackson 1970: fig. 5).

Reflecting standard views of cultural differences, Europeans claimed that the Chinese ventures were inefficient, based on deficient technological knowledge of shaft mining and not suitable to exploit many potentially rich site (Posewitz 1889: 266, 275). Although James Jackson (1970: 31) acknowledges that the Chinese miners were "guided by an acute appreciation both of the composition of the gold-bearing deposits and of the economics of mining", he still reproduces the traditional story line that their work first and foremost had a "speculative" character. Uncritically quoting an 1848 source, Jackson demeaningly claims the Chinese were "indefatigable and desperate miners" who would "run every risk and many hardships" to find gold.[18]

Although our knowledge of cultural interchange during the early time is limited, social and linguistic aspects support the idea that knowledge and skill went through processes of creolization. Intermarriages between Chinese men and Dayak women were not uncommon. The given names in Malay, respectively today Bahasa Indonesia, also used by the Chinese miners of the washing channels *parit* or *kotak*, literary "box", the hoe for digging (*chankoel* or *patjol*), the *kulit* (literary "skin") and *kol*(*l*)*ong* (deep)[19] for the types of mines also indicate that acculturation processes took place. Language and agricultural skills opened up ways for collaboration and mutual understanding: Dayak worked for Chinese miners, local people helped clearing mining sites of trees and bushes by slash-and-burn techniques (Somers Heidhues 2003: 36, ft. 69; 39, ft. 80). In the 1860s, when the Chinese mining population was declining, women of non-Chinese descent were engaged in panning. They wore Chinese clothes – dark blue slacks, a jacket and a kind of red cotton turban under a miner's hat – and carried in their hand a small hoe (*patjol*) with a short handle and under the arm the washing pan. They were singing Hakka "mountain songs" while panning the gold.[20]

When Helbig visited Kalimantan in 1937, various groups were involved in mining activities. In various trading zones in West Kalimantan, ground slicing was undertaken by Chinese under the supervision of Chinese and Europeans. Panning was done by women in the water channels or by two to three women sitting in a large wooden tub supervised by a Chinese foreman who was probably working for a European company (Helbig n.d. "Borneo Mappe I": figs. 24/12, 25/8). They used a washing pan and a hoe. The mining-village Tewah at Gunung Mas (literary "gold mountain") consisted of around 600 houses and about 3000 inhabitants, including elderly people, women and

18 Jackson (1970: 32), quoting the governor James Brooke (Brooke/Mundy 1848: 366).

19 Posewitz (1889: 250); Wong Lin Ken (1965: 45) simply distinguishes smaller (*kulit*) and larger (*kol*(*l*)*ong*) mines in the tin industry.

20 Re-reading the source of Somers Heidhues (2003: 35, ft. 62), some additions were made after Faber (1864: 465).

children, most of whom were also involved in the mining activities. The Dayak reworked the Dutch mine which had been closed in 1904. The Dayak entered the old tunnel, dug new shallow shafts following the veins some hundred meters in winding lines and panned in riverbeds in the miners' village. The closed-down factories – industrial ruins including a boiling house, railway and a high chimney – were already reclaimed by the thick vegetation of the jungle (Fig. 5).

The miners used tools and transportation means of both local and foreign origin in a creole manner. Apart from baskets, they also recycled petroleum containers for carrying and storing back dirt, ore or tools. By the 1930s, the heavily sooty resin torches were replaced by small petroleum lamps imported from Japan or Germany. The latter proved to be more suitable than the former, though more expensive (Helbig 1938: 389). It is known from Central Sumatran mines that working day and night, 1000 torches made of resin were needed for an eight-day period (van Hasselt 1881: 401, pl. LXXXI: 5). The shafts were supported by logs which were trimmed by hammers, mallets and chisels imported from Germany, *tjap Djerman* (literary "German stamp"; Helbig 1938: 389; 1982: 366). Whereas the load was shouldered by a yoke put on both shoulders or carried on one side with a bar made from bamboo (*pikulan*), the Dayak carried a cylindrical pannier either held with a headband or with two straps on their back. Another allegedly Malay method enabled two people to carry a conically shaped basket with a longer stick set on their shoulders (Fig. 2; Helbig 1949: 104; 1982: fig. 122). Subsequently, the ore was crushed in front of their houses by means of short and heavy iron sticks in prefabricated cylindrical containers or on wooden anvils of oblong shape,[21] then being sorted in rectangular or round sieves with bamboo rims. During the time-consuming crushing process, the lumps of ore were stored in lockable boxes under their houses, additionally protected by a fence. As described by Helbig (1937: 21) in 1937, the gold-refining process used hydrochloride acid in order to dissolve the gold-silver alloy in a crucible above a coal fire so that bars were produced and traded. The gold was also directly worked on site by Dayak or Malay[22] jewellers (Fig. 4).

Describing the anachronism of simultaneously used manual and mechanical instruments, Helbig takes a critical viewpoint of the technical progress of mechanisation and industrialisation. In a romantic manner, Helbig (1982: 366) admires the entrepreneurship and "simple" tools of the locals:

> Prehistoric craftsmanship in the era of technology – the neighbouring ruins do indeed not tell a story of proud superiority! Even in the deeper mines would the European miner wonder about the fact that humble people are able to make a profit from using such simple tools.

An 1873 decree about the exploitation of mineral-rich soil in the former Dutch East Indies stipulated that mining licences or concessions for mining had to be granted by the government. This decree stimulated a series of articles on the lure of gold ore, arguing that the Sumatran mountains were as potentially rich as the Californian and Australian gold fields (Rueb 1991: 14; Reid 2005: 180, ft. 106). Nationalistic competition inflated the idea of spectacular riches. By 1908, as many as 170 exploration and mining societies had emerged in the former Dutch East Indies.[23] European companies worked at several sites in the Bengkulu and West Coast residencies until 1940 (Schmiedell 1924; ter Braake 1944: 53–58). Engineers and miners mainly dealt with management issues, infrastructural improvement and the technology of deep-shaft mining – carried out by electricity-driven instruments and chemical devices, such as compressors, stone crushers, mills, tippers, trains, bucket dredges, furnaces and filters. German miners instructed the locals how to use the power drill (Müller-Herrings 1915: 964). An euphoric fascination of technique and machinery glosses over the real and hard-working life: "Everywhere, machines rattle and engines sing the song of work." The negative sides of life abroad in

21 Helbig (1938: fig. on p. 390) refers to gold-mining activities before the operation of Erdmann & Sielekens in 1938 in Lebong Tandai/South Sumatra (Helbig n.d. photo album "Sumatra und Nias 389-Schluss": figs. 130/3–8).

22 His captions are contradictory (photo caption of Helbig n.d. "Borneo Mappe I": fig. F: 63/8; 1949: opposite of p. 144; 1982: fig. 121).

23 Zangger (2020: 67) based on Wright (1908).

a remote region are deleted in the manuscript of Zeumer (1941) who writes about the dull social life, the temptation of alcohol and women among his compatriots.

We find modifications of the modernisation narrative also in other sources. Driven by a nearly romantic perspective, Helbig (K. 43: 100) contrasts "the roaring and banging of the ore mills" with the "murmuring of the mountain creek". Although rail transport was available, gold was carried by men forming a chain of people behind the tracks in Lebong Tandai in 1930.[24] This was only possible due to the large indigenous labour force involved in the mining companies. In 1940, for example, about "35 Europeans and [1~~500–2,000~~] almost 1700 Kulis", mostly Javanese workers, were employed at Rejang Lebong (Zeumer 1941: III, 3).

The process of modernisation was strongly socially segregated. Food precautions for European miners were strictly controlled due to health reasons. Meal preparations were supervised by a European and tested by a doctor, whereas the workers got rice packed in banana leaves – a solution which was said to be perfectly suitable for work in the mines (Zeumer 1941: 3). However, photo albums and an amateur film on the Mining Company Redjang Lebong from ca. 1933 by H. J. A. Sanders (1876–1939), the owner of a gold mine in Lebong Donok/South Sumatra, blur the boundaries between the private and public realm (Anomymous n.d.). For example, the Asian mining staff was invited to attend the more official occasions at Sanders' home (Noordegraaf/Pouw 2009; National Museum of World Cultures inv. no. TM-33001183). Mainly describing the work in the mining factory, its machinery and labourers by following the stages of extracting the ore from the rocks, Sanders' material visualises an apparently close-knit small colonial community by including shots relating to food preparation, the market, the company hospital, his office and mansion.

The tools in small-scale mining operations directed by Europeans mixed locally rooted material and Western tools, such as shovels, pickaxes, pressurised water pipes and rail transport together with bamboo ladders, buckets and basketwork lifted by hand to carry the backdirt and ore.[25] Also linked to practical circumstances, simple and re-fashioned tools helped in gold processing in 1937 on Kalimantan. The daily amount of gold was roasted in a soup ladle and stirred with a spatula above a kitchen hearth, which consisted of a container with coal. Afterwards the gold was weighed with a Chinese gold scale and stored in a marmalade glass (Helbig n.d. photo album "Borneo Mappe I": figs. F: 25/10–11).

Conclusion: Creole Solutions in the Trading Zones

The history of gold tools and techniques in Sumatra and Kalimantan illustrates the explanatory power of concepts such as "creole technology", "trading zone", "circulation" and "appropriation". On the one hand, European and Chinese extraction methods circulated across the archipelago, allowing the exploitation of gold deposits on a larger scale. On the other hand, indigenous methods of gold mining, panning and working continued to exist and prove their efficacy. Importantly, our story is not simply one of the parallel co-existence of various techniques. It is also a narrative about how knowledge and skill, tools and methods entered fruitful combinations on the local level. For example, Gunung Mas, the "Golden Mountain" which Helbig visited in 1937, was a "trading zone" of sorts (Hård/Tjoa-Bonatz 2020) – a site where German petroleum lamps, Dayak gold pans, Chinese gold scales and Malay jewellery tools were used simultaneously and interchangeably. At the same time, Gunung Mas was a truly "creole" worksite where European administrators, Chinese miners, Dayak or Malay goldsmiths and traders met and mixed. In a process that have clear similarities to the emergence of pidgin or creole languages, European exploiters depended on the panning skills of Chinese and Dayak

24 See photo montan.dok 2600046. Montanhistorisches Dokumentationszentrum (montan.dok) at Deutsches Bergbau-Museum Bochum/Bergbau-Archiv (BBA) in Bochum.

25 Unknown site(s) of 1889 – ca. 1908 (Harb/Thomsen 2020: 126–131). The Swiss entrepreneur Johann Traugott Zimmer-Sonderegger (1854–1918) founded over 12 mining companies on Sulawesi, Kalimantan and Sumatra (Zangger 2020: 75).

labourers, whereas indigenous miners adopted construction techniques from an earlier active Dutch company. Like many other gold-rich sites in the country, Gunung Mas may be considered a "trading zone", where people of different social and linguistic background shared information and where technologies of different background, in part, co-existed side by side and, in part, enabled new creole solutions – despite the fact that information exchange was always piecemeal and fragmentary. In this sense, Gunung Mas reminds us of the high-energy-physics laboratories which Galison (1997) analysed by means of the trading-zone concept. Attracting gold workers from various areas of the former Dutch East Indies and abroad, the Gold Mountain and other extraction sites became creative sites where new, "creole technologies" developed (Edgerton 2007).

Our inventory of museum artifacts testifies to the great variety of technological forms. Across the Indonesian archipelago, goldsmiths' tool kits contained objects of different character, and gold traders' assaying instruments reflect local traditions – despite the existence of international and cross-cultural standards. Gold pans and baskets, scales and weights, carrying and storing tools, spoons and shovels, mallets and hammers, anvils and decorating tools differed from area to area. Craftspersons used various raw materials to make their tools, and they adopted designs from other areas in an often highly creative manner. The material culture of gold extraction and working in the former Dutch East Indies exhibits a richness which is just as impressive as the jewellery and other gold objects which museums across the world ordinarily show their visitors. This article has made a case for the need to study this culture further. We advise anyone who is keen on doing so to follow anthropologist Hannerz' (2010: 544) dictum that the "study of [cultural] diversity remains the best antidote to unthinking ethnocentrism".

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