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AND METALWORK
IN THE SECOND MILLENNIUM BC

A conference in honour of
James D. Muhly

Nicosia, 10th–11th October 2009

edited by
Vasiliki Kassianidou and George Papasavvas

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Contents

<i>Preface</i> by V. Kassianidou and G. Papasavvas	vii
<i>List of contributors</i>	xi
<i>Abbreviations</i>	xiv
1 Reminiscences: working with Jim Muhly <i>R. Maddin</i>	1
2 Late Bronze Age copper production in Cyprus from a mining geologist's perspective <i>G. Constantinou</i>	4
3 Metallurgical production and trade on Bronze Age Cyprus: views and variations <i>A. B. Knapp</i>	14
4 Pyrgos-Mavrorachi in Cypriot metallurgy <i>M. R. Belgiorno, D. Ferro and D. R. Loepp</i>	26
5 Tinker, tailor, farmer, miner: metals in the Late Bronze Age economy at Kalavassos <i>A. K. South</i>	35
6 Standing on ceremony: the metallurgical finds from Maroni-Vournes, Cyprus <i>R. C. P. Doonan, G. Cadogan, and D. Sewell</i>	48
7 From regional gateway to Cypriot kingdom. Copper deposits and copper routes in the chora of Paphos <i>M. Iacovou</i>	58
8 The role of the Apliki mine region in the post c. 1400 BC copper production and trade networks in Cyprus and in the wider Mediterranean <i>N. H. Gale and Z. A. Stos-Gale</i>	70
9 'Reconstructing' the Enkomi tombs (British excavations): an instructive exercise <i>D. Pilides</i>	83
10 Metallurgy and metalwork in Enkomi: the early phases <i>V. Kassianidou</i>	94
11 The Enkomi cup: niello versus <i>kuwano</i> <i>A. Giumlia-Mair</i>	107
12 Profusion of Cypriot copper abroad, dearth of bronzes at home: a paradox in Late Bronze Age Cyprus <i>G. Papasavvas</i>	117

13. Cyprus and Crete: the transformation of the Minoan metalworking industry <i>P. P. Betancourt</i>	129
14. Metallurgy and metalworking in the harbour town of Knossos at Poros-Katsambas <i>N. Dimopoulou</i>	135
15. Cyprus and Sardinia, beyond the oxhide ingots <i>F. Lo Schiavo</i>	142
16. On the cessation of local copper production in the Aegean in the 2nd millennium BC <i>Y. Bassiakos and T. Tselios</i>	151
17. Late Bronze Age Alalakh and Cyprus: a relationship of metals? <i>K. A. Yener</i>	162
18. The evidence for metallurgical workshops of the 2nd millennium in Ugarit <i>E. Dardaillon</i>	169
19. The merchants of Ugarit: oligarchs of the Late Bronze Age trade in metals? <i>C. Bell</i>	180
20. A unique casting mould from the new excavations at Timna Site 30 (Israel): evidence of western influence? <i>E. Ben-Yosef</i>	188
21. New perspectives on Iron Age copper production and society in the Faynan region, Jordan <i>T. E. Levy, E. Ben-Yosef and M. Najjar</i>	197
22. Alloying and resource management in New Kingdom Egypt: the bronze industry at Qantir – Pi-Ramesse and its relationship to Egyptian copper sources <i>T. Rehren and E. B. Pusch</i>	215
23. On ancient tin and tin-bronze in the Asian Old World: further comments <i>V. C. Pigott</i>	222
24. Just a few rusty bits: the innovation of iron in the Eastern Mediterranean in the 2nd and 1st millennia BC <i>H. A. Veldhuijzen</i>	237
Colour Plates	251

10. Metallurgy and metalwork in Enkomi: the early phases

Vasiliki Kassianidou

Introduction

Enkomi, located on the eastern coast of Cyprus is justifiably considered to be the most important Late Bronze Age settlement on the island. First of all, it stands apart from most Late Cypriot sites in having a long habitation history that spans the whole of the LBA. Secondly it is the most extensively excavated settlement of this period.

It was first investigated at the end of the 19th century by a team from the British Museum, who having failed to recognize the presence of a settlement focused their search on the rich tombs (Murray *et al.* 1900, 3) (see Pilides in this volume). The LBA ‘necropolis’ was also explored by the Swedish Cyprus Expedition in 1930, but they too failed to recognize that the impressive architectural remains they were uncovering were contemporary with the tombs. Instead they concluded that they belonged to the Byzantine period (Gjerstad *et al.* 1934, 468). It was not until 1934 when a French team led by the well known archaeologist Claude Schaeffer, who was at the time also excavating the contemporary site of Ugarit in Syria, began excavations at the site that the true nature and importance of Enkomi was recognized (Schaeffer 1936, 68). The excavations at Enkomi were interrupted by the Second World War and were resumed in 1946. Because of his commitments at Ugarit and in order to speed up the process of unveiling the remains of this clearly important LBA site, Schaeffer invited the Department of Antiquities to collaborate with him by excavating predetermined sections of the city (Schaeffer 1952, vii).

This task was assigned to Porphyrios Dikaïos, who at the time was the Curator of the Cyprus Museum and had already excavated numerous early prehistoric sites such as the well known site of Khirokitia. Dikaïos began excavations in 1948 and conducted a total of 12 seasons of excavations over the next ten years (Dikaïos 1969, 1). His excavations focused in three areas (shown in Fig. 10.1). Areas I and II are in the central part of the town where among other things Dikaïos excavated the so-called Ashlar Building as well as

the Sanctuary of the Horned God. The third, Area III, is located on the northern edge of the town and it is there that he discovered the remains of metallurgical workshops that were active for most of the history of the site and which are the subject of the present paper.

The fact that Dikaïos identified and carefully collected the remains of the metallurgical workshops, including waste material such as slag, means that today, more than 50 years after the conclusion of his excavations, these finds are available for study and reinterpretation. In his monograph, published 40 years ago (Dikaïos 1969 and 1971), he describes in detail the excavated remains, the stratigraphy and the finds. It is thanks to his meticulous work that scholars of the following generations can return again and again to study the material from Enkomi and interpret it from a different perspective. One such recent publication is the book by Crewe (2007) entitled *Early Enkomi Regionalism, Trade, and Society at the Beginning of the Late Bronze Age on Cyprus*, which will often be cited in the course of this paper.

A review of the available bibliography shows that there are two subjects that have dominated publications on Enkomi and the LBA over the last 20 years. The first is the discussion of the role Enkomi played in the political system of the LBA, whether or not it was the capital of a politically united island and whether or not it should be identified with Alashiya of the texts (*e.g.* Courtois 1969; Iacovou 2007; 2008; Knapp 1997; Merrillies 1992; Peltenburg 1996, 29–34). The second is the discussion on the role Enkomi played in the production and trade of Cypriot copper, namely whether or not it controlled production throughout the island and whether it was the sole port of export for this valuable commodity (*e.g.* Knapp 1994; Muhly *et al.* 1980, 90; Pickles and Peltenburg 1998, 87–90; Stech 1982; 1985).

A number of scholars have also tried to interpret the archaeometallurgical material which was found in these workshops (*e.g.* Courtois 1982; Kassianidou 2008, 258;

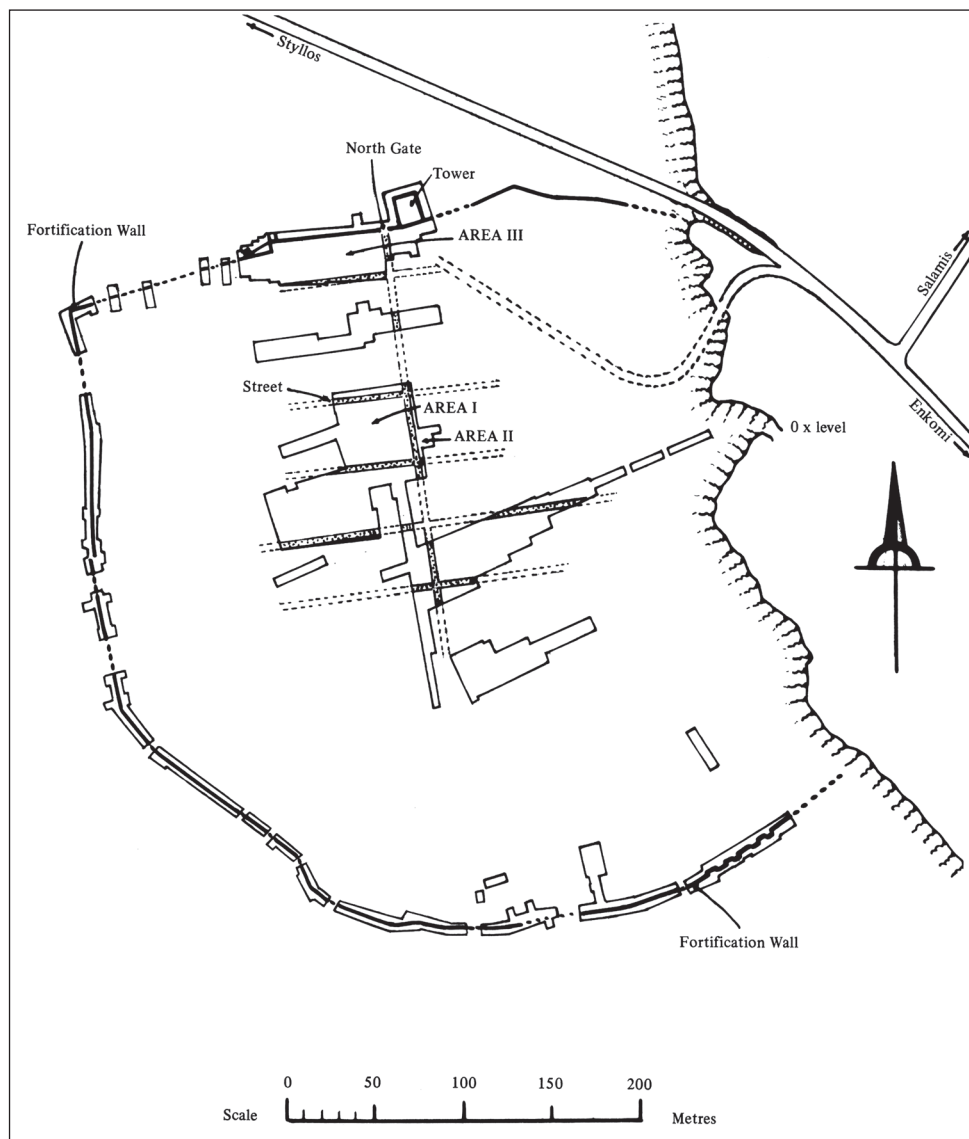


Fig. 10.1. Plan of Enkomi showing the three areas excavated by Dikaios.

Lagarce and Lagarce 1986; Koucky and Steinberg 1974, 177; Stech 1982, 105; Tylecote 1982, 92). The finds are intriguing because they are located within an urban centre at a significant distance from the rich ore deposits of the Troodos Mountains (Fig. 10.2).

The only person, however, who actually carefully studied the metallurgical artefacts, is Jim Muhly. He dedicated the year he spent in Cyprus as a Senior Fulbright Scholar (1987–1988), to systematically recording the material stored in the Cyprus Museum. He published a small part of this work in 1989 in an article entitled ‘The organization of the copper industry in Late Bronze Age Cyprus’ which has since been cited by all those who study this subject including myself. It is in this article that he made the following statement:

What is now needed, what is absolutely essential in order to understand the development of copper smelting technology at a site such as Enkomi, is a careful study of the stratified slags coming from all the major periods of activity at the site’ (Muhly 1989, 305).

A new project

Although 20 years have passed since Muhly’s work, no one has actually followed up on his recommendation until now. As a tribute to him, I decided to take up the challenge and take a closer look at the archaeometallurgy of Enkomi. In order to do this, a multidisciplinary project co-directed by myself and Giorgos Papasavvas has been designed and we

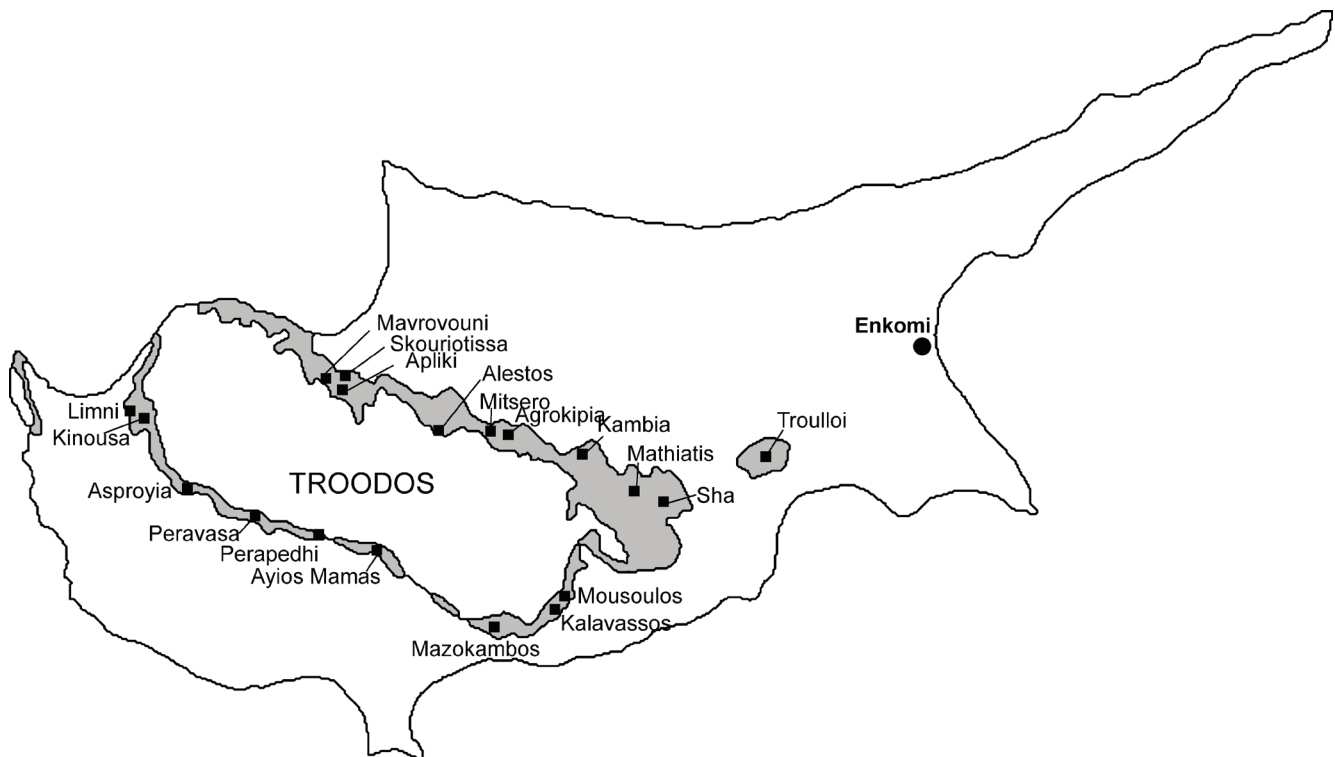


Fig. 10.2. Map of Cyprus showing the pillow lava formation (in shaded grey), the main mines and the location of Enkomi.

have already applied for funding to the University of Cyprus, in order to bring it to fruition.

The Department of Antiquities has already granted us the permit to study the finds, and for this I would like to take this opportunity to sincerely thank the Department's director, Dr Maria Hadjicosti. I would also like to thank Dr Hadjicosti for another more practical reason. In 1989 the Enkomi material was moved from the Department's storerooms in Nicosia to storerooms in Larnaca. Dr Hadjicosti was responsible for this move and she compiled a list of the contents of each of the 6000 or so trays, where she not only gives the inventory number and the location of the trays within the store room but also a brief description of the contents of each tray. Thus our task was made considerably easier: with the help of this catalogue we know which trays contain metallurgical material such as slag, tuyères or crucible fragments.

The peak of the copper industry in Enkomi, as everywhere else on the island dates to the Late Cypriot IIC period which roughly corresponds to the 13th century BC. Nevertheless, this paper will only discuss the archaeometallurgical materials and their contexts from archaeological strata which date to the LC I or from c. 1600–1450 BC for reasons which will be made clear below. Because the project is still in a very preliminary stage, none of the finds have yet been analysed and therefore no analytical data will be presented here. This will be completed in a later phase.

The copper workshops of the 'Fortress'

Although a description of the workshops has been published by Dikaïos, they will be briefly presented here again, for the sake of readers who are not familiar with the site. In a chapter dedicated to the history of excavations at Enkomi, Crewe (2007, 69–74) has compiled the evidence for the chronological phasing of Enkomi as presented by Dikaïos and later amended by others, as well as the correlation between excavation levels and floors as defined by the excavator. This most useful summary has been much referred to during the preparation of the following discussion.

The earliest phase of occupation, which Dikaïos defines as Level A, is represented by the remains of a wall founded on bedrock (Dikaïos 1969, 15). Based on the pottery, the excavator dated these remains and, therefore, the foundation of Enkomi, to MC III (c. 1725–1600 BC) (Dikaïos 1971, 499). The fact that tuyère fragments were found between the bedrock and the earliest floor of Room 106 of the Level I Fortress, located at a distance of approximately 20m from the remains of the Level A structure, led Dikaïos to the following conclusion: 'This means that these tuyères had been used at the time before the erection of the Level I Fortress, consequently during Middle Cypriote III, namely at the time of the Level A "Fortress"' (Dikaïos 1971, 500). This statement forms the basis for the assertion that copper production in Enkomi begins at the end of the MBA.

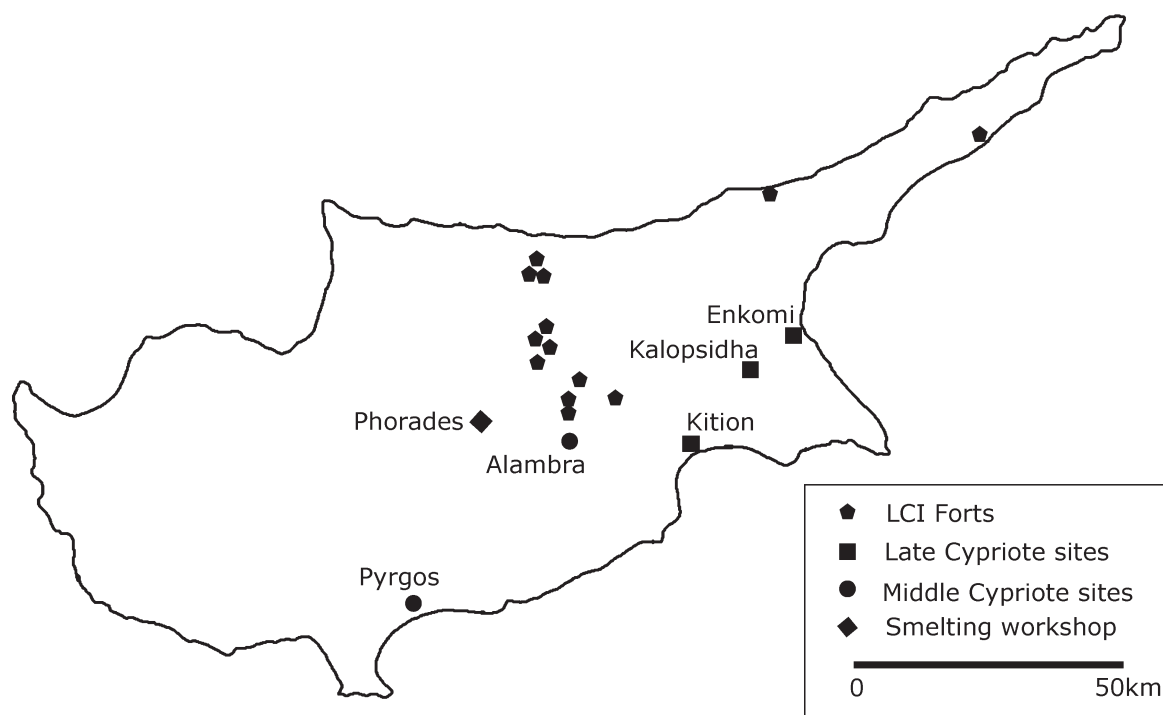


Fig. 10.3. Map of Cyprus with sites mentioned in the text.

Muhly (1989, 300), however, notes that ‘Enkomi, however, is better seen as a LC site’, echoing the position of other scholars who argued that the foundation of Enkomi should be dated in the beginning of the LC (Baurain 1984, 76). More recently, through a careful study of the ceramic material from Dikaïos’ excavations, Crewe (2007, 75) reached the conclusion that the earliest phase of occupation at Enkomi actually dates to LC IA, namely to *c.* 1650–1550 BC, and therefore suggests that perhaps this earliest wall may have been contemporaneous to the large rectangular building of Level IA.

Its massive architecture and thick external walls, as well as the fact that one of the two doors to the building had a complex arrangement with a dog-leg entranceway, led Dikaïos to identify this building as a Fortress (Dikaïos 1969, 16–18; 1971, 501), something which was later contested by Fortin (1989). Such fortresses dating to LC I are known from other inland areas (Fig. 10.3), and they form the first monumental constructions known to date from Cyprus (listed by Fortin (1983); for recent discussion and references see Crewe 2007, 64–68; Peltenburg 2008, 145–147). Their establishment has been used as an indication that LC I was a time of turmoil and upheaval (Merrillees 1971, 75–78) while the fact that most of these fortresses are inland, suggested to some that the threat was internal rather than external (Catling 1962, 141). Peltenburg (1996, 35) argued that since some of the fortresses are located along the route linking the mining regions of Troodos with the east coast, perhaps they were established by Enkomi to control and

protect the transport of copper from the mines to the town. Crewe (2007, 71), on the other hand, has turned the argument around and suggests that the fortresses may in fact be a local response to a threat of expansion from neighbouring regions such as Enkomi. It is beyond the scope of this presentation to discuss this further.

In the earliest phase of this building (Level IA) the plan of which is shown in Figure 10.4, metallurgical activity is most visible in Room 101, although a small number of tuyère fragments have also been recovered in other rooms. Among the finds from Room 101 were a number of tuyère fragments (Inv. 2295, Inv. 2299, Inv. 2303, and Inv. 2305) and crucible fragments (Inv. 2295 and Inv. 2299). As pointed out by Muhly (1989, 299): ‘It is particularly significant that one of the elbow or bent tuyères (that from tray 2295D) comes from a deposit below Floor IX (Area III, Room 101, Level IA), indicating that the type was in use right from the beginning of the history of Enkomi’ (more on the typology of the Enkomi tuyères below). A pit excavated in Room 101 lined with mud mortar and stained with copper oxidation products was identified by the excavator as a smelting furnace (Dikaïos 1969, 18). The presence of slag, however, is not noted in the publication and no slag was identified during the current investigation of the Enkomi material among the finds from Level IA. The end of this phase is marked by the destruction of the building, while the beginning of the next is marked by its restoration.

In Level IB, which corresponds to LC IB (1550–1450

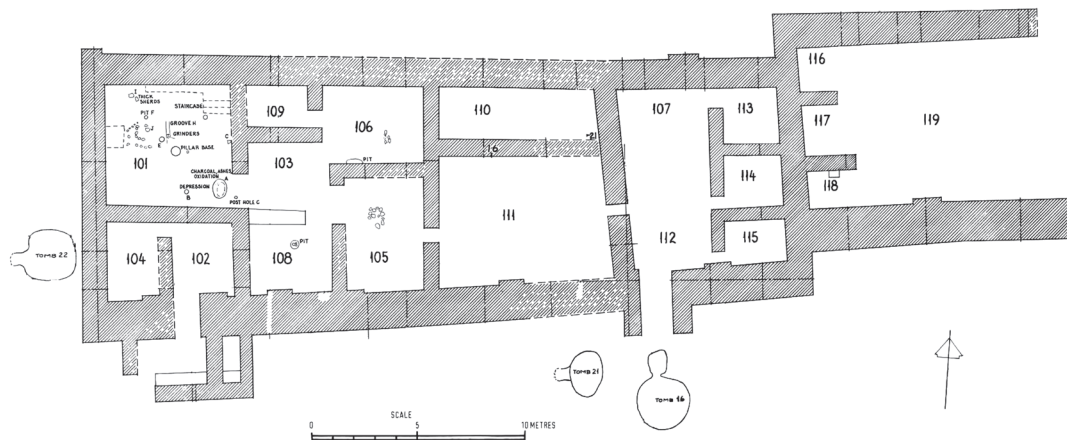


Fig. 10.4. Plan of the 'Fortress' in Level IA (Dikaïos 1971, pl. 243).

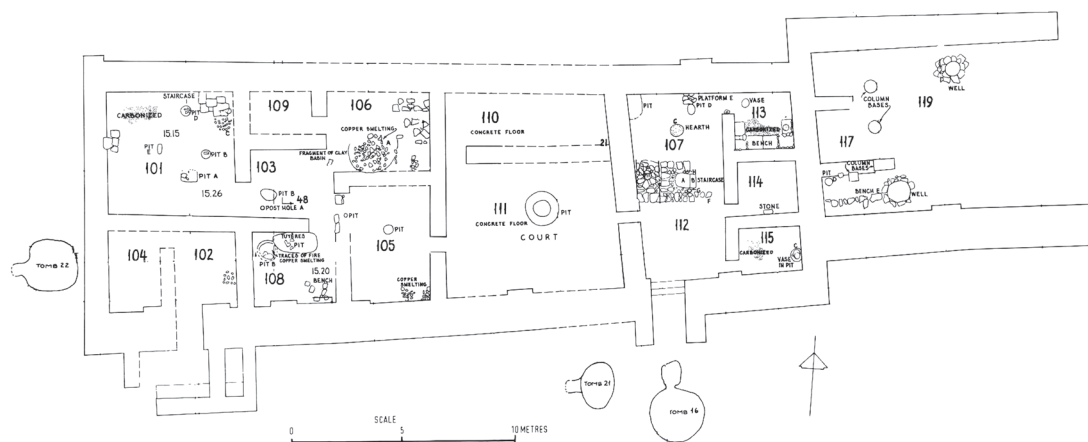


Fig. 10.5. Plan of 'Fortress' in Level IB (Dikaïos 1971, pl. 245).

BC), metallurgical activities are evident in almost all the rooms of the western part of the refurbished building (Fig. 10.5). A number of succeeding floors (Floors IX–V) are associated with this Level, and tuyère and crucible fragments as well as slag were found in practically all of them. In Room 101 a hearth dug in the floor was found filled with ashes, while quantities of tuyère fragments, slag and carburized material were spread on many parts of the floor. Again this was identified as a possible smelting installation (Dikaïos 1969, 22).

In Room 103, a semi circular installation built of stones and abutting the wall, with a diameter of 1.4m, and associated with several tuyère fragments was also identified as a smelting furnace (Dikaïos 1969, 22). The excavation of Level IB in Room 103 yielded numerous tuyère fragments and several almost complete tuyères (Inv. 2327, Inv. 2336, Inv. 2339, Inv. 2340, Inv. 2341, Inv. 2343, and Inv. 2346), including some excellent examples of the elbow type which

are so characteristic of the Enkomi assemblage (Fig. 10.6). Among the finds were also some small crucible fragments (Inv. 2346). Furthermore, among the few pieces of slag (Inv. 2332 and Inv. 2343) collected there are spillages of metal, the analysis of which will show whether the process here was refining, or alloying. Interestingly one of the most important finds from this Level in Room 103 is the earliest known tablet (Inv. 1885) in the still undeciphered Cypro-Minoan script (Dikaïos 1969, 23).

Tuyère and crucible fragments (Inv. 2351 and Inv. 2353) were also found in Room 105 associated with features which Dikaïos (1969, 23) identifies as smelting installations. It is, however, Room 106 which has provided one of the richest assemblages of this Level. Inventory number 2500 consists of four trays full of fragments of large vessels which may be parts of pyrotechnological installations, tuyère fragments and crucible fragments. The fragments of metallurgical ceramics come from open bowls with a convex base which

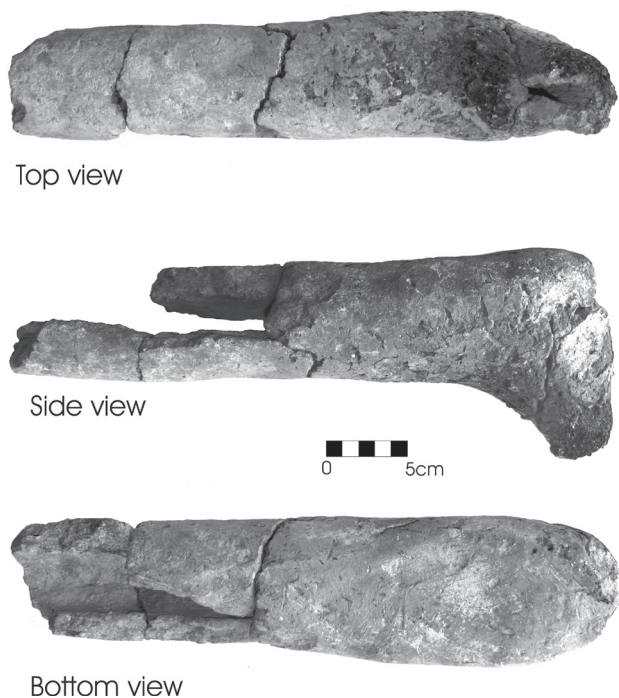


Fig. 10.6. Inv. 2336. Elbow tuyère from Enkomi, Room 103, Level IB (photograph: V. Kassianidou).

are often slagged on their inner surfaces (Fig. 10.7). A fragment of a stone vessel, with a wide diameter and a thick rim, found among the artefacts included in Inv. 2500, could possibly derive from bellows. Two stone pot bellows (Inv. 4543 and Inv. 4544) were found in Room 30, under Floor V which dates to LC IIB (Dikaios 1971, 43). Dikaios mistakenly identified them as moulds for casting copper ingots, but Davey (1979, 110) argued that these in fact form a set of foot operated pot bellows.

All the finds comprising Inv. 2500 were found in a depression in the central area of the room, with a diameter of 2m and a depth of 0.15m, which is believed to have been the remains of a smelting installation (Dikaios 1969, 23). Tuyère fragments, some clear parts of bent tuyères (Inv. 2501, Inv. 2503, Inv. 2504, Inv. 2506, Inv. 2507, Inv. 2509, Inv. 2510 and Inv. 2527), a fragment of a terracotta mould (Inv. 1887/8) and a small quantity of slag (Inv. 2503 and Inv. 2510) were all collected in this room.

In Room 108 another pit lined with clay and filled with ashes and charcoal was excavated. It was associated with a complete tuyère and tuyère fragments (Inv. 3782). Therefore, it too was identified by Dikaios (1969, 24) as a smelting installation.

According to Dikaios (1969, 31) the end of the period culminates in the destruction of the Fortress. Crewe (2007, 77) more recently has suggested that the evidence of burning may be related to the use of the building while the debris

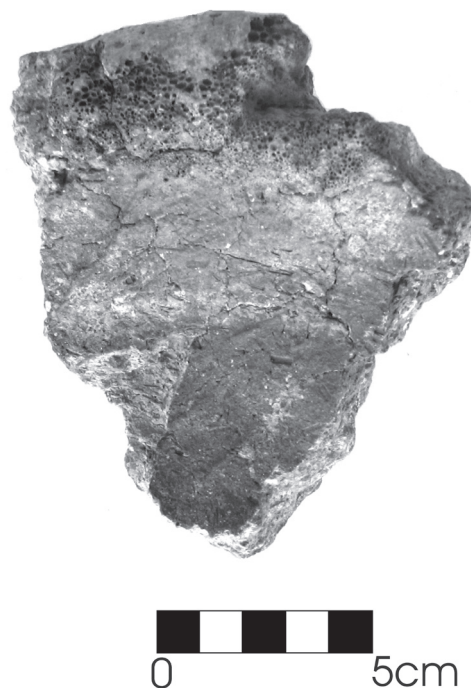


Fig. 10.7. Inv. 2500. Crucible fragment from Enkomi, Room 106, Level IB (photograph: V. Kassianidou).

identified as the cause of destruction may in fact 'have been caused by collapse through disuse rather than deliberate destruction of walls'.

In the following phases a new building with a new ground plan was constructed in this area (Dikaios 1969, 37–89). In practically every room there is evidence for metalwork suggesting to some that this was once a metallurgical factory, especially in the 13th century, the time that the Cypriot copper industry peaked (Dikaios 1969, 65). Among the most important metallurgical features of the later phases is an extensive slag heap, 1m thick, found in Level IIB which dates to LC IIC (c. 13th century BC) (Dikaios 1969, 61). The plethora of archaeometallurgical finds are equally interesting and not as well known as the ones that have been presented above. However, as was already stated, the scope of this paper is limited to LC I, and this is not only dictated by the limitations of a paper published in the proceedings of a conference but is related to a more important factor.

The recent discovery and excavation of a LC I primary smelting workshop at the site of Politiko-Phorades, directed by Bernard Knapp and the author, enables us to know much more about the smelting technology of this period, the form of the installations and the waste products. Thus the metallurgical finds from the two sites which are so different (Enkomi is an urban centre located on the coast, while Phorades is a smelting workshop located in a mining region) can be compared and contrasted.

Politiko *Phorades* and LC I smelting technology

The excavation of *Phorades* was a joint project of the University of Glasgow and the University of Cyprus (Knapp and Kassianidou 2008; Knapp *et al.* 2001; Kassianidou 1999; Knapp 2003a). The field directors of this small but very complicated site were Mike Donnelly and Paul Duffy.

Hidden in the foothills of Troodos near Politiko village and at a distance of c. 500m from a copper ore deposit, this workshop has yielded a total of three tons of primary smelting slag, hundreds of furnace and tuyère fragments and more than 50 almost complete examples. In sharp contrast only a limited number of ceramic sherds were collected while there were none of the ground stone tools so common on contemporary sites. Fortunately the sherds form a typical assemblage of LC I pottery including White Slip I and Base ring. The date of the site is confirmed by a series of radiocarbon dates which fall within the 16th–15th centuries BC.

The slag is very different from that coming from MC sites (for example slag from Alambra (Gale *et al.* 1996, 389–390) and from Pyrgos-Mavroraki (Belgiorno 2004, 31; Giardino 2000, 21)) or from later LC sites (for example the large cakes of tap slag from Apliki (Muhly 1989, 306) or the plano-convex slag from Kition (Tylecote 1982, 89)). It has a very characteristic plano-concave shape which can only have been produced when the full contents of the furnace, *i.e.* the slag and the metal were tapped in a pit (Fig. 10.8). After the metal was allowed to settle the two immiscible phases solidified and could easily be separated as shown in the smelting experiments by Bamberger and Wincierz (1990, 133) who followed a procedure described by Agricola (*De Re Metallica* IX, 404–407). The slag bearing the imprint of the metal was discarded while the metal, which was in fact matte, had to be processed further in order to be converted into copper. Among the thousands of fragments of slag all of which were counted and weighed, not a single different one was found. The chemical and microscopic analysis also shows the same consistency. This is text-book quality fayalitic slag, the result of a very efficient technology which was repeated at least 150 times over an unknown span of time.

This slag is certainly not the product of a primitive technology such as the one proposed for the LC period based on observations made on samples of slag coming from excavated urban centres such as Kition and Enkomi (Stech *et al.* 1985, 399; Muhly 1989, 303). Until the discovery of *Phorades* the established position was that furnace conglomerate was produced somewhere near the mining districts, and then transported to the urban centres. It was suggested that ores were smelted in small furnaces forming a pool of copper at the bottom of a chunk of slag which still

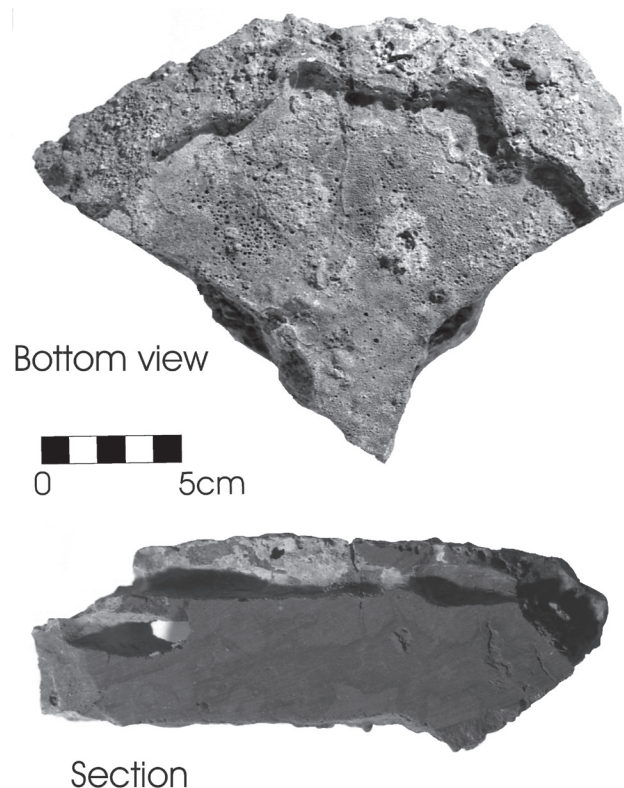


Fig. 10.8. Two fragments of slag from *Phorades*. Bottom view and section (photographs: Christopher Parks).

contained numerous prills of copper. It was thus argued that copper was recovered largely through the crushing of the slag in order to remove the prills trapped within it. The prills were then melted together to form a copper ingot. Although the chemical analysis of the *Phorades* slag indicates that it still contains about 2% copper, sections show that the metal is finely dispersed within the slag matrix and the prills are so small that the metal could not have been retrieved by crushing.

The above reconstruction is totally justified if one looks at the slag from Enkomi (even that of the later phases) which is mostly nodular in shape, and covered with significant amounts of copper and iron corrosion products (Fig. 10.9). What can be stated at this point is that the Enkomi slag looks nothing like the slag from *Phorades* (it seems more 'primitive'). Whether this has to do with the process that produced it (which can be smelting, refining and even casting), can only be revealed after its chemical and microscopic analysis. What can also be stated is that in the early phases slag is only present in very small quantities. There are many possible reasons behind this. Perhaps slag was not produced in great quantities because of the type of process carried out in these workshops (casting and refining produce limited amounts of slag while smelting produces

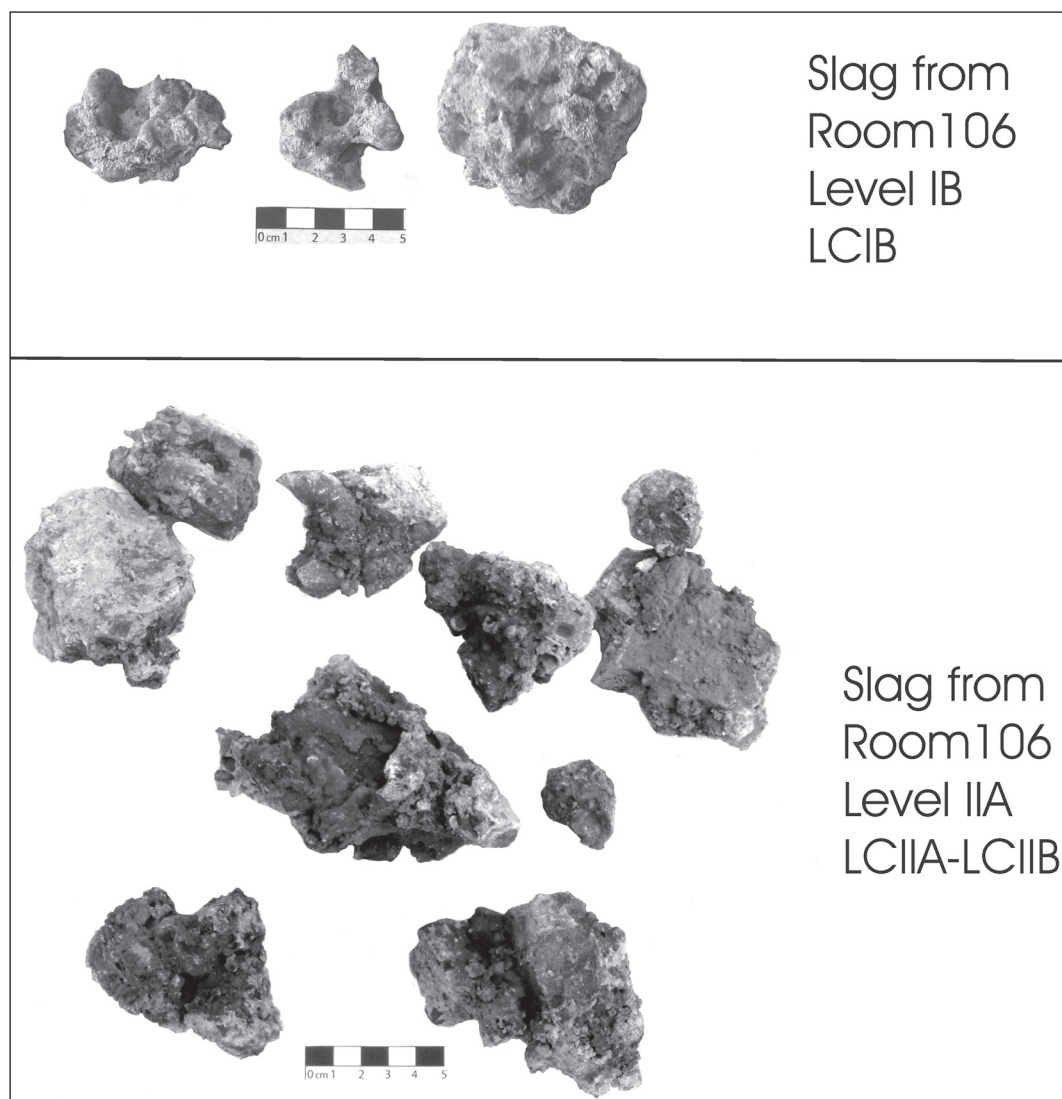


Fig. 10.9. Slag found in Level IB (LCIB) and Level IIA (LCIIA–B) of Area III at Enkomi.

large amounts). Perhaps the smiths systematically cleared away slag from their working areas and dumped it elsewhere, as they seem to have done in the LC IIC period creating a slag dump which was found to be 1m thick (Dikaïos 1969, 61). Finally, it may be due to the recovery strategy followed by the excavation team who may not have identified, collected or kept every single piece of slag uncovered.

It might be suggested that *Phorades* is a *unicum* and does not necessarily represent the technology of this period but I will argue that in fact this is not the case. As is well known, *Phorades* was discovered during the Sydney Cyprus Survey Project (SCSP) which was directed by Bernard Knapp (Knapp 2003b, 133). During the study of the survey area, the boundaries of which are delimited by the villages of Mitsero and Politiko, fragments of slag of the same type were collected in two different survey units neither of which

is in close proximity to *Phorades* (Kassianidou 2003, 216). Furthermore, during the Troodos Archaeological and Environmental Survey Project (see Given *et al.* 2002), which followed SCSP, a single such fragment was collected from one of the Survey Units near the village of Nikitari (Given *et al.* in prep.).

Unfortunately none of these Survey Units has produced any other archaeological finds that could enable us to date the three slag occurrences, which thus remain without context. Nevertheless, I propose that since at *Phorades* this type was found in a well defined archaeological context which has been securely dated to LC I, then the other three should be dated to this period as well.

Such slag could only be produced with the help of raised temperatures which were achieved through the use of tuyères connected with bellows. The tuyères from *Phorades* are



Fig. 10.10. S.F. 250. One of the best preserved examples of a cylindrical tuyère from Phorades (drawing: Glynnis Fawkes).

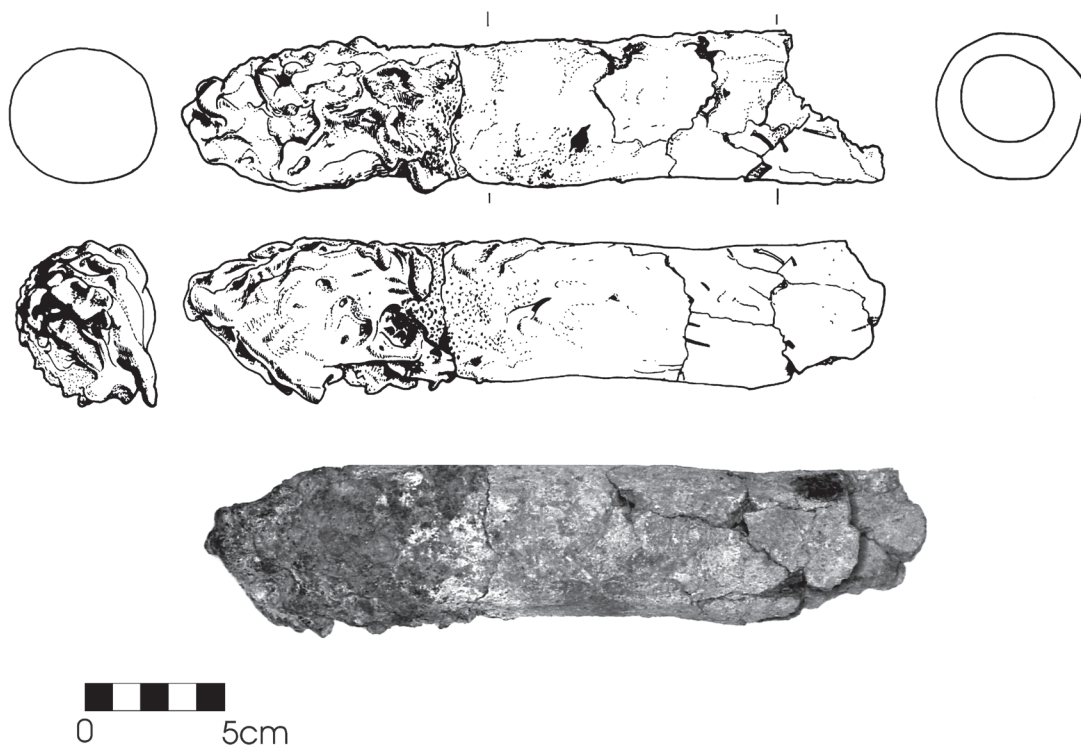


Fig. 10.11. S.F. 264. Cylindrical tuyère from Phorades with a melted nozzle (photograph: Christopher Parks; drawing: Glynnis Fawkes).

very consistent in their shape. They are almost all cylindrical with a borehole diameter of c. 2cm (Fig. 10.10). Those which preserve the nozzle are usually heavily slagged and some have actually begun to melt (Fig. 10.11). The use of bellows is indirectly shown by some tuyère fragments, on the inner surface of which are often detected droplets of

slag which have been sucked in. Furthermore, I have recently argued (Kassianidou 2011) that a large sherd and two smaller ones which could not be identified by our ceramic specialist as coming from a known type of the period, must have been part of a ceramic pot bellow such as the one exhibited in the Museum of the Pancyprrian Gymnasium (Inv. Π.Γ.096)

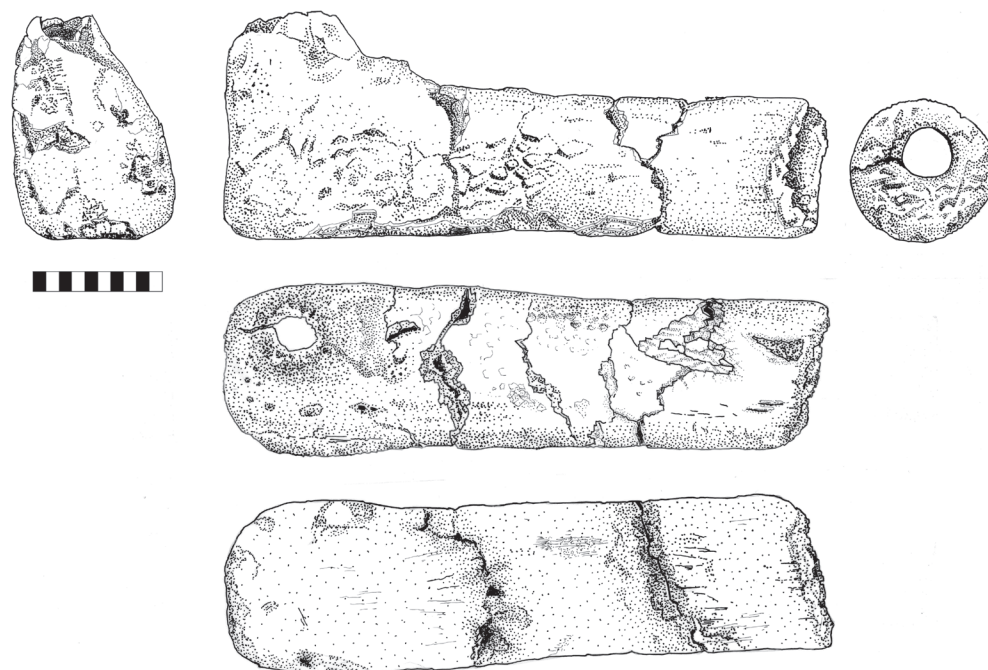


Fig. 10.12. Inv. 1678.1. Elbow tuyère from Enkomi, Room 106, Level IB (drawing: Demetrios Tsouris).

(Karageorghis 2007, 136; Kassianidou 2011, 42–43). The latter unfortunately has no known provenance, but due to similarities to examples from Enkomi and Alassa, it can only be of LC date (Kassianidou 2011). Apart from the stone bellows mentioned above, the excavations of Area III at Enkomi have also produced ceramic examples. The only one (Inv. 1691/1) published by Dikaïos (1971, 577, pl. 120.5) dates to LC IIIA, in other words it is several hundred years later than the period in question. There are other examples (Inv. 2520.2 and Inv. 3488.1) from Area III in the storeroom of the Cyprus Museum which have not yet been published but they too come from later levels.

The smelting furnaces at *Phorades* were cylindrical structures with flat bases, well defined rims and built entirely of clay. Many of the pieces are also heavily slagged and some show evidence of multiple use and repair. None of them shows any signs of having tuyères incorporated in their walls, as in the reconstruction proposed by Tylecote (1982, 91, fig. 4) for the examples from Kition, and therefore we suggest that the tuyères were introduced from the top.

They are completely different from the installations identified by Dikaïos (e.g. 1969, 22) as smelting furnaces in the rooms of the Fortress: those are pits dug in the floor, they are often filled with ash and charcoal and have a diameter that can reach 1.40m. I believe that none of these installations are actually smelting furnaces. Leaving aside the problems that would have been created by smelting sulphide ores in closed rooms, there are other more compelling reasons to reject this identity. First of all they

are too big: it is generally agreed that in order to achieve the appropriate conditions needed to smelt ores (*i.e.* high temperatures and reducing atmosphere) the furnaces should have a diameter of *c.* 40cm (Craddock 1995, 171; Bamberger and Wincierz 1990). Secondly it is now known that in a smelting furnace ash is not expected to be found because it readily reacts with the charge and is incorporated in the slag (Tylecote *et al.* 1977, 307). I suggest that the installations were hearths in which crucibles, used either for refining or for melting metal were heated. Many such crucible fragments (e.g. Inv. 2346, Inv. 2351, Inv. 2353, Inv. 2500) were among the finds from the rooms which were said to contain smelting furnaces.

The tuyères from Enkomi are also, I believe, of a type that is more likely to have been used to melt metal rather than smelt ores. All the ones that are well preserved are of the elbow type (Fig. 10.12). There are also some cylindrical examples, but they never have a nozzle, which leads me to believe that they are in fact segments of elbow tuyères. In general the elbow type shape is believed to be related to activities of melting and casting as the air is driven from above on the surface of an open crucible (Tylecote 1981, 117). There are also other reasons why these should not be identified as smelting tuyères. Although the bore hole at the far end of the tuyère is 2–2.5cm at the nozzle it narrows down to just one centimetre indicating the wish to have a well controlled draft of air. Also the fact that all of them have a flat base on which they can sit on a surface shows that they were meant to be used and set down time and time

again. Finally, although they all exhibit a certain degree of slagging none of them are in the state of the tuyères from *Phorades*. I believe that this is because they were exposed to lower temperatures, unsuitable for smelting (which requires temperatures of the order of 1200–1300°C) but high enough to melt copper (melting point 1083°C), gold (melting point 1064°C) and bronze (the melting point depends on the content of tin but it is generally below 1000°C).

Conclusions

To summarize based on the comparison of the archaeometallurgical finds from the Enkomi Fortress which date to the LC I to those coming from a contemporary primary smelting workshop excavated at the site of *Phorades*, I believe that the processes that were taking place in the Enkomi workshops were not related to the extraction of metal from its ores but rather to secondary processes such as refining and casting. Whether the copper was then cast into ingots (of the oxhide or bun shape) for export or just ingots and artefacts for local use is an open question. This new interpretation does not diminish the importance of the workshops or change in any way the identification of Enkomi as a centre for production and export of Cypriot copper. I therefore still follow Peltenburg's (1996, 31) assertion that 'the *raison d'être* (of Enkomi) was, at least in part, the exploitation of Cypriot copper resources on a large, perhaps unprecedented scale'.

In this respect I disagree with Crewe (2007, 18, 156), who questions the importance of the copper industry during the early LC. She partly bases her argument on the small amount of metallurgical material found in the early phases of Enkomi which she compares to that from *Phorades* (Crewe 2007, 17). However, I believe that such a comparison is not appropriate: the Enkomi workshops are located inside a building which was in continuous use within an urban centre. Thus it was probably systematically cleaned of waste material which may have been dumped in an area outside the limited boundaries of Dikaïos' excavations. Indeed this practice is recorded by the formation of an extensive slag dump in Level IIB which dates to LC IIC (c. 13th century BC) (Dikaïos 1969, 62). *Phorades*, on the other hand, was once a smelting workshop, but when operations ceased it basically became a dumping site of metallurgical waste, namely slag, broken furnaces and broken tuyères. Anything that was still useful, such as ground stone tools and pottery, was carefully collected and removed when the workshop was abandoned.

Furthermore, excavations in the rest of Enkomi (especially in the areas excavated by the French team (Crewe 2007, 71)) did not expose the LC I levels and thus we cannot be sure that Area III was the only one dedicated to copper

production in this period: in the later periods copper workshops are spread practically all over the town (Courtois 1982) and there is no reason to assume that this was not the case from the beginning.

Crewe (2007, 156) also raises the question of whether Enkomi's early role had anything to do with the export of copper. She believes that Enkomi was initially mainly exporting ceramic and agricultural products in exchange for luxury goods and bulk commodities. She argues that the reason behind the foundation of the settlement was the fertile Mesaoria Plain and that the sought-after commodity was agricultural produce (2007, 157). I find that this interpretation disregards the fact that throughout the island's history Famagusta Bay has always been the location of the main port of export. The reason for choosing this particular position can only be the favourable conditions for establishing a port. Furthermore, as important as agricultural produce and pottery may have been (especially the latter to archaeologists because of its archaeological visibility), precious metals, copper and tin were always the high value goods for which trade networks were established (Sherratt and Sherratt 1991, 363). Indeed the ancient sources of this period which mention Alashiya (Muhly 1972; Knapp 1996), the name by now accepted by almost everyone to refer to Cyprus, mention copper as the commodity exported par excellence (Knapp 1996, 8; Muhly 1996, 49). Pottery on the other hand is never mentioned (for example in the Amarna letters: Moran 1992, 104–113). It has, therefore, been argued that once Cyprus began to export copper, the trade of pottery also grew, but the pottery was the secondary rather than the primary load of the trading boats (Artzy 1985, 137).

As limited as the finds from Enkomi may seem (although in reality they are not, especially if compared to other contemporary sites with metallurgical workshops, such as Kition for example (Karageorghis and Kassianidou 1999; Stech *et al.* 1982; Tylecote 1982)), I believe that they do show that from the start it was a centre that was involved in the final stages of production of copper and subsequently in its trade.

The questions of whether Enkomi also controlled production of copper in the whole of the island and whether it was the sole port of export for the metal are much more complicated and will have to wait for another occasion to be addressed.

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