

Institute of Archaeology, University College London, 31–34 Gordon Square, London WC1H 0PY. Telephone: 071-387 7050 ext. 4721

## IAMS Returns to the Arabah

Important current fieldwork by several IAMS groups in the Arabah convinced the Editor of the IAMS Newsletter to delay the appearance of No. 15 in order to immediately publish this work. Because of the extent of the new discoveries, IAMS Newsletter No. 15 is being published as a special, enlarged issue and combined with No. 16.

Volume Three of *Researches in the Arabah*, the final, definitive report on the archaeo-metallurgical Arabah Project 1959–84, will be the unique story of almost 5000 years of copper mining, from the fifth millennium B.C. to the seventh century A.D. Since the first publication of the Timna mines in 1981, several new discoveries of mine workings and smelters of additional historical periods and different technologies were made by our IAMS group and we decided to return to the Arabah and include these new discoveries in the forthcoming volume.

In the preparation of the definitive report on the excavations of copper smelting sites in the Timna Valley (1964–84), Site 39, the Chalcolithic smelting workshop, was re-investigated. This confirmed the previously proposed interpretation and date of the site, which are discussed in the following pages.

October–November 1989 and December–January 1990 saw several IAMS teams at work in the Timna Valley as well as in Nahal (wadi) Amram, south of Timna, directed by the authors of the reports published in this issue of the IAMS Newsletter.

*The Editor*

## The Discovery of a Copper Mine and Smelter from the End of the Early Bronze Age (EB IV) in the Timna Valley –

More to one of the most intriguing problems in the history of the Ancient Near East

### I THE EB IV ENIGMA

The final phase of the Early Bronze Age, EB IV (also called MB I and EB–MB), about 2200–2000 B.C., is still a rather enigmatic chapter in the early history of the southern Levant. It is agreed by most archaeologists that in contrast to the northern region, where large urban sites dominated the scene, the south (Palestine, Trans-Jordan, the Negev, and Sinai, and, at least, part of North-west Arabia), was inhabited by semi-nomadic pastoral tribes who left behind simple dry-built habitations, burial tumuli and rock-cut tombs.

However, archaeologists and historians, summing up the evidence from excavations and surveys, reached quite different, often conflicting, historical conclusions as to the development of this semi-nomadic lifestyle in the south. Kathleen Kenyon (1979, chapt. 6), who used the term ‘intermediate EB–MB’, advanced the theory of an Amorite invasion from the semi-arid northern fringes of

the Fertile Crescent, which overran the Levant, blotting out the preceding Early Bronze Age urban civilization. Y. Aharoni (1966, 125–31), after first agreeing with Kenyon regarding the Amorite wave, later opposed her idea for this phase of the historical development (1982) and discussed the possibility that these people were of ‘Kurgan’ origin, following P. Lapp (1966, 94–116) who first proposed the idea of an influx of Proto-European ‘Kurgan’ people from the Caucasus all the way down to the southern Levant.

A totally different idea for the solution of the EB IV Enigma, was subsequently proposed by R. Cohen (1983, 16–29; he uses the term ‘MB I’). Cohen, who himself has extensively excavated sites of this period all over the Negev, stated, ‘who are these people? We really don’t know’. Yet, he proposes to see their appearance as the slow immigration of people from the south, or south-

west into the Negev of Palestine and reaches the rather surprising conclusion, 'these MB I people may be the Israelites whose famous journey from Egypt to Canaan is called the Exodus'.

The rather astonishing discrepancy between the various historical interpretations of the archaeological evidence has its explanation in the fact that each side of the argument is right – up to a point – for part of the EB IV phenomena. For it must be emphasized that the EB IV Enigma reflects intricate, complex historical and cultural processes, which can only be properly comprehended in a strictly regional context and not as one overall historical event or development.

Considering our region (from the Nile Delta to the Negev Mountains, the Arabah and North-west Arabia) we see during EB IV (we prefer in this region to call it 'Sinai-Arabah Copper Age – Late Phase'; Rothenberg 1988, Introduction) a strong southward movement of ideas and technology. There were possibly perhaps also people who carried their tools and pottery into an old-established, indigenous, local culture and technological tradition, at the southern arid fringe of the Fertile Crescent, an area deeply entrenched in an age-old heritage of tribal cultural, economic and social coherence – still much in appearance to this day.

As a result of extensive surveys and excavations in the Negev, the Arabah and Sinai, as well as the scientific investigation of the archaeological and archaeo-metalurgical finds, one of the present authors (B.R.) concluded (Rothenberg 1979; 1989, 13–15) that a fundamental revision of previous ethnical and chronological concepts concerning the region had become necessary. This also relates to the EB IV enigma. Since early Chalcolithic times (radiocarbon-dated to the fifth millennium B.C., at the latest) and at least up to the end of the Early Bronze Age (including EB IV), most of the Nile Delta (Maadi, etc.), Sinai and the Negev, and also large parts of North-west Arabia, were inhabited by indigenous population groups which developed their own style of architecture, distinct flint and ceramic industries, and mined and smelted copper wherever suitable ores were available.

Although intruding cultural elements from adjacent, more fertile Pre- and Proto-Dynastic Egypt, Canaan and Palestine, could be identified amongst the finds in these settlements and burials – important for the establishment of a comparative chronology for Sinai, the Arabah, the southern Levant and Egypt (Rothenberg 1988, 14) – the autochthonous development of the local cultures were only occasionally and marginally effected by these intruders, with the exception of the EB IV developments in the southern Levant.

One of the basic facts, established by the extensive petrographic studies of Y. Glass (in Rothenberg 1988, 96–113), which led to this new historical concept, is the continued existence of distinctive ceramic industries in south and central Sinai, which supplied most of the pottery used by the local inhabitants of the region from the early Chalcolithic to, at least, EB IV. This dominant local pottery tradition is recognizable at the habitation sites also during the periods when 'imported' wares made

their appearance at many sites in Sinai and the Arabah. The latter must be understood as evidence for foreign peoples who traded with the local inhabitants, like the Canaanite EB II trading posts in southern Sinai, or gradually integrated into the local indigenous population groups, producing a symbiosis of the newly arrived with the locally developed technology. We therefore find in the region sites with very few or even without any of the typical imported ceramic types, but with the typical local EB IV pottery after it had integrated the 'foreign' technological elements. We suggest that the latter sites belong to the latest phase of EB IV, when the newcomers had already been fully absorbed by the dominant local culture.

Characteristically, the 'composite' EB IV population groups, mainly as a result of the influx of the more advanced newcomers from the metal-rich north, now made extensive use of copper-based alloys for its weapons – distinctive types of daggers and javelins (see Merkel, J. E. and Dever, W. G., *IAMS Newsletter*, No. 14, 1989) and, sometimes, fenestrated axes, the latter generally made of tin-bronze by a sophisticated casting process.

One of the present authors (B.R.), in an ongoing systematic study of EB IV metal objects from the Levant, was able to establish the co-existence in this region of two distinct contemporary metalworking technologies. One is a rather simple casting technology of unalloyed copper (and re-used imported arsenical copper), with cold working for final shape and hardening of the cutting edges – found generally in inland Palestine, the Negev and central Sinai and going back to early Chalcolithic times. The second has more sophisticated use of copper-based alloys – arsenical copper and tin-bronze – often showing the use of lost wax casting techniques. These sophisticated objects, mostly weapons, were mainly found to the north of the more primitive, southern region, where only unalloyed copper was used, though occasionally there was an 'infiltration' of tin-bronze objects also into the south. Whilst arsenical copper and tin-bronze found in the south were obvious 'imports' from the north, the origin of the local copper working tradition, and especially of the copper itself, until recently posed a very intriguing problem: Where were the local copper mines and smelters which produced the raw unalloyed material for the local coppersmith of the EB IV period?

## II THE DISCOVERY OF AN EB IV COPPER SMELTER AND ITS MINE

We had actually discovered an EB IV (our Sinai-Arabah Copper Age – Late Phase) smelter and mine in Timna as far back as 1967, in the course of our surface exploration of the entire Western Arabah, but we did not realize that these were EB IV sites because we had found only very few and rather atypical sherds among the debris which were undatable at the time.

The smelting site, Site 149 on our survey map, was located on a small, solitary hillock in the middle of the wide estuary of Nahal (wadi) Timna (Fig. 1). On its low, flat western slope a number of cup-marked stones stuck



Fig. 1. The hillock of Site 149, in the middle of Nahal (wadi) Timna. The workshop is located on the low slope to the right of the hill.

out of the sandy ground, and bits of blue ore and small slag lumps were dispersed everywhere, indicating a metallurgical workshop. The actual smelting location was found to be the flat top of the hill, where we found several heaps of heavily charred and partly slagged, mostly brick-shaped rocks, obviously dismantled stone-built smelting furnaces, and quite a mass of small slag lumps (0.5–3cm.).

In spite of our very intensive search, we were unable to find more than a handful of sherds—obviously early, handmade pottery—and these could not be dated. This was rather frustrating because the site was very different from all the other smelting sites we had investigated in the region. First of all the blue ore, believed at the time to be azurite (but since identified by the Geological Survey of Israel, Jerusalem, as the copper silicate bisbeeite), had not been found in such dominant quantities in any of the copper smelters of Timna. The stone-built furnaces of Site 149 did not really fit with our ideas about prehistoric copper smelting furnaces, up till then of the primitive hole-in-the-ground type. The relatively large quantity of slag also indicated a hitherto unknown scale of prehistoric copper production. Furthermore, the slag appeared to be much more homogeneous and solid than the Chalcolithic slag so far encountered in the Arabah (Rothenberg *et al.* 1978, 9.)

Continuing the survey, we looked for the source of the blue copper ore (bisbeeite) found on hillock 149 and, after a systematic search in the vicinity, we located a group of workings, Sites 250, 250A and 250B, which showed clear traces of blue mineralisation in the rock faces. These workings could actually have been seen

from the smelter's hill. Looking north-west, there is a colourful low range of hills (Fig. 2) with one steep mountain, Givat Sasgon, at its end. Right in the upper slope of the lower ridge are two low and long rock shelter-like caves in each of which we found a thick vein of mineralisation, mainly the blue ore bisbeeite.

There were actually three different places of special interest on this mountain. In one of the two 'caves' (Site 250), in a shallow, ashy habitation midden, we found a number of sherds and many very fine flint drills, together with tiny bits of platy blue ore. It was obviously a bead manufacturing workshop—and the pottery could be dated to the Chalcolithic period of the region (our 'Sinai-Arabah Copper Age—Early Phase').

The second 'cave', Site 250A (Fig. 3), looked more like mine workings but because of a huge rockfall it could not be properly investigated at the time. There was a thick vein of mineralisation in its rockface, mainly of bisbeeite. There were no finds here other than quite a lot of ore and a large mineralised boulder on some flat ground in front of the 'cave' with some roughly spherical flint hammerstones. From here a clear path could be seen running down the hill in the direction of our hill smelter, Site 149.

Climbing up towards the cliffs of Givat Sasgon we noticed some slag which had apparently slipped down from another site higher up the slope. Right at the top of the saddle, close to Givat Sasgon, we found the actual smelting site, Site 250B, and a shallow heap of very rough and viscous-looking slag. This slag was quite different and far more primitive than the slag observed previously at Site 149. Luckily, with the slag, there were quite a few pottery sherds which could be dated to the

Fig. 2. Givat Sasgon: Site 250. The entrance to the mining 'caves' are clearly visible on the hill to the right.

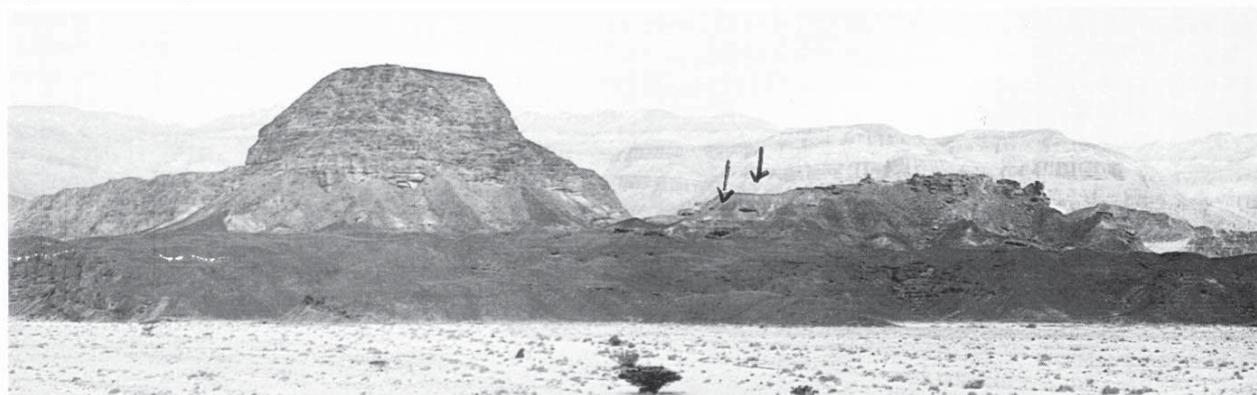




Fig. 3. Entrance to mining 'cave', Site 250A. To the right, the ore dressing platform, partly covered by rock fall, with a large mineralised boulder.

Chalcolithic period of the region. Obviously, in this period there was mining, smelting and bead-making on this mountain, based on the use of the blue bisbeeite ore.

### III EXCAVATIONS IN 1984, AND AGAIN IN 1990

The circumstances of the particular type of copper ore, the location of the mine, Site 250–250A, quite close to the smelter, Site 149, and the fact that no other mine of this type of ore has been found in the area, evidently connected the mine and the smelter. However, the very obvious technological difference between the Chalcolithic smelter, Site 250B, and the smelting debris at Site 149, plus the necessity to secure the relation of the smelter, Site 149, to the bisbeeite mine on the opposite hill and the importance of a reliable date for such a unique and obviously advanced smelting technology, demanded systematic excavations.

We were able to solve the immediate dating problems of Site 149 in 1982, even before we were able to excavate the sites. This was in the course of the systematic petrographic investigations of the pottery of Sinai and the Arabah (by Jonathan Glass), which became instrumental in creating the new regional Chronology: The Sinai-Arabah Copper Age—Early, Middle and Late Phase (Rothenberg 1988, 14). The sherds from Site 149 produced a secure date for this site: The Sinai-Arabah Copper Age—Late Phase, approximately equivalent to Early Bronze Age IV of the Levant. This identification and dating naturally emphasized the great importance of

this site because it was the first ever discovered smelter of this enigmatic period.

### Excavating in the copper mines of Givat Sasgon (Sites 250 and 250A)

The mine workings on Givat Sasgon were investigated in detail and partly excavated in October 1989 and January 1990. Michael Beyt and Amit Segev of the Geological Institute of Israel, Jerusalem, have recently concluded a thorough geological re-investigation of the Timna Valley (to be published, together with the report on the mines of the Arabah, in Vol. 3 of *Researches of the Arabah*). According to their up-to-date geological information about this part of the Timna Valley all the mine workings so far, extracting mainly copper carbonate malachite and some chalcocite, had been found in the cretaceous Amir-Hatira Formations, also called the Middle White Nubian Sandstone. Givat Sasgon, now identified as an ancient mining site, contains mainly hydrated copper silicates—chrysocholla and bisbeeite—located in the shaly facies of the Timna formation of the Cambrian (Fig. 4), which was also the main target of the modern mining operations in Timna.

#### *Excavating Mining Site 250A*

This shaly facies is rather distorted and the sandstones above it are rather shattered and brecciated on contact. This means that both the rock types encountered in the mine were very highly jointed and, therefore, easily mineralised by hydrothermal solutions. The jointing also means that they could easily have been mined using

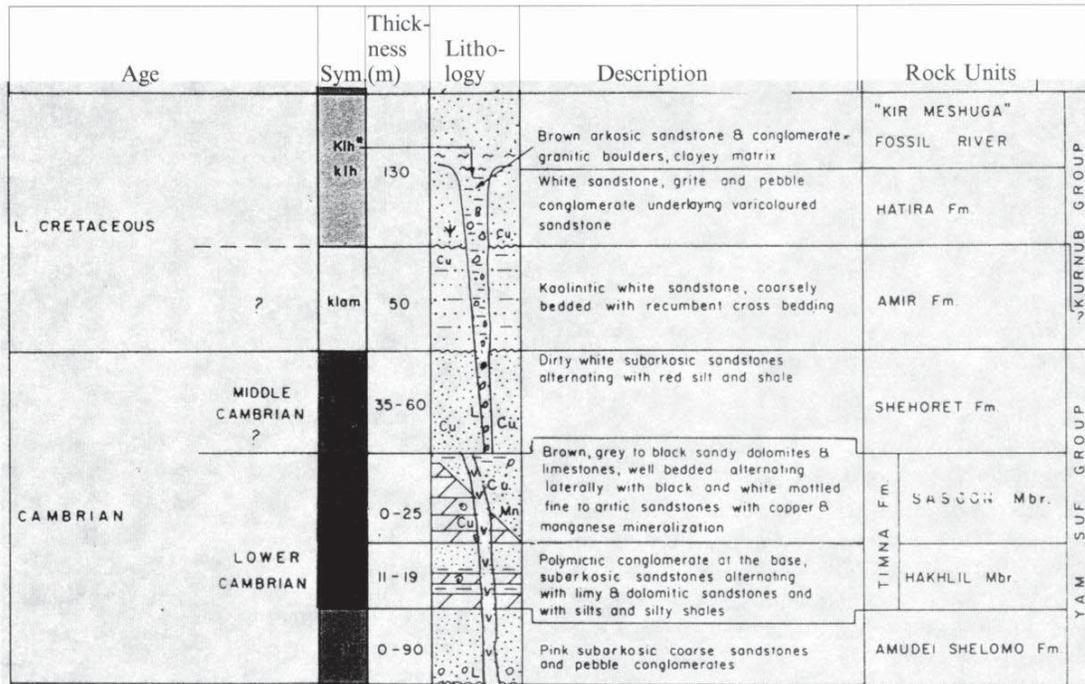


Fig. 4. Schematic geological section of the Timna region.

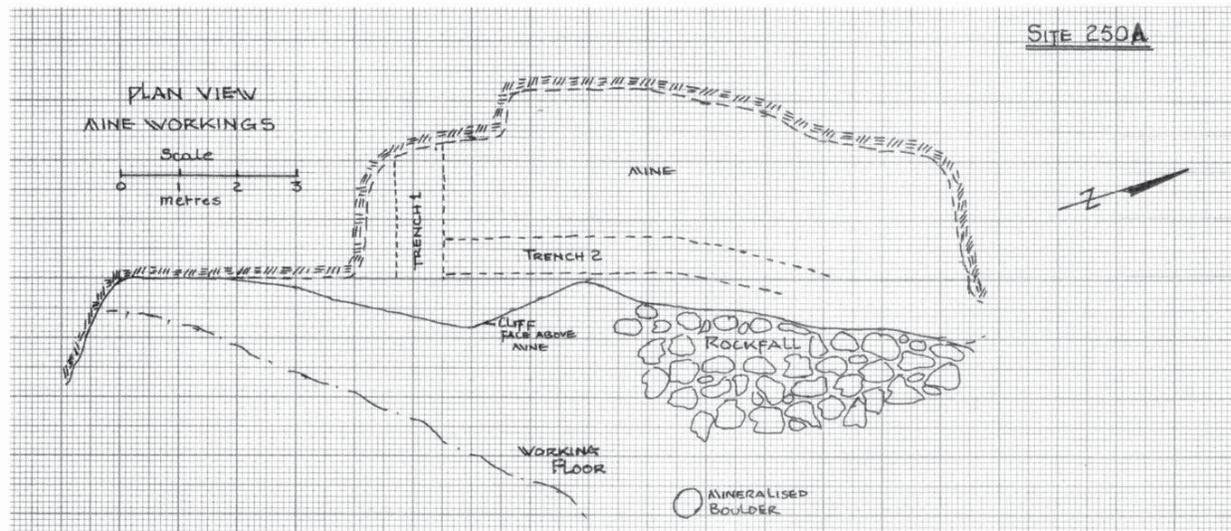
nothing but hammers or hammer and gad (or pick). Due to their friability it is unlikely that tool marks would be preserved.

Fig. 3 shows the mine entrance as it exists today, under a low cliff face, which runs roughly SW-NE. The eastern end of the workings have been destroyed by a rock fall. At the western end of the workings the shales and brecciated sandstones are cut back to a depth of about half a metre under the brow of the more competent overlying sandstones, and this very probably indicates the full extent of the natural weathering of this horizon. The fact that no mineralisation was noted in the shales at this end of the occurrence supports the view that this slight undercut was formed naturally. The shales also fold down and thin out rather sharply at this western end of the outcrop. The shale horizon then flattens out

towards the east, and reaches a width of about 70-80cm., the flattening giving an almost horizontal dip where the mining has taken place.

About four metres from the position where the shales fold down at the western end of the shale exposure, they are cut back another metre into the cliff and this cut deepens rapidly to reach four metres, a further four metres to the west (Fig. 3). This sudden deepening marks the beginning of actual mining activity. In the side walls and in the roof of this excavation some mineralisation can be seen, and this adds credence to the supposition that the material removed from this excavation was ore and that the sudden deepening of the undercut under the sandstone brow is the start of the ancient mine workings. The workings were, at this point, filled with sand to about 20cm. from the roof and excavation was required

Fig. 5. Plan of mine 250A,



to establish the height of the ancient mine workings. Fig. 5 is a diagram of the mine as measured during the excavation. The sand filling had clearly been introduced largely by water.

In January 1990 the mine was investigated by trenching. Unfortunately no working tools were found during this excavation. It seems probable that it was simply a hammer operation, all that would be needed in this friable rock. The miners probably followed the best mineralisation in and stopped working when the quality of the ore dropped. The size of the workings must relate to the amount of pre-existing mineralisation. No tunnels were seen, nor was there any evidence of exploration probe holes in the walls of the excavation.

Our first excavation trench, a cross section of the mine, was cut at the western end of the workings from the lip of the cliff face into the face of the mine working left by the ancient miners. The height of the mine proved to be about 80cm. at this point and it stayed roughly constant on the face. The floor of this trench showed traces of mineralisation, confirming that there had been mineral to mine at this point.

A second trench, cut parallel to the cliff face, stayed at the roughly 80cm. height for about three metres, then there was a lip and thereafter the mining height was only about half a metre. Again there was evidence of mineralisation, confirming the nature of the rock removed. The cutting of this trench enabled the extent of the remaining workings to be measured. An unknown amount of working was destroyed when the cliff face collapsed at some time after mining had ceased.

To the south-east of the mine opening on a level area of the hillside there was a well mineralised boulder of the brecciated sandstone (Fig. 3). This showed where the boulder lay in relation to the mine – it was unlikely to have been moved to its present site by natural forces and must rather have been moved by human intervention. This gives further proof that this excavation in the cliff face was indeed a mine.

No waste dump has been identified but there is a drainage channel running away from the site and any waste there has probably long since been washed away. In any event, this is not a large excavation and the amount of debris would not have been very extensive. In addition, debris from the mine would not, in this area, look very different from the natural rock scree after several thousand years of weathering.

#### *Excavating Site 250 – the mine and bead workshop*

Under the overhanging rock ledge, the cavity was about nine metres long, orientated SW–NE, and gradually deepened to about four metres. Inside, behind the washed-in sand fill, close to the inner wall were the remains of a fireplace and near it a small storage pit for broken blue ore. Under the sand were more flint drills and also larger flint debitage, plus several handmade sherds of the kind found during the survey, and many more blue ore lumps. There were two small lumps of slag, though there were no signs of any metallurgical activity.

Outside the ‘cave’, on the slope below, there was a quantity of finds which must have gradually slipped

down from above: flint tools, including drills, more sherds, a hammer stone and also a lot of blue ore.

At the inner rock face was a vein of mineralisation several centimetres thick containing blue bisbeeite ore *in situ*. Obviously this ‘cave’ had been created by mining the mineralized rock face to extract the blue ore. The ore was of a high-grade blue tint and glittered in the light – a very attractive material for jewellery.

Besides the actual mining ‘caves’ blue mineralisation outcropping can be seen dispersed at several other locations on the mountain, which could have led to surface mining and exploration all over the site, following the outcropping mineralized vein.

#### **Excavating the EB IV workshop and smelter Site 149.**

Site 149 was excavated in 1984 and recently re-investigated in January 1990. The workshop area on the lower slope (149A) had a low wall running right through it (N–W), probably acting as a shield against the strong north wind. About 15 crushing anvils and mortars and many small round stone hammers were found in small groups as if workers had just left for a short break (Fig. 6). Inside some of the mortars were chunks of still uncrushed blue ore and finely crushed bisbeeite ore was found dispersed all over the site. Obviously the smelting charge for the furnaces on top of the hill above was prepared here.

There were also numerous tiny fragments of slag on the floor and it seems that slag lumps containing numerous visible copper prills were also crushed here.

One of the surprise finds of the excavation was a quantity of drop-like, nodular slag, some looking like dross, which had the typical appearance of crucible melting-refining slag. Furthermore, on the floor of the workshop were found fragments of clay vessels, slagged on their concave inside and obviously connected with this crucible melting slag. Evidently at Site 149 there was

Fig. 6. Ore and slag crushing workshop at Site 149





Fig. 7. Typical sample of the clay 'rods', some with fragments of the crucible-like vessel still adhering. 1:1.

also secondary extractive refining metallurgy, perhaps also casting of copper ingots (for a similar situation at the Hathor Mining Temple at Timna see Rothenberg 1988, 192–7).

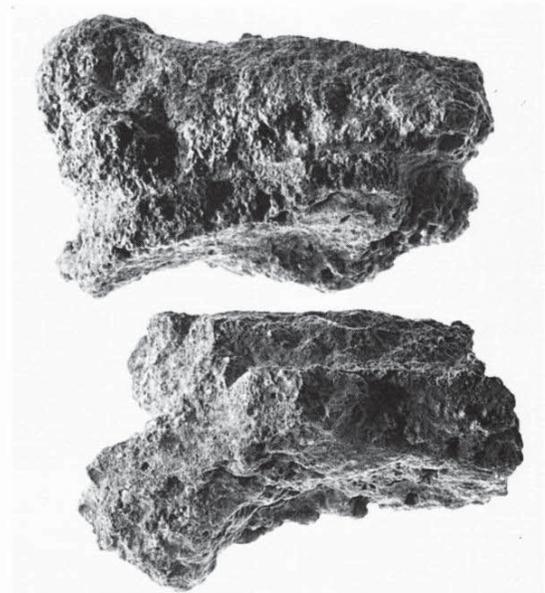
The clay vessels or crucibles had a peculiar, thickened, clay coil-like rim (about 1–1.5cm. diameter), attached from the outside to the edge of the straight wall of the handmade vessel (Fig. 7). Many such fragments were also found among the slag on top of the hill. Site 149 produced several hundred of these round clay fragments, looking like broken rods, sometimes with a slight slagging on one side, but never showing any signs of high temperature firing. Judging from the light buff colour, the 'rods' were fired under oxidizing conditions – not smelting! Whenever a 'rod' was found still sticking to a piece of the vessel's wall, the inside of the vessel showed a crust of slag, typical of the encrustation often found in used crucibles (Fig. 8). The slight curvature of the slagged fragments indicated that the diameter of these vessels must have been quite large – pointing to a secondary refining and concentration process by re-melting the metal-rich slag in a fairly large crucible-like vessel. This would also explain why the small 'rods' often showed no obvious curvature. Some of the straight 'rods' give the impression of not having been fired and were apparently never used, these were probably pre-prepared coils and not actually applied.

It is of considerable interest that this peculiar ceramic technology (manufacturing the vessel rim separately and attaching it at the finishing stage of the vessel's production), is well known as a typical technique of the EB IV potter (Amiran, R. 1969, 80) and can be observed on many types of vessels of this period. Site 149, the only EB IV smelting site found so far in the southern Arabah and Sinai, is the only smelter where such peculiar 'clay rods' have been found and there can be little doubt that they are characteristic of the technology of this period only. However, in the copper smelting sites of the Feinan region, in the north-east Arabah, many similar clay 'rods' were reported (Bachmann and Hauptmann, 1984, 115–17) and repeatedly discussed in recent literature (Hauptmann *et al.* 1985, 171–2), being interpreted as implements for removing slag from the furnace wall or from inside a blocked tuyère. Alternatively, in his latest publication on Feinan, Hauptmann now relates the clay 'rods' to a totally new type of smelting furnace model, dated to Early Bronze II and III (Hauptmann 1989, 129–30): 'shallow, widely opened natural draught furnaces

without a shaft... bowl-shaped back- and side-walls nearly 60cm. in diameter and up to 40cm. high. The bottom is semicircular'. Hauptmann discusses 'a front constructed of vertical orientated claysticks like a pipe-grating'. The photographs of the furnace remains in Feinan show 'multiple renewed backwalls of the furnaces' after excavation (Hauptmann 1989). A photograph of the same 'furnaces', before excavation, was previously published by Bachmann and Hauptmann (1984, Abb. 11) who noted that macroscopic examination showed almost no effect of heat. On both photos there were no discernable signs of the characteristic charred ground usually found around a smelting furnace – or of the heavy slagging of the wall of a furnace which produces tapped slag (cf. the smelting furnaces of Site 2 at Timna, Rothenberg 1985).

The extensive experimental and theoretical research of the last few years (Merkel 1983; Bamberger *et al.* 1986 and 1988), and our own field experience in the excavation of almost complete copper smelting furnaces from the Chalcolithic Period to Early Islamic times in the Arabah (see Rothenberg 1985), make it almost impossible to envisage a pyrotechnological smelting process in a large and shallow bowl under partial oxidising conditions as

Fig. 8. Detail of 'rods' with slagged, curved inside of the original rim of a crucible-type vessel. 2:1.



proposed by Hauptmann (and this only with natural draught), which could exist without a chimney effect of some kind. It is also extremely difficult to imagine a reducing atmosphere in a wide-open bowl standing in the wind achieving the high temperatures ('1200–1250°') required for several hours to produce the tapped slag described by Hauptmann as related to these 'furnaces' (1989, 129–30). Simply because no tuyères were found at the related slag heaps at Feinan is not evidence for a totally different technology which thermodynamically seems unacceptable. At numerous smelting sites of different periods in the southern Arabah, Sinai and the huge smelting sites in Andalusia (Rothenberg and Blanco 1981), no proper tuyères were found and it is obvious that a different kind of heat protection was used for the bellows. Surely, the mathematical model of the smelting of oxide ores, developed by Bamberger and his colleagues (Bamberger *et al.* 1988), and based on the almost complete furnaces excavated in the southern Arabah, cannot be totally ignored in the reconstruction of smelting furnaces of very similar periods (?) at Feinan, in the adjacent northern Arabah.

Although the detailed process technology of Site 149 has yet to be investigated – hence no reconstruction of the production chain is posited here – preliminary chemical investigation of some of the slags has shown them to be of the fayalite type, as common in Timna, indicating fluxing with iron oxide. Most of the slag is broken into small pieces, but much of it shows clear flow patterns on their top surface. There is also larger, platy slag pieces with the same pattern on top and sand baked into the bottom surface. There can be little doubt that at the end of the smelting process most of the slag was tapped out onto the sandy floor in front of the furnace and most of it was broken up to extract any entrapped copper prills.

Quite a number of EB IV sherds were found on the floor but no other traces of habitation. It seems that the workers lived somewhere else and, nearby in the Arabah, several habitation sites of this period have been identified and dated recently.

Site 149 exhibits pyrotechnical process details not yet encountered elsewhere in the Arabah or Sinai and these seem to indicate a 'foreign' origin of the smelter – people and technology – or at least a strong influence from outside the area. The remains of Site 149 bear witness to a major step forward in the history of extractive metallurgy, the advance from the primitive, indigenous, prehistoric hole-in-the-ground plus bellows technology to, at least, partly stone-built furnaces and a smelting process that already had a quite large-scale proper production of low-viscosity, tapped slag. The archaeological evidence points to subsequent crucible extraction and refining of crude copper prills – and suggests even the casting of ingots.

*Beno Rothenberg and C. T. Shaw*

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It is with deep regret that we announce the death in June of Professor R. F. Tylecote, one of our founder Trustees. An appreciation of his work will appear in our next issue.

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