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Pharaonic Copper Mines in South Sinai

The next issue of Archaeo-Metallurgy, IAMS Monographs, to be published early in 1988, will be *Pharaonic Copper Industries in South Sinai* by Beno Rothenberg, with H. G. Bachmann, J. Glass, A. Schulman and R. F. Tylecote. The Editor of IAMS Newsletter is pleased to be able to publish a pre-view of some of the so far unpublished new discoveries which will prove to be of interest to both metallurgists and Egyptologists and of considerable importance for the history of metal in the Old World.

Are there any ancient copper mines and smelters in the Sinai Peninsula – did the Pharaohs of Egypt ever mine and smelt copper in South Sinai? Since these questions were first raised by travellers in the early nineteenth century, a lot of ink has been spilled over arguments for and against – strangely enough, not by the geologists, metallurgists and archaeologists who explored Sinai, but mainly by the philologists and historians who have never been to Sinai, and as a kind of 'backfire' from discussions about the meaning of some hieroglyphic texts.

Richard Lepsius, in the 33rd of his famous letters[1] written during his antiquities hunting mission in 1845 on behalf of His Majesty Fredrick William IV of Prussia, made the following, often quoted statement concerning the Egyptian mining temple at Serabit el-Khadim in South Sinai:

> 'the divinity, who was mostly revered here in the New Empire, was Hathor, with the designation, also found in Wadi Maghara, "Mistress of Mafkat", i.e. "the copper country"; for *mafkat* signified "copper" in the hieroglyphical, as well as in the Koptic language. Therefore, no doubt copper was also obtained here. This was confirmed by a peculiar appearance, which strangely enough has not been observed by any earlier travellers. East and west of the temple are to be seen great slag-hills . . . covered with a massive crest of slag . . . the mines could not have been in the immediate neighbourhood but the old . . . paths which lead into the mountain no doubt point them out. Unfortunately we had not time for it . . . we rode further, and visited the Wadi Nasb, in which we also found traces of ancient smelting-places . . .'.

The meaning of *mafkat* (=copper) as viable evidence for Pharaonic copper mining was entirely within 'the spirit of the time' of the early nineteenth century, although even then slag samples from the 'slag-hills' at Serabit could have been analysed. (When investigated by us in 1967, this 'slag' turned out to be natural nodules of haematite and manganese, common in the Nubian Sandstone horizon of Sinai and the Arabah.)

It is rather amusing that as recently as 1984 the historian J. Muhly used the meaning of *mafkat* (now revised as 'turquoise') as the principal evidence for his astonishing conclusion that: 'In contrast to the evidence from the Wadi Arabah no ancient copper mines have yet been identified in the southern Sinai. Nor have any copper smelting sites been found in the area'.[2] This draconian statement is even the more astonishing since for some 150 years there have been detailed reports by geologists, geo-scientists and archaeologists who explored southern Sinai, concerning numerous ancient copper mines and copper smelters in various parts of South Sinai. As long ago as 1822 Richard Rüppel undertook a mineralogical exploration on behalf of Mehmet Ali, Pasha of Egypt, in order to study the feasability of renewing the operation of the ancient copper mines and smelters in the region of Bir Nasib:

> '. . . in the vicinity [of the well of Nasib] are large slag heaps and ruins of several smelting furnaces. The mines of the ore are situated about one and a half hours to the north-west [Gebel Um Rinna?]. Here, in several horizontal sandstone layers, have been squeezed wedge-shaped masses of earthy copper oxide (cuivre oxidé noir terreux) of unusual dimensions; . . . The old inhabitants drove shafts and labyrinth-like cavities in many directions, leaving pillars of rock untouched to prevent the whole from caving in . . . Judging by the dimensions of these workings the quantity of ore extracted must have been very large . . . even now immense masses of cupriferous rock are still to be seen. Another mine, where caverns of about 80 feet had been emptied, seemed to have been deserted because of depletion . . . the ore contained 18% of pure copper

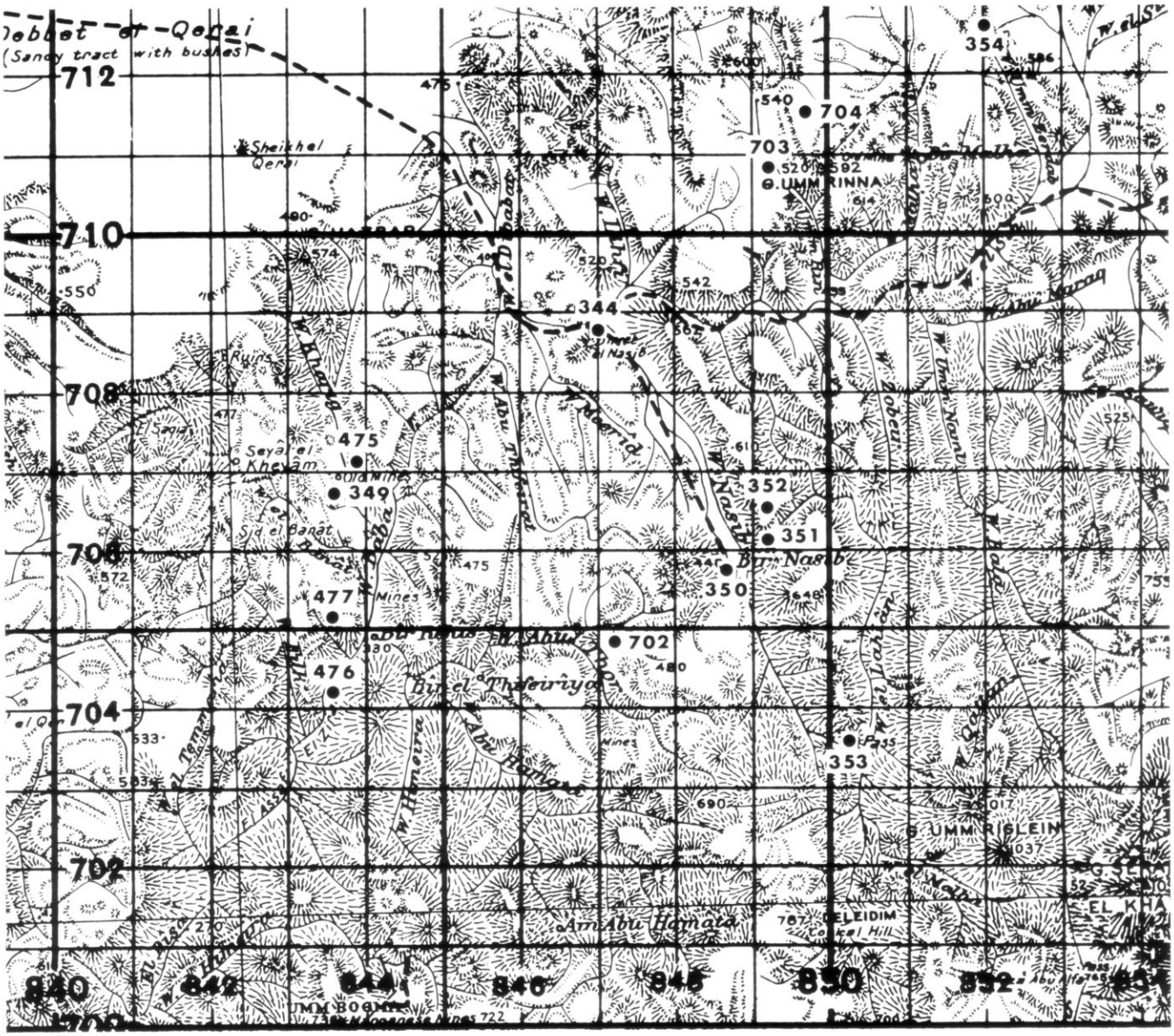

Fig. 1. Map of Pharaonic copper mining and smelting sites in south-west Sinai.

> of high quality . . . These ores could be reduced without any additional flux and I obtained 18% pure copper and an equal quantity of iron slag . . . on the hill above the other mine I found a small, 8 feet long obelisk of sandstone, on its side, facing the ground, it showed . . . beautifully worked hieroglyphs . . .'[3]

This is a first-hand field report by an eminent mineralogist about ancient copper mines and huge heaps of smelting slag at Bir Nasib and his experimental smelting of the local ore.

Flinders Petrie's pioneering work in Sinai[4] was mainly concerned with excavations at the mining temple of Serabit el-Khadim and the turquoise mining camps of Maghara, but on the pages of his Sinai report, especially in the chapters contributed by C. T. Currelly, there are numerous references to substantial remains of ancient copper mining and smelting in various parts of the South Sinai. Although many of these remains, reinvestigated by the present author's Arabah Expedition, [5] turned out to be prehistoric and pre-Pharaonic, they represent pertinent evidence for ancient copper mining and smelting in Sinai.

Modern geology

S. M. El Shazly of the Geological Survey of Egypt, published in 1959 a report on the copper deposits of Sinai: 'Several ancient [copper] mines have been reported in Sinai, which included Gebel Um Rinna, Serabit el-Khadim and Maghara . . . the copper ore mined in Sinai in the ancient time was largely malachite associated with a little azurite and chrysocolla . . .'. Shazly also reports, 'copper mineralisation at several localities in Sinai which include Serabit, Regeita, Samra, Abu El Nimran and others'.[6] Heaps of copper smelting slag were reported by geologists and archaeologists at many locations in South Sinai, from Wadi Samra and Dahab in the far south, to the area of Wadi Regeita, north of St Catherine's Monastery; the miners' camps of Maghara along the full length of Wadi Nasib, the Wadi Ba'ba-Kharig, to the huge mining site of Gebel Um Rinna. Wherever slag heaps were located, copper mineralisation and mine workings could be found nearby. There could not possibly be any reasonable doubt about the existence of ancient copper mining and smelting sites in South Sinai: these are

Fig. 2. Entrance to the Pharaonic copper mine in Wadi Kharig.

overwhelming basic facts reported by generations of explorers and scientists who worked in the field.

Dating the mines and smelters of South Sinai

The date of the ancient mines and smelters is, of course, of decisive importance for the history of Sinai and for metal history; this problem has been one of the main objectives of the Arabah Expedition's Sinai survey 1967–78.

The Arabah Expedition, led by the present author, worked for 15 seasons in Sinai, systematically exploring Central and South Sinai with special emphasis on mining and archaeo-metallurgy. Among the scientists taking part in some of the fieldwork mention should be made of H. G. Bachmann, R. F. Tylecote, A. Lupu, J. Glass, P. Wincierz, C. Hope and a group from the German Mining Museum, Bochum, under its Director Min. Ing. H. G. Conrad. Large clusters of prehistoric (Chalcolithic-Early Bronze Age) mining and smelting sites and related settlements were identified in the region of the ancient copper mines of Regeita, Samra and Abu el Nimran, Wadi Shelal (South) and other areas of South Sinai.[7] However, the Pharaonic copper mining expeditions concentrated their main efforts in the area between Gebel Um Rinna and Bir Nasib, in the north-west corner of South Sinai, adjacent to the ancient turquoise mines. Since substantial quantities of copper slag, furnace parts and crucibles were found in the mining camps of Maghara excavated by Petrie and copper mineralisation has been located in the hills around Maghara and Serabit (i.e. even in the Pharaonic turquoise mining camps copper was worked), there cannot be any doubt that these activities took place in Old, Middle and New Kingdom times. In the following we shall report briefly on two major copper mining and smelting sites in South Sinai which can be securely dated to Pharaonic times by newly discovered archaeological finds and hieroglyphic inscriptions (Fig. 1).

Fig. 3. Egyptian rock drawing at the copper smelter of Wadi Kharig.

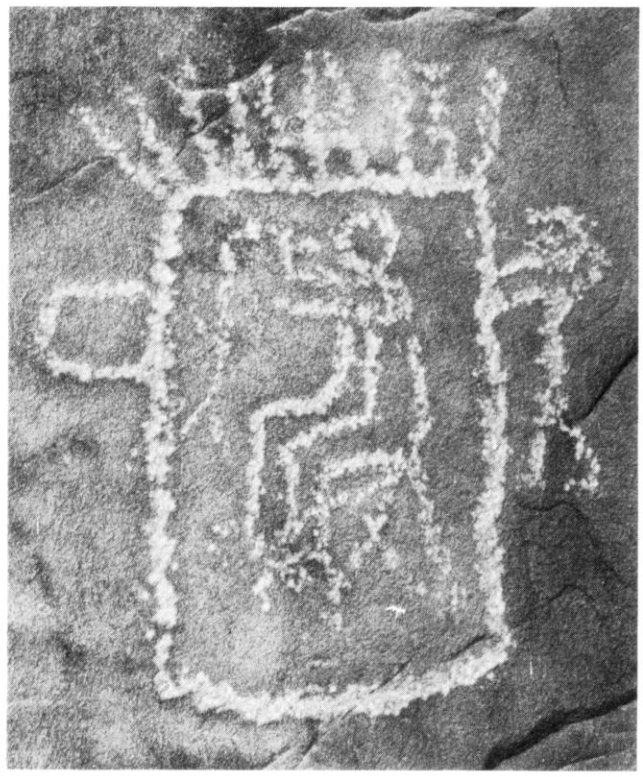

Fig. 4. Monumental rock inscription of the Pharaoh Sahure, c. 2480 B.C., 5th Dynasty, in the copper miners' camp of Wadi Kharig.

Old and Middle Kingdom copper mines and smelters in Wadi Ba'ba–Wadi Kharig.

One of the many 'old mines' in Wadi Ba'ba is located at its junction with Wadi Kharig[8], Site 349 on our survey map (Fig. 2). The mine is a very rough and irregular excavated adit, about 100m. long, 10m. wide and 2m. high. It still shows copper mineralisation and manganese and iron ores; the latter had apparently been left untouched by the ancient miners as they were only interested in the copper ore. Copper mineralisation – mainly paratacamitre and malachite [Bachmann] – occurs throughout this area of south-western Sinai, together with manganese and iron in one and the same geological horizon, and it was exactly this complex geological situation which had previously prevented the identification of many of the 'old mines' as ancient copper mines.

Along the bottom of the mining hill, and further along the Wadi Kharig, copper smelting slag and furnace fragments, accompanied by Egyptian sherds [C. Hope, J. Glass, A. Schulman] were evidence of copper smelting *in situ*. Here too, an Egyptian rock engraving was found (Fig. 3). It is a crude drawing of a shrine in which the Egyptian god Ptah (who is frequently associated with workmen), sits on a chair, holding what appears to be a sceptre [Schulman].

Further up on the hill, right above the copper mine, a stela of Sesostris I (1971–1928 B.C.) of the 12th Dynasty, was discovered by our expedition. It mentioned Hathor as the patron deity of the Pharaoh [Schulman]. About 150m. further on, we located a typical Egyptian miners' camp,[9] similar to the camps of Maghara. It consisted of a long row of semi-detached rooms, constructed in a semi-circle against a cliff. Engraved on this rock was a monumental hieroglyphic inscription of the 5th Dynasty (Fig. 4), which reads: '. . . the King of Upper and Lower Egypt, Sahure, who lives forever – Thoth, Lord of Terror, who smites the Land of the Setjet [Asia]' [Schulman]. In the workers' camp Egyptian potsherds were found together with fragments of copper casting crucibles and casting slag. Evidently Site 349 was a centre of Old and Middle Kingdom copper mining and is, in fact, the earliest Pharaonic copper mining camp so far discovered in Sinai.

Bir Nasib (Site 350 on our map), a huge Pharaonic copper mining district (Fig. 5)

Our expedition systematically explored the whole region of Bir Nasib and a large number of copper mining sites, dated by archaeological evidence from Chalcolithic to Nabataean times and perhaps also later, could be identified.

Already in the early nineteenth century, Rüppell noted a large slag heap at Bir Nasib, immediately next to the ancient well which is still the main water source of the region. Petrie surveyed this slag heap and his calculations of about 100,000 tons of slag[10] was recently confirmed by H. G. Bachmann, who calculated the quantity of metallic copper produced at Bir Nasib as about 5000 tons – a huge quantity of copper for ancient times. Bachmann also established that the Egyptian smelting slag at Bir Nasib is 'manganese-rich of fayalite

Fig. 5. The huge slag heap of Bir Nasib. The ancient copper mines are located in the slopes of the many low hills surrounding the valley of slag.

Fig. 6. Base of a New Kingdom scarab found in the slag heap of Bir Nasib.

Fig. 7. Ancient copper mining adits at Bir Nasib.

Fig. 8. Entrance to an ancient copper mine with a Nabataean inscription across its 'lintel'.

Fig. 9. Egyptian Middle Kingdom (on extreme left behind the figure) and New Kingdom rock engravings from the copper mines of Bir Nasib.

type', as should be expected considering the close relation between manganese deposits and copper mineralisation typical of this area.[11]

During our first surveys of Bir Nasib (1967, 1972) we found a large quantity of pottery on the surface of the site, including not only Nile-ware Egyptian sherds of the Old, Middle and New Kingdom [C. Hope, A. Schulman, J. Glass, J. Crowford], but also Nabataean and Roman-Byzantine and many recent Arab sherds. It therefore became imperative to try and date the huge slag heap by excavation. In 1978 we cleared several trial trenches at different parts of the slag heap, utilising some of the large pits dug previously by treasure-hunting bedouin (see Fig. 5).[12]

In the top layer of the slag a scarab (Fig. 6) and glass bead were found, dating, according to A. Schulman, to the New Kingdom. In both the two uppermost slag layers a number of Nile-ware New Kingdom sherds were found, but there was also locally manufactured pottery of typical Egyptian shapes [J. Glass, C. Hope]. In the layers below, there was more Nile-ware pottery, but in the restricted space excavated not enough characteristic sherds were found to allow a more precise dating of these earlier layers.

Our trial trenches provided definitive stratigraphic and ceramic evidence for a New Kingdom date for the site's top layers and it seems reasonable to assume that the lower layers belong to earlier periods of the Pharaonic copper industries at Bir Nasib. These are probably related to the hieroglyphic and proto-Sinaitic rock engravings of the Middle Kingdom[13] found on the hills surrounding the valley of Bir Nasib.

The huge heap of copper slag at Bir Nasib had remained an enigma since its discovery in the early nineteenth century because of the rather pertinent and obvious question: where are the copper mines which supplied the huge quantities of copper ore for the smelters of Bir Nasib? Already during our first Sinai surveys we had noticed a large number of small adits in the hills of the area around Bir Nasib (Figs 7–8), but because of the black manganese mineralisation visible, and since we were in the region of modern manganese mining, we related these adits to old manganese prospecting. However, close investigation of them in 1978 and subsequent analytical studies of their mineralisation, in comparison with the ore fragments found in the slag heaps, carried out by the IAMS group of experts, established that most of these adits were in fact (mainly) copper as well as turquoise mines: 'Bir Nasib, the largest smelting site in Sinai, is also a place of copper ore and turquoise mining . . . The small adits visible in the sandstone cliffs surrounding the smelting area . . . show green lumps consisting of malachite, paratacamite and quartz . . . The whole district, extending as far as Um Bogma and Gebel Um Rinna . . . is rich in copper mineralisation. Due to the close relation between manganese deposits and copper mineralisation, all within the Nubian Sandstone, Bir Nasib should rather be considered the centre of an ancient copper mining district instead of an individual mine' [H. G. Bachmann, in forthcoming IAMS Monograph 2].

The copper mines close to the smelter of Bir Nasib are dated by hieroglyphic inscriptions to the Middle and New Kingdom. A well defined path, going up the steep slope east of the slag heap, leads to an area of copper as well as turquoise mining on top of the mountain.[14] According to the Egyptian tradition, these mine workings were commemorarted by royal hieroglyphic inscriptions and proto-Sinaitic inscriptions of the Middle Kingdom (already mentioned above). Some Nabataean inscription near the workings indicate that mining occurred here also in later periods.

On the opposite side of the valley, about 200m. south of the slag heap, and right next to the ancient copper mines, a large hieroglyphic inscription of the Ramesside period, and a smaller inscription probably of the Middle Kingdom, were discovered by the present author (Fig. 9). The Ramesses II inscription is of particular interest because it shows, on either side of the royal cartouche, two figures who are named as the 'Royal Butler Neferronpe' and the 'Captain of the Host, Paenlevi'; 'high ranking members of the Egyptian hierarchy, and clearly the joint leaders of an expedition to the Pharaonic mines and smelters of Bir Nasib'.[15]

Since some of the pottery found by our surveys in 1967 and 1972 at Bir Nasib dates to the Old Kingdom, it is hoped that future excavations at the site will provide stratigraphic evidence also for such early Egyptian workings. There is already evidence for prehistoric smelting in the area, producing copper by a very primitive smelting process, but these sites are outside the scope of this report.

Beno Rothenberg

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9 See plan in Rothenberg, ibid, 1979, p. 163.
10 Petrie, ibid, p. 27.
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