Early Islamic Copper Smelting – and Worship – at Beer Ora, Southern Arabah (Israel)

The smelting site at Beer Ora (Site 28 on our Survey map) was discovered by the author in 1959 during his archaeological exploration of the Arabah Valley from the Dead Sea to the Red Sea.¹ It is located about 25km. north of modern Eilat, one km. from an ancient well, still used today by a small settlement, and consists of two very large slag heaps surrounded by smaller heaps (Fig. 1).

Most of the slag pieces were broken off large circular slag plates, 50–80cm. in diameter and c. 7cm. thick. There were also complete slag plates, most of which had a small 'cast in' hole in the centre. This ring-shaped slag was obviously tapped, very heavy, solid and black, with very few copper inclusions, and obviously the product of an advanced smelting technique (Fig. 2).

Unlike all the other smelting sites of the Arabah, it was surprising that at Site 28 no stone-built structures were visible anywhere; indeed, there were no structures whatsoever. We assumed at the time that the workers’ habitation may have been somewhere near the ancient well or in a nearby wadi, where some structural remains and Roman sherds had been found by our Survey.

Only a handful of apparently Roman sherds were found during our surface survey of the slag heaps, most

Fig. 1. View of the smelting camp at Beer Ora.
of which could be dated to the second century A.D.,
while some others remained difficult to define.
In 1969 we excavated at Beer Ora.2 The most
important find was a group of smelting furnaces in a
fairly good stage of preservation. The smelting hearth
was a mortar-lined pit, dug into the ground without any
stone support and with a slag-pit attached to it. There
were tuyère fragments but none as found in situ. One
of the smelting furnaces had been refitted with mortar
lining after a previous run – and abandoned unused
(Fig. 3).
Although the furnaces at Beer Ora seemed to be of
much less sophisticated construction than the earlier
Egyptian New Kingdom smelters of the Timna Valley,
the smelting technique appeared to be rather similar.
There were, however, characteristic differences which
only became apparent during the subsequent metallur-
gical study of the slag – Pyroxene type of slag instead of
Fayalite and Knebelite types3 – but these were basically
connected with the fluxes used and not the result of a
different smelting technology.
Upon excavation, the smaller slag heaps turned out
to be collapsed buildings constructed of slag plates
standing on edge. Most of these rather small structures
were used as stores but some were also habitations.
One had a small kitchen attached to it, where remains
of cooking utensils were found (Fig. 4).
Right in the centre of the smelting site we noticed a
curious arrangement of slag plates which had been
inserted into the ground, standing on edge, to form a
rectangular ground plan, 7.5 × 5.5m. with an ‘apse’ at
its south side (Fig. 5). Excavation showed that these
slag plates had been carefully set into narrow, triangu-
lar foundation trenches and the ‘apse’ was constructed
with particular care by using a double row of smaller
slag pieces. The method of construction suggested that
the lines of slag could only have been intended as the
demarcation of a plot by a kind of symbolic fence.
Clearing the inside down to a hard trodden surface,
c. 10cm. below the present surface, some sherds and
traces of a fireplace or two were found, but nothing to
indicate the function of the structure.
In the first publication of Beer Ora in 1972,4 based on
the dating at that time of the pottery found to the
Roman period, it was suggested that this enigmatic
structure could be a ‘symbolic’ early Christian church.
Reference was made to the observations in Sinai of
Bedouin ‘mosques’, which are, in fact, only segregated
plots, marked out simply by a line of stones or shells,
with an ‘apse’ indicated as the mihrab.
In 1982 we excavated a rock-cut smelting furnace at
Site 2 in the Timna Valley, reported in IAMJ News-
letter No. 5.5 This furnace (Fu Z) was dated by pottery
and the general context of the site to the Egyptian New
Kingdom, like most of the smelting camps of Timna.
It therefore came as a great surprise that a charcoal
sample taken from the very bottom of this furnace at
the end of our excavation, produced a radiocarbon date
of A.D. 740, i.e. Early Islamic. The implications of
such a late date for Fu Z, which was of the same type as
most of the New Kingdom smelting furnaces at Site 2,
and also showed the same ring-shaped tapped slag,
made it imperative to systematically re-investigate
many of the Arabah and Timna sites and installations.
This renewed investigation included the systematic
collection of a large series of charcoal samples from all
slag heaps in Timna and the Arabah which contained
mainly ring-shaped slag, including the large slag heap
of Beer Ora.
The radiocarbon dating of these samples proved that
the Timna furnaces in question were indeed of a New
Kingdom date, but at several sites there was also
evidence for a later, secondary use of New Kingdom
installations.6
The large slag heap of Beer Ora had already been
sectioned in our previous excavation and we could
therefore obtain well-stratified charcoal samples from
the top of the heap to its bottom. All these turned out
to date to the Early Islamic Period, the bottom sample
to A.D. 640.7
Parallel to these scientific investigations there were
also new developments on the archaeological front. As
part of our preparations for the final publication of our
Arabah and Timna research – the first two volumes of
which are due for publication in 1988 - Professor M. Gichon re-investigated the pottery of the Classical periods found at our Arabah sites in order to update the reports prepared many years ago. Since a number of Early Islamic sites have been excavated within the last ten years, in the Arabah as well as in Arabia, much new comparative material became available. One of the important results of these recent ceramic studies was the re-dating to Early Islamic of a number of sherds which had previously been considered ‘Late Byzantine or later’.

C14 dating, as well as the new pottery identification and dating of Beer Ora, established that the history of this site was rather more complicated than has been assumed so far. At the beginning, during the Roman Period, it was a copper smelter close to a Roman well and station. During the Early Islamic Period, when the southern Arabah was occupied by Muslim invaders, copper mining and smelting was restarted in the whole area. Beer Ora, probably because of its rich water source, and the proximity of a rich copper mining area at the nearby southern fringe of Timna, became the major Early Islamic smelter of the Southern Arabah.

Tracing each of the Early Islamic sherds to its exact stratigraphic context made it evident that the smelting furnaces of Beer Ora, previously published as Roman installations, and the related characteristic Pyroxenetype ring slag, must now be re-dated to the Early Islamic Period. This re-dating may also explain the fact that the Beer Ora slag showed fluxing with limestone, a fact which was quite difficult to accept for the Roman Period in the Arabah. Although the use of limestone as flux in a smelting charge in the Early Islamic Period still seems rather early, it appears now to be well established by Bachmann's phase studies of the Beer Ora slag.

We now have the first reliably identified Early Islamic copper industry in the Arabah, using quite advanced extractive metallurgical production methods, and this new information adds a further chapter to the long history of copper mining and smelting in the Arabah.

In the light of these new and important re-interpretations, we can now ascertain the function of the

Fig. 5. ‘Mosque’ outlined in slag with the mihrab orientated south towards Mecca.
Arsenical Copper Smelting at Batán Grande, Peru

The Sicán Archaeological Project, under the direction of Professor Izumi Shimada (Harvard University), is a long-term interdisciplinary study carried out to date over nine seasons (1978–86). A primary research aim is an understanding of both cultural and technological aspects of Sicán copper production. John Merkel, who recently took a doctoral degree in archaeo-metallurgy on an IAMS Fellowship at London University, is collaborating with Dr. Stuart Fleming (MASCA, University of Pennsylvania) on the analytical programme of the Sicán Archaeological Project. Dr. Merkel (currently at Harvard, but shortly to join the staff of the Institute of Archaeology, University College London) is on the Scientific Committee of IAMS. The project is supported by grants from the National Geographic Society, the National Science Foundation and Harvard University.

Starting with the Middle Sicán Period, A.D. 900–1100, copper-arsenic alloys definitely replace unalloyed copper to become the mainstay of the North Peruvian metallurgical tradition. At the sites around Batán Grande (Fig. 1), indigenous copper production ended with the Spanish conquest at A.D. 1532–5. This brief report will discuss new evidence from technical investigations of the ores, slag, speiss, copper and furnaces, including copper smelting experiments conducted on site.

Based on work to date, it appears that Batán Grande represents part of an extensive, regional network of copper production sites. Six prehistoric mines and three smelting sites have been identified and, in part excavated in the Batán Grande area. The earliest remains of copper smelting furnaces date from c. A.D. 900–1000. At the site of Huaca del Pueblo, Batán Grande, five rows of small bowl-shaped furnaces have been excavated (Fig. 2). More than fifty examples of such furnaces have been examined altogether in the three

Fig. 1. Relevant archaeological sites in the Batán Grande region of North Coast Peru.